B.Tech. (Computer Technology)

2022 Regulations, Curriculum & Syllabi

Stay Ahead

BANNARI AMMAN INSTITUTE OF TECHNOLOGY

An Autonomous Institution Affiliated to Anna University - Chennai • Approved by AICTE • Accredited by NAAC with "A+" Grade

SATHYAMANGALAM - 638401 ERODE DISTRICT TAMILNADU INDIA

Ph : 04295-226000/221289 Fax : 04295-226666 E-mail : stayahead@bitsathy.ac.in Web : www.bitsathy.ac.in

BANNARI AMMAN INSTITUTE OF TECHNOLOGY, SATHYAMANGALAM

REGULATIONS 2022

(CHOICE BASED CREDIT SYSTEM)

(Common to all B.E./B.Tech. Degree Programmes)

Regulations 2022 have been prepared in accordance with the guidelines given by the University Grants Commission, All India Council for Technical Education and affiliating Universities incorporating the features of the Choice Based Credit System (CBCS). The Regulations 2022 is applicable to the candidates admitted to the Bachelor of Engineering (B.E.) / Bachelor of Technology (B.Tech.) Degree Programmes of the Institution in the Academic Year 2022-2023 for Regular admission (Academic Year 2023-2024 for Lateral Entry) and subsequently.

The regulations hereunder are subjected to amendments as may be decided by the Academic Council of the Institution from time to time. Any or all such amendments will be effective from such date and to such batches of students (including those already in the middle of the programme) as may be decided by the Academic Council.

1. ADMISSION

Candidate, seeking admission to the B.E./B.Tech. Programme, shall satisfy the conditions of admission prescribed by the Directorate of Technical Education (DoTE) and Anna University, Chennai as given below.

1.1 Regular Admission

Candidates, for admission to the first semester of the eight semesters B.E./B.Tech. Degree Programmes, shall be required to have passed:

Higher Secondary Examination (10 +2) of curriculum (Regular Academic Stream) prescribed by the Government of Tamil Nadu with Mathematics, Physics, and Chemistry as three of the four subjects of the study prescribed under Part-III or any other examinations of any Board or University or authority accepted by the Syndicate of the University / DoTE, Chennai as equivalent thereto.

(or)

Should have passed Higher Secondary Examination of Vocational Stream (Engineering/Technology), prescribed by the Government of Tamil Nadu.

1.2 Lateral Entry Admission

1.2.1 The candidates who possess Diploma in Engineering / Technology awarded by the State Board of Technical Education and Training, Tamil Nadu or its equivalent are eligible to apply for lateral Entry admission to the third semester of B.E. / B.Tech. programmes in the branch of study as per the eligibility criteria prescribed by the DoTE from time to time.

(or)

The candidates who possess the Bachelor Degree in Science (B.Sc.) (10+2+3 stream) with Mathematics as a subject in B.Sc. is eligible to apply for lateral entry admission to the third semester of B.E./B.Tech. programmes, as per the eligibility criteria prescribed by the DoTE from time to time. Such candidates shall undergo two additional Engineering subject(s) one each in third and fourth semesters, as bridge courses.

2. PROGRAMMES OFFERED

A candidate may be offered admission to any one of the programmes offered by the Institution for the candidates specified in Clause 1.1 and as per the eligibility criteria of DoTE for the candidates under Clause 1.2 from the list given below:

B. E. Programmes

1. Biomedical Engineering
2. Civil Engineering
3. Computer Science and Design
4. Computer Science and Engineering
5. Electrical and Electronics Engineering
6. Electronics and Communication Engineering
7. Electronics and Instrumentation Engineering
8. Information Science and Engineering
9. Mechanical Engineering
10. Mechatronics

B. Tech. Programmes

1. Agricultural Engineering
2. Artificial Intelligence and Data Science
3. Artificial Intelligence and Machine Learning
4. Biotechnology

5. Computer Science and Business Systems
6. Computer Technology
7. Fashion Technology
8. Food Technology
9. Information Technology
10. Textile Technology

3. STRUCTURE OF THE PROGRAMME

3.1 Every programme shall have a distinct curriculum with syllabi consisting of theory, laboratory, project, soft-skills and personality development courses, as prescribed by the respective Boards of Studies, broadly categorized under:

Basic Science (BS) courses including Mathematics, Physics, Chemistry and further specialization in these subjects

Engineering Science (ES) courses including Engineering Graphics, Basics of Electrical / Electronics / Civil / Mechanical, Engineering Mechanics and Computer Programming.

Humanities and Social Sciences (HSS) courses including Language Courses, Management Courses, Soft Skills and Professional Ethics.

Professional Courses(PC) include Discipline Core Courses, Professional Electives, and Open Electives.

Employability Enhancement Courses (EEC) includes Project Work, Mini Project and /or Internship, Seminar, Industrial /Practical Training, Startup Management, Value Added, and Certificate Courses.

The medium of instruction is English for all the Courses (except Tamil), examinations, seminar presentation, projects, and any other courses that a student registers for.

3.2 Each course is normally assigned a certain number of credits based on the following.

Contact period per week	Credit(s)
1 Lecture / 1 Tutorial period	1
2 laboratory Periods (Laboratory / Seminar / Project Work / etc.)	1

3.3 All the B.E. / B.Tech. Students will study Communicative English I during the firstsemester. In the second semester, they will be provided an option to enroll and study Communicative English II / German / Japanese / French / Hindi. while the lower segment will study Communicative English II.

3.4 Every student shall be required to opt for 10electives from the list of electives. Students can opt for the electives (Core / Professional) from his / her own discipline courses, during IV to VII Semesters, if he/she satisfies the prerequisite for that particular course.

3.5 However, out of ten electives, every student shall be required to opt for, a minimum of one and subject to a maximum of three courses as open electives from the list of electives of the branch / branches other than his / her branch of specialization, if he/she satisfies the prerequisite for that particular course. The course / content should not be covered in their own curriculum and syllabi.

3.6 Students can also opt for **one-credit courses** of 15 to 20 hours duration, which will be offered by the experts from the industry on specialised topics. Students can opt for such **one-credit courses** during the semesters I to VI as and when these courses are offered. A student will also be permitted to register the **one-credit courses** offered by other departments, provided the student has fulfilled the necessary prerequisites or the courses that may not require any prerequisites. Under no circumstances, the same one credit course shall be repeated in subsequent semesters in any department / centre for the same batch of the students and a maximum batch size for a given course shall not exceed 40. In case of disciplines with multiple divisions (intake more than 60) multiple batches/ different course(s) shall be offered to other batch(es) of students.

On successful completion of one credit courses, credits will be indicated in the grade sheet, but will not be considered for computing the Cumulative Grade Point Average (CGPA). However, if a student wishes to avail the exemption from any one of the electives (other than open elective) of the semester VII, he / she can do so by exercising his / her option in writing to the respective Head of the Department during the beginning of the VII semester, following the equivalence norm, that one **regular elective** (in the **VII Semester**) is equivalent to **three one-credit courses** completed by the student during the previous semesters, III to VI. Details of the one credit courses offered by the department shall be forwarded to the Office of the Controller of Examinations. However, one credit courses completed during I to II semesters shall be maintained in the Grade sheet as “Additional credits earned” (not considered for the computation of SGPA/CGPA).

3.7 A student can register for Self-Study Elective(s) over and above the electives from any branch of Engineering / Technology at the rate of one per semester starting from V semester onwards provided he/she maintains a Cumulative Grade Point Average (CGPA) of 8.50 or above till the previous semesters with no current arrears. Credits will be indicated for such courses in the grade sheets (additional credits) but will not be considered for computing the CGPA.

3.8 A Student may be permitted to credit three online courses with the approval of the Departmental Consultative Committee constituted by the Head of the Department, subject to a maximum of 9 credits. The Head of the Institution shall form a 3-member committee with one of the members as HoD and two senior faculty members to ensure that the student has not studied such courses and would not repeat it again as Professional Core/Professional Elective/Open Elective courses. A student can get exemption for a maximum of 9 credits (refer amendments of R2022 approved in 29th ACM) during the entire programme (in lieu of core elective or open elective). These online courses shall be chosen from the SWAYAM NPTEL platform, provided the offering organisation conducts regular examination and provides marks. The credits earned shall be transferred and the marks earned shall be converted into grades and transferred, provided the student has passed in the examination as per the norms of the offering organisation.

For online courses the following grading pattern is applicable in case of credit transfer and CGPA calculations

Range of percentage of total marks	Letter Grade	Grade Point
91 - 100	O	10
81 - 90	A+	9
71 - 80	A	8
61 - 70	B+	7
51 - 60	B	6
40-50	C	5
< 40	U	0

3.9 Industrial Training / Internship

The students may undergo Industrial training / Internship optionally for a period as specified in the table during summer / winter vacation and the credits earned will be indicated in the grade sheet. If the student earns three credits in Industrial Training / Internship, the student may drop Professional Elective subjected to a maximum of one. In such cases, Industrial Training / Internship need to be undergone continuously from one organization only. However, if the number of credits earned is 1 or 2, these credits shall not be considered for classification of the degree. The students may also undergo Internship at Research organization / University (after due approval from the Department Consultative Committee) during summer / winter vacation.

Duration of Training / Internship	Credit(s)
2 Weeks	1
4 Weeks	2
6 Weeks	3

3.10 Socially Relevant Projects

A student may be permitted to carry out socially relevant projects during semester II to semester VI in consultation with the faculty guide and submit the project report, in the prescribed format, at the end of the Semester for valuation.

On successful completion of socially relevant project work, one credit will be indicated in the grade sheet (Additional credits), but these credits will not be considered for computing the CGPA.

3.11 Mandatory courses

The student shall study the mandatory courses prescribed by the institute which will be mentioned in the Grade Sheet. However, it will not be considered for computation of CGPA.

For the students who complete the Mandatory Course satisfying the attendance requirement, the title of the Mandatory Course will be mentioned in the Grade Sheet.

3.12 Choice of Professional Elective Courses

The professional Elective Courses are listed in the Curriculum in Table format as verticals (Specialisation groups). A student can choose all the Professional Elective

Courses either from one of the verticals or a combination of courses from all verticals in a semester. However, students irrespective of enrolling for additional Insertion of New Clause 6.3 are not permitted to choose more than one course from a row. Students are permitted to enroll in more than one elective course from the same vertical in a semester. In the subsequent semesters students are permitted to enroll one more course in a row, provided if he/she has cleared the earlier course of the same row. For a professional elective course and open elective course, the minimum number of students enrolment permitted shall be 10. However, the minimum number is not applicable for students enrolling B.E. / B. Tech. (Hons) and B.E. / B. Tech. Minor. For the offer of each professional elective at least two choices shall be offered.

4. VALUE ADDED COURSES

A student can opt for the Value Added Courses offered by the various departments from semester II to VII.A separate certificate will be issued on successful completion of the value added course by the competent authority.

5. DURATION OF THE PROGRAMME

5.1 A regular student (admitted after 10+2) or equivalent is normally expected to satisfactorily fulfil the requirements for award of the degree B.E. / B.Tech. within four academic years (8 semesters) from the date of admission but in any case not more than 7 years (14 Semesters); lateral entry students shall fulfil such requirements within three academic years (6 semesters) from the date of admission but in any case not more than six years (12 semesters) leading to the award of Degree of Bachelor of Engineering (B.E.) / Bachelor of Technology (B.Tech.) of Anna University, Chennai.

5.2 The total period for completion of the programme from the commencement of the semester, to which the student was admitted, shall not exceed the maximum period (Clause 5.1), regardless to the break-of-study (vide Clause 15) or period of prevention in order.

5.3 Each semester shall consist of minimum 75 working days. Head of the Department shall ensure that every faculty member teaches the course as prescribed in the approved curriculum and syllabi.

5.4 Special Theory / Practical Sessions may be conducted for students who require additional inputs (remedial classes) over and above the number of periods normally specified, as decided by the Head of the Department, within the specified duration of the semester / programme.

6. COURSE ENROLLMENT AND REGISTRATION

6.1 Each student, on admission shall be assigned to a faculty advisor (vide Clause 8) who shall advise / counsel the student about the details of the academic programme and the choice of course(s) considering the student's academic background and career objectives.

6.2 Each student shall register for all courses to be undergone in the curriculum of a particular semester (with the facility to drop courses to a maximum of 8 credits (vide clause 6.6)). The courses dropped in earlier semesters can be registered in the subsequent semesters when offered.

Every student shall enrol for the courses of the succeeding semester, in the current semester. However, the student shall confirm the enrolment by registering for the courses within the first five working days after the commencement of the semester concerned.

6.3 The courses that a student registers in a particular semester may include

i. Courses of the current semester.

ii. Courses dropped in the lower semesters

6.4 The maximum number of credits that can be registered in a semester is 30. However, this does not include the number of Re-appearance (RA) and Withdrawal (W) courses registered by the student for the appearance of the examination.

6.4.1 From the V to VIII semesters, the student has the option of registering for additional courses in a semester. With regard to enrolling for B.E. / B. Tech. (Hons) or B.E. / B. Tech. Minor. Maximum number of credits enrolled in a semester (Honours and Minor) shall not exceed 36. The online courses registered for B.E. / B. Tech. (Hons.) and B.E. / B. Tech. minor shall be over and above this 36 credits.

6.5 Flexibility to Drop Courses

6.5.1 A student has to earn the total number of credits specified in the curriculum of the respective programme of study in order to be eligible to obtain the degree. However, if a student wishes, the student is permitted to earn more than the total number of credits prescribed in the curriculum by opting for one credit courses, self-study electives, or additional courses.

6.5.2 From the III to VII semesters (from IV to VII semesters in case of lateral entry students), the student has the option for dropping existing courses. The number of courses a student can drop is limited to 2 in a given semester. The student is permitted to drop the course(s) within 30 days of the commencement of the academic schedule. In such cases, the attendance requirement as stated in Clause 7 is mandatory.

6.5.3 The student shall register Project work I in semester VII and Project work II in semester VIII only.

6.6 Reappearance Registration

6.6.1 If a student fails in a theory course, the student shall do reappearance registration (examination) for that course in the subsequent semesters or when it is offered next.

6.6.2 On registration, a student may attend the classes for the reappearance registration courses, if the student wishes, and the attendance requirement (vide Clause 7) is not compulsory for such courses.

6.6.3 If the theory course, in which the student has failed, is either a professional elective or an open elective, the student may register for Semester End Examinations of the same professional elective or open elective course, respectively in the subsequent semesters.

6.6.4 In this case (Clause 6.6.3), the student shall attend the classes, satisfy the attendance requirements (vide Clause 7), earn Continuous Assessment marks and appear for the Semester End Examination.

6.6.5 The student who fails in any continuous assessment courses shall register for the same in the subsequent semesters or when offered next, and **repeat** the course as per Clause 6.6.4.

6.6.6 If a student is prevented from writing the Semester End Examination of courses due to lack of attendance, the student has to repeat the semester when it is offered next time.

7. REQUIREMENTS FOR APPEARING FOR THE SEMESTER END EXAMINATIONS OF A COURSE

A student who has fulfilled the following conditions (vide Clause 7.1 and 7.2) shall be deemed to have satisfied the attendance requirements for appearing for Semester End Examination of a particular course.

7.1 Every student is expected to attend all the periods and earn 100% attendance. However, a student shall secure not less than 80% overall attendance.

7.2 If a student, secures overall attendance between 70% and less than 80%) in the current semester due to medical reasons (prolonged hospitalization / accident / specific illness) or participation in Institution/ University/ State/ National/ International level extra and co-curricular activities, with prior permission from the Head of the Department, shall be permitted to appear for the current semester examinations subject to the condition that the student shall submit the medical certificate / participation certificate attested by the Head of the Institution (along with condonation form). Such certificates along with the condonation forms shall be forwarded to the Office of the Controller of Examinations for verification and permission to attend the examinations. However, during the entire programme of study, a student can avail such condonation in any two semesters only.

7.3 A student shall normally be permitted to appear for Semester End Examination of the course(s) if the student has satisfied the attendance requirements (vide Clause 7.1 – 7.2) and has registered for examination in those courses of that semester by paying the prescribed fee.

7.4 Students who do not satisfy Clause 7.1 and 7.2 and who secure less than 70% overall attendance would not be permitted to move to the higher semester and has to repeat the current semester in the next academic year as per the norms prescribed.

7.5 In the case of reappearance (Arrear) registration for a course, the attendance requirement as mentioned in Clauses 7.1 - 7.3 is not applicable. However, the student has to register for examination in that course by paying the prescribed fee.

7.6 A student who has already appeared for a course in a semester and passed the examination is not entitled to reappear in the same course for improvement of grades.

8. FACULTY ADVISOR

To help the students in planning their courses of study and for general advice on the academic programme, the Head of the Department will attach a certain number of students to a faculty member of the department who shall function as faculty advisor for those students. The faculty advisor shall advise and guide the students in registering of courses, reappearance of courses, monitor their attendance and progress and counsel them periodically. The faculty advisor also discusses with or informs the parents about the progress / performance of the students concerned.

The responsibilities of the faculty advisor are:

- To inform the students about the various facilities and activities available to enhance the student's curricular and co-curricular activities.
- To guide student enrolment and registration of the courses.
- To authorize the final registration of the courses at the beginning of each semester.

- To monitor the academic and general performance of the students including attendance and to counsel them accordingly.

9. COMMITTEES

9.1 Common Course Committee

9.1.1 A theory course handled by more than one faculty member including the discipline with multiple divisions (greater than or equal to 2) shall have a "Common Course Committee" comprising of all members of faculty teaching that course with one of the members as the Course Coordinator, nominated by the Head of the Institution (Head of the Department in the case of multiple divisions of a discipline) and student representatives (one per specialization or division) registered for that course in the current semester. First meeting of the Common Course Committee shall be held within fifteen days from the date of commencement of the semester. Two subsequent meetings in a semester may be held at suitable intervals. During these meetings, the student members shall meaningfully interact and express their opinions and suggestions of all the students to improve the effectiveness of the teaching learning process. It is the responsibility of the student representatives to convey the proceedings of these meetings to all the students.

9.1.2 In addition to this, Common Course Committee (without the student representatives) shall meet to ensure uniform evaluation through the common question papers during continuous assessment and Semester End Examinations.

9.2 Class Committee Meeting

For all the courses taught, prescribed in the curriculum, Class Committee meeting shall be convened thrice in a semester (first meeting within 15 days from the commencement of the semester and other two meetings at equal interval after the first meeting) comprising members of the faculty handling all the courses and two student representatives from the class.

One of the members of the faculty (preferably not handling any courses to that class), nominated by the Head of the Department, shall coordinate the activities of the committee. During these meetings, the student members shall meaningfully interact and express their opinions and suggestions of all the students to improve the effectiveness of the teaching learning process. It is the responsibility of the student representatives to convey the proceedings of these meetings to all other students.

10. SYSTEM OF EXAMINATION

10.1 Performance in each course of study shall be evaluated based on (i) Continuous Assessment throughout the semester and (ii) Semester End Examination at the end of the semester for the regular courses or as given in the Clause 17.

10.2 Each course, both theory, theory with lab component and laboratory including project work, shall be evaluated as per the scheme of assessment given in Clause 17.

10.3 The Semester End Examinations shall normally be conducted after satisfying the Clause 5.2.

10.4 For the Semester End Examinations, both theory, theory with lab component the internal and external examiners (from Academia) shall be appointed by the Controller of Examinations as per the guidelines given by the Examination cum Evaluation committee of the Institute.

11. PASSING REQUIREMENTS AND PROVISIONS

11.1 The Passing requirement for a student in a course is determined based on the marks obtained both in continuous assessment and Semester End Examinations. A student who secures not less than 50% of total marks prescribed for the course [Continuous Assessment + Semester End Examinations] with a minimum of 45% of the marks prescribed for the Semester End Examinations, shall be declared to have passed the course and acquired the relevant number of credits.

11.1.1 If a student fails to secure a pass in a particular course, i.e., failing to obtain minimum marks, as stated above, it is mandatory that he/she shall reappear for the examination in that course in the subsequent semester(s) whenever the examinations are conducted for that course, till he / she secures a 'Pass'.

Continuous Assessment (CA) marks obtained by the student in the first appearance shall be retained and considered valid for one subsequent attempt, except Clause 6.6.4, 6.6.5, 6.6.6 and 6.6.7. However, from the third attempt onwards, the student shall be declared to have passed the course if he/she secures a minimum of 50% in the course prescribed during the Semester End Examinations.

11.2 If a candidate fails in the seventh semester examinations of Project work I, he/she has to resubmit the Project Report within 30 days from the date of declaration of the results. If he / she fails in the Semester End examination of Project work II, he/she shall resubmit the Project Report within 60 days from the date of declaration of the results. The resubmission of the project report and the subsequent viva-voce examination will be considered as reappearance with payment of exam fee. In case a student fails in the resubmission of a project report and subsequent viva-voce examination, the student shall register for the course again, when offered next.

11.3 The passing requirement for the courses which are assessed only through continuous assessment (Laboratory and EEC courses except project work), shall be fixed as minimum 50% and the remaining grades are decided as per clause 12.4. If a candidate fails in EEC courses (Except Project work), he/she has to register and repeat the course within 30 days from the date of declaration of the results. In case a student fails to register within 30 days, he/she shall register for the course again, when offered next.

11.4 The minimum number of total credits to be earned by a student to qualify for the award of degree in the various branches of study as prescribed by the respective Boards of Studies is given below:

Branch of Study	Minimum Credits	
	Regular Admission	Lateral Entry
B.E. Programmes		
Biomedical Engineering	163	121
Civil Engineering	164	122
Computer Science and Design	163	119
Computer Science and Engineering	163	119
Electrical and Electronics Engineering	163	121
Electronics and Communication Engineering	163	121
Electronics and Instrumentation Engineering	163	121
Information Science and Engineering	162	118
Mechanical Engineering	164	122
*Mechatronics / #Mechatronics Engineering	165	123
B.Tech. Programmes		
Artificial Intelligence and Data Science	165	121
Artificial Intelligence and Machine Learning	163	119
Biotechnology	165	123

Computer Science and Business Systems	163	123
Computer Technology	163	119
Fashion Technology	163	121
Food Technology	163	121
Information Technology	163	119
Textile Technology	163	121

*-applicable to candidates admitted during the AY.:2022-2023

#-applicable to candidates admitted during the AY.:2023-2024 onwards

11.5 Total number of credits to be earned by the student shall be more than or equal to the total number of credits prescribed in the curriculum in force. If the credit assigned for L T P of the courses are not same in two Regulations under consideration, then equivalence shall be arrived as per the credit assignment followed in the Regulations in force.

11.6 Student Migration and Credit Transfer: Normalization of the credits will be carried out in consultation with the Board of Studies of the programme concerned and approved by the Head of the Institution, if a student migrates from other affiliated institutions to Bannari Amman Institution of Technology or rejoins from previous regulation to this regulation.

11.7 A student shall be declared to have qualified for award of B.E/B.Tech. degree if he/she successfully completes the course requirements (vide Clause 7, 10 and 11) and passed all the prescribed courses of study of the respective programme (listed in Clause 2), within the duration specified in Clause 5.1.

12. ASSESSMENT AND AWARD OF LETTER GRADES

12.1 The assessment shall be based on the performance in the Semester End Examinations and/or Continuous Assessments, carrying marks as specified in Clause 17. Letter Grades (based on Credits and Grades) are awarded to the students based on the performance in the evaluation process.

12.2 Credit Point is the product of Grade Point and the number of credits for a course and Grade Point is a numerical weight allotted to each letter grade on a 10-point scale (as specified in Clause 12.4), while the Letter Grade is an index of the performance of a student in a said course.

12.3 Condition for Relative Grading

The students' strength is greater than 30, the relative grading method shall be adopted. If the students' strength is less than or equal to 30 then the absolute grading system shall be followed with the grade range as specified below. The relative grading system shall not be applicable for laboratory, project works and continuous assessment courses.

O	A+	A	B+	B	C	U
91-100	81- 90	71- 80	61-70	56- 60	50–55	<50

12.4 The performance of a student will be reported using Letter Grades, each carrying certain points as detailed below: A student who earns a minimum of 5 grade points in a course is declared to have successfully passed the course.

Description	Letter Grade	Grade Points
Outstanding	O	10
Excellent	A +	9
Very Good	A	8
Good	B +	7
Average	B	6
Satisfactory	C	5
Reappearance	U	0
Withdrawal	W	0
Absent	AB	0
Shortage of Attendance	SA	0

'U' ---Reappearance is required for that particular course

'SA' --- shortage of attendance (Clause 7) and hence prevented from writing end semester examination.

12.5 After completion of the evaluation process, Semester Grade Point Average (SGPA), and the Cumulative Grade Point Average (CGPA) are calculated using the formula:

$$SGPA/CGPA = \frac{\sum_1^n C_i * g_i}{\sum_1^n C_i}$$

Where

C_i : Credit allotted to the course.

g_i : Grade Point secured corresponding to the course.

n : number of courses successfully cleared during the particular semester in the case of SGPA and all the semesters, under consideration, in the case CGPA.

RA grades will be excluded for calculating SGPA and CGPA.

12.6 A student who does not appear for the Semester End Examinations in a course, after registering for the same, shall be deemed to have appeared for that examination for the purpose of classification (Subject to Clause 14 and 15).

12.7 For the non-credit courses grades shall be indicated as given in Clause 17 and shall not be counted for the computation of SGPA/CGPA.

For the co-curricular activities such as NCC / NSS / NSO / YRC etc.., a completed status will appear in the grade sheet. Every student shall put in a minimum of 75% attendance in the training and attend the camp compulsorily. The training and camp shall be completed before registering for the fifth semester courses. A completed status in the co-curricular activities is compulsory for the award of a degree.

12.8 **Revaluation:** A student, who seeks the revaluation of the answer script, is directed to apply through proper application to the Office of the Controller of Examinations in the prescribed format through the Head of the Department. The Office of the Controller of Examinations shall arrange for the revaluation and declare the results. Revaluation is not permitted for the courses other than theory courses. In the case of theory courses with laboratory component, a student can seek revaluation for the theory component only, following the procedure stated above.

12.9 **Eligibility for the Award of Degree**

A student shall be declared to be eligible for the award of the B.E. / B.Tech. degree provided the student has

i. Successfully gained the required number of total credits as specified in the curriculum corresponding to the student's programme within the stipulated time.

ii. Successfully completed the course requirements, appeared for the Semester End Examinations and passed all the courses prescribed in all the 8 semesters within a maximum period of 7 years for regular / 6 years for lateral reckoned from the commencement of the first semester to which the candidate was admitted.

iii. Successfully completed the NCC / NSS / NSO / YRC / Extra-curricular/ Co-curricular requirements.

iv. No disciplinary action is pending against the student.

v. The award of degree must have been approved by the Syndicate of the University.

12.10 Conduct of Academic Audit

The purpose of the academic audit is to encourage departments to evaluate the quality of their education processes, thereby assure and regularly improve the quality of teaching learning process and the outputs. A regular academic audit is conducted in the Institute to evaluate the performance of various departments so that the issues that need attention can be identified to improve the overall quality of curriculum design, teaching learning process, and evaluation. The academic audits are conducted by internal and external academic experts.

12.11 Conduct of Special Examination

The special or makeup exams may be conducted for the students who missed the regular examination due to participation / representing the institute in various activities and the schedule may be included in the academic calendar. The special or makeup exams may be conducted after the completion of Semester End Examinations and prior to publishing the results of semester end examinations.

12.12 In the consolidated grade sheet the CGPA earned shall be convertedinto Percentage of marks as follows: Percentage of Marks = CGPA × 10

13. CLASSIFICATION OF THE DEGREE AWARDED

For the purpose of the 'Award of Degree', the duration of completion of the programme shall be the total duration taken by a student for completing first time registration of all the required courses and satisfying Clause 11, regardless of the period of Break of study as per Clause 15 and satisfy any one of the conditions required as given below.

13.1 First Class with Distinction: A student who satisfies the following conditions shall be declared to have passed the examination in **First class with Distinction**:

- Should have passed the examination in all the courses of all the eight semesters (six semesters for lateral entry students) in the student's First Appearance within five years / four years for lateral, which includes authorised break of study of one year. Withdrawal from examination (vide Clause 15) will not be considered as an appearance.

- Should have secured a CGPA of **not less than 8.50**
- Should **NOT** have been prevented from writing Semester End Examination due to lack of attendance.

13.2 **First Class:** A student who satisfies the following conditions shall be declared to have passed the examination in **First class**:

- Should have passed the examination in all the courses of all eight semesters (six semesters for lateral entry students) within five years / four years for lateral, which includes one year of authorized break of study (if availed) or prevention from writing the Semester End Examination due to lack of attendance (if applicable).
- Should have secured a CGPA of **not less than 6.50**

13.3 **Second Class:** All other students (not covered in clauses 13.1 and 13.2) who qualify for the award of the degree shall be declared to have passed the examination in **Second class.**

14. WITHDRAWAL FROM THE EXAMINATION

14.1 A student may, for valid reasons, be granted permission by the Head of the Department to withdraw from appearing in the examination in any course(s) only once during the entire duration of the degree programme. The application shall be sent to the office of the Controller of Examinations through the Head of the Institution with required documents.

14.2 Withdrawal application shall be valid only, if the student is eligible to write the examination as per Clause 7 and, if it is made within 10 working days before the commencement of the Semester End Examination in that course or courses and also recommended by the Head of the Department.

14.3 Notwithstanding the requirement of mandatory 10 working days notice, applications for withdrawal for special cases under extraordinary conditions will be considered on the merit of the case.

14.4 If a student withdraws a course or courses from writing Semester End Examinations, he/she shall register the same in the subsequent semester and write the Semester End Examination(s).

14.5 Withdrawal shall not be considered as an appearance in the examination for the eligibility of a student for First Class with Distinction or First Class.

14.6 Withdrawal is permitted for the Semester End Examinations in the final semester, only if the period of study of the student concerned does not exceed 5 years (for regular) / 4 years (for lateral) as per clause 13.1 & 13.2.

15. AUTHORIZED BREAK OF STUDY FROM A PROGRAMME

15.1 A student is permitted to go on break of study for a fixed period of one year as a single break in the entire course of study.

15.2 A student is normally not permitted to break the period of study temporarily. However, if a student happens to discontinue the programme temporarily during the middle of programme of study, for reasons such as personal accident or hospitalization due to ill health or in need of health care, he/she shall apply to the Head of the Institution in advance, in any case, not later than the last date for registering for the semester examination, through the Head of the Department stating the reasons for the break of study. However, a student detained for want of minimum attendance requirement as per Clause 7 shall not be considered as permitted 'Break of Study' and Clause 15.3 is not applicable for such case.

15.3 The student is permitted to re-join the programme after the break / prevention due to lack of attendance, shall be governed by the curriculum and regulations in force at the time of rejoining. The students re-joining in new regulations shall apply to the Academic In charge in the prescribed format through the Head of the Department at the beginning of the readmitted semester itself for prescribing additional/equivalent courses, if any, from any semester of the regulations in force, so as to bridge the curriculum in force and the old curriculum.

15.4 Authorized break of study will be counted towards the duration specified for passing all the courses (vide Clause 5.1 and 5.2) and for the purpose of classification of degree (vide Clause 13).

15.5 The total period for completion of the programme reckoned from the commencement of the first semester to which the student is admitted shall not exceed the maximum period specified in Clause 5.1, irrespective of the period of break of study in order that he / she may be eligible, for the award of the degree (vide Clause 13).

15.6 In case of valid reasons (as stated in Clause 15.2) extended break of study may be granted by the Head of the Institution for a period not more than one year in addition to the earlier authorized break of study.

15.7 If a student does not report back to the Institute, even after the extended break of study, the student's name shall be permanently deleted from the college enrollment. Such students are not entitled to seek readmission under any circumstances.

16. IMPLEMENTATION OF HONOURS / MINOR DEGREE

16.1 B.E. / B.Tech. (Hons.)

- The students should have earned additionally a minimum of 18 credits from more than one vertical of the same programme.
- Should have passed all the courses in the first attempt.
- Should have earned a minimum CGPA of 7.50.

16.2 B.E. / B.Tech. Minor in another discipline

The student should have earned additionally a minimum of 18 credits in any one of the verticals of other B.E/B.Tech. programmes.

- B.E / B.Tech. (Hons.) and B.E./B.Tech. Minor in another discipline will be optional for students and the students shall be permitted to select any of them only.
- B.E/B.Tech. (Hons.) or B.E./ B.Tech. Minor shall be offered by the Department irrespective of the number of students enrolled.

If the student has failed in the additional courses or faced a shortage of attendance, they will not be printed in the grade sheet and will not be considered for CGPA calculation and classification of degree.

16.3 Students can earn a maximum of 6 credits in online mode (SWAYAM NPTEL platform), out of these 18 credits with the approval of the Departmental Consultative Committee constituted by the Head of the Department.

16.4 B.E./ B. Tech. (Honours) in the same discipline, B.E. / B.Tech. Honours and B.E. / B.Tech. Minor in another discipline degrees will be optional for students.

16.5 For category 16.1, the students will be permitted to register for the courses from V Semester onwards provided the CGPA earned by the students until semester III should be of 7.50 and above and cleared all the courses in the first attempt.

16.6 For category 16.2, the students will be permitted to register the courses from semester V onwards provided the CGPA earned by the students until semester III is 7.50 and above.

16.7 If a student decides not to opt for Honours, after completing a certain number of additional courses, the additional courses studied shall be considered instead of the professional elective courses which are part of the curriculum. If the student has studied more number of such courses than the number of Professional Elective courses required as per the curriculum, the courses with higher grades shall be considered for the calculation of CGPA. Remaining courses shall be printed in the grade sheet, however, they will not be considered for the calculation of CGPA.

16.8 If a student decides not to opt for Minor degree, after completing a certain number of courses, the additional courses studied shall be considered instead of open elective courses which are part of the curriculum. If the student has studied more of such courses than the number of open electives required as per the curriculum, the courses with higher grades shall be considered for calculation of CGPA. Remaining courses shall be printed in the grade sheet, however, they will not be considered for the calculation of CGPA.

16.9. If a student successfully completes all the requirements of the programme and also meets the requirements of B.E. / B. Tech. (Hons) or B.E. / B. Tech. Minor but desires not to opt for the additional qualification, then he/she has to submit a declaration with regard to the same 30 days before the completion of VIII semester.

16.10 Classification of the Degree Awarded

The conditions for First Class with Distinction, First Class, and Second Class are the same as Clause 13.1, 13.2 and 13.3 except the following classification.

First Class: A student who satisfies the following conditions shall be declared to have passed the examination in First class for the purpose of the 'Award of Degree', of **B.E. / B.Tech.** Honors should have secured a CGPA of not less than 7.50.

17. SCHEME OF ASSESSMENT

Courses offered under B.E. / B.Tech. Programmes are assessed as given below:

I CO- CURRICULAR /EXTRACURRICULAR ACTIVITY

a. CO-CURRICULAR ACTIVITY

Component	Applicable from academic year 2024-2025 onwards
	Marks
Continuous Internal Assessment (CIA)	**100**
Distribution of marks for CIA	
Programme Organization / Participation	20
Member of Technical society (International / National repute like IEEE, IET etc.)	20
Brief Report of event	20
Sharing of Views / Presentation / Seminar	20
Attendance	10
Coordinator Assessment	10
Total Marks	**100**

b. EXTRACURRICULAR ACTIVITY (NCC/NSS/ NON-TECHNICAL CLUBS)

Component	Applicable from academic year 2024-2025 onwards
	Marks
Continuous Internal Assessment (CIA)	**100**
Distribution of marks for CIA	
Activity plan and Programme Organization	20
Participation (National / State / Regional /Institute)	20
Activity Report	20
Achievements	20
Attendance	10
Coordinator Assessment	10
Total Marks	**100**

c. EXTRA CURRICULAR ACTIVITY (SPORTS AND GAMES)

Component	**Applicable from academic year 2024-2025 onwards**
	Marks
Continuous Internal Assessment (CIA)	**100**
Distribution of marks for CIA	
Participation (National / State / Regional /Institute)	20
Regular practice	20
Skill Development	20
Sportsmanship (sports ethics) and Teamwork	20
Achievements	10
Coordinator Assessment	10
Total Marks	**100**

II COMPREHENSIVE WORK

Component	**Applicable till academic year 2022-2023**
	Marks
Concept Application	50
Comprehensive Interview	50
Total Marks	**100**

III ENGINEERING DRAWING

Component	**Applicable till academic year 2023-2024**	**Applicable from academic year 2024-2025 onwards**
	Marks	**Marks**
Continuous Internal Assessment (CIA)	**100**	**50**

Distribution of marks for CIA		
Exercise (Minimum 10 Exercises /Modelling)	60	-
Model Examinations	40	25
Class work	-	05
Assignments (Minimum 8)	-	20
Semester End Examinations (SEE)	-	**50**
Total Marks	**100**	**100**

IV ENVIRONMENTAL SCIENCE

Component	Applicable till academic year 2023-2024	Applicable from academic year 2024-2025 onwards
	Marks	**Marks**
Continuous Internal Assessment (CIA)	**100**	**100**
Distribution of marks for CIA		
Periodical Test I	25	25
Periodical Test II	25	25
Innovative Practices / Case studies (50)	50	-
Assignments / Case studies	-	50
Total Marks	**100**	**100**

V HOSPITAL TRAINING

Component	Applicable till academic year 2023-2024	Applicable from academic year 2024-2025 onwards
	Marks	**Marks**
Continuous Internal Assessment (CIA)	**100**	**60**
Distribution of marks for CIA		
Assessment by Industry	30	-

Viva-voce	20	-
Presentation	30	-
Case Study / Report	20	-
Daily Work log	-	30
Workplace learning report (1 page)	-	10
Trainer Assessment	-	20
Semester End Examinations (SEE) *a. Presentation* *b. Report* *c. Viva voce*	-	**40** *20* *10* *10*
Total Marks	**100**	**100**

VI HUMAN VALUES AND ETHICS

Component	Applicable till academic year 2023-2024	Applicable from academic year 2024-2025 onwards
	Marks	**Marks**
Continuous Internal Assessment (CIA)	**100**	**40**
Distribution of marks for CIA		
Periodical Test I	25	15
Periodical Test II	25	15
Innovative Practices / Case studies	50	-
Assignments / Case studies	-	10
Semester End Examinations (SEE)	-	**60**
Total Marks	**100**	**100**

VII INDUSTRIAL TRAINING/ INTERNSHIP

Component	Marks
Midterm Review	30
Final Presentation	30
Viva-voce	20

Case Study / Report	20
Total Marks	**100**

VIII LABORATORY COURSES

Component	**Applicable till academic year 2023-2024**	**Applicable from academic year 2024-2025 onwards**
	Marks	**Marks**
Continuous Internal Assessment (CIA)	**100**	**60**
Distribution of marks for CIA		
Preparation	20	10
Experiment and Analysis of Results	20	10
Record	10	10
Test – Cycle I	25	15
Test – Cycle II	25	15
Semester End Examinations (SEE)	-	**40**
Total Marks	**100**	**100**

IX LANGUAGE COURSES

a. LANGUAGE ELECTIVES - COMMUNICATIVE ENGLISH II / HINDI / GERMAN / JAPANESE / FRENCH)

Component	**Applicable till academic year 2023-2024**	**Applicable from academic year 2024-2025 onwards**
	Marks	**Marks**
Continuous Internal Assessment (CIA)	**100**	**50**
Distribution of marks for CIA		
Test1 *a. Listening* *b. Speaking* *c. Reading* *d. Writing*	**25** *5* *10* *5* *5*	**25** *5* *5* *5* *10*
Test 2	**25**	**25**

a. Listening *b. Speaking* *c. Reading* *d. Writing*	*5* *10* *5* *5*	*5* *5* *5* *10*
Oral Exam	**50**	-
Semester End Examinations (SEE)	**-**	**50**
Total Marks	**100**	**100**

b. TAMIL COURSES

Component	Applicable till academic year 2023-2024	Applicable from academic year 2024-2025 onwards
	Marks	**Marks**
Continuous Internal Assessment (CIA)	**100**	**40**
Distribution of marks for CIA		
Periodical Test	50	-
Quiz/ Assignment	50	20
Case study report	-	20
Semester End Examinations (SEE)	**-**	**60**
Total Marks	**100**	**100**

c. FOUNDATIONAL ENGLISH / SOFT SKILLS & EFFECTIVE COMMUNICATION / ADVANCED ENGLISH AND TECHNICAL EXPRESSION

Component	Applicable till academic year 2023-2024	Applicable from academic year 2024-2025 onwards
	Marks	**Marks**
Continuous Internal Assessment (CIA)	**100**	**60**
Distribution of marks for CIA		
Test	**50**	-
Quiz/ Assignment	**50**	-
Test 1 *a. Listening* *b. Speaking*	-	**30** *5* *10*

c. Reading *d. Writing*		*5* *10*
Test 2 *a. Listening* *b. Speaking* *c. Reading* *d. Writing*	**-**	**30** *5* *10* *5* *10*
Semester End Examinations (SEE)	**-**	**40**
Total Marks	**100**	**100**

d. BUSINESS COMMUNICATION AND VALUE SCIENCE COURSES

Component	**Applicable from academic year 2024-2025 onwards**
	Marks
Continuous Internal Assessment (CIA)	**50**
Distribution of marks for CIA	
Periodical Tests	25
Laboratory Assessment	25
Semester End Examinations (SEE) *Laboratory Assessment only*	**50**
Total Marks	**100**

X MINI PROJECT I & II

Component	**Applicable till academic year 2023-2024**	**Applicable from academic year 2024-2025 onwards**
	Marks	**Marks**
Continuous Internal Assessment (CIA)	**100**	**60**
Distribution of marks for CIA		
Review I	25	30
Review II	25	30
Final Presentation and Viva-voce	30	**-**
Report	20	

Semester End Examinations (SEE) *a. Report* *b. Presentation & Viva Voce*	**-**	**40** *20* *20*
Total Marks	**100**	**100**

XI PROJECT WORK I

Component	Applicable till academic year 2023-2024	Applicable from academic year 2024-2025 onwards
	Marks	**Marks**
Continuous Internal Assessment (CIA)	**50**	**60**
Distribution of marks for CIA		
Review I *a. Literature Survey* *b. Identification of topic and Justification* *c. Work plan* *d. Problem Statement and Literature Survey* *e. Contribution to the work* *f. Viva voce*	**20** *5* *5* *10* - - -	**30** - - *10* *5* *10* *5*
Review II *a. Approach & Results* *b. Conclusion* *c. Methodology & Results* *d. Conclusion with report* *e. Publication* *f. Viva voce*	**30** *15* *15* - - - -	**30** - - *10* *10* *5* *5*
Semester End Examinations (SEE) *a. Report* *b. Presentation* *c. Viva voce*	**50** *20* *20* *10*	**40** *15* *15* *10*
Total Marks	**100**	**100**

XII PROJECT WORK II

Component	Applicable till academic year 2023-2024	Applicable from academic year 2024-2025 onwards
	Marks	**Marks**
Continuous Internal Assessment (CIA)	**50**	**60**

Distribution of marks for CIA		
Review I *a. Progress* *b. Problem Statement and Literature Survey* *c. Methodology* *d. Work Contribution* *e. Viva voce*	**10** *10* - - - -	**20** - *5* *5* *5* *5*
Review II *a. Approach & Results* *b. Work Contribution* *c. Viva voce*	**10** *10* - -	**20** *10* *5* *5*
Review III *a. Conclusion & Final Presentation* *b. Report* *c. Publication of Paper in Conferences / Journals* *d. Results & Discussions* *e. Report and Contribution* *f. Publication* *g. Viva voce*	**30** *10* *15* *5* - - - -	**20** - - - *5* *5* *5* *5*
Semester End Examinations (SEE) *a. Presentation* *b. Viva voce* *c. Report*	**50** *30* *20* -	**40** *15* *10* *15*
Total Marks	**100**	**100**

XIII SOCIALLY RELEVANT PROJECT

Component	**Applicable from academic year 2024-2025 onwards**
	Marks
Continuous Internal Assessment (CIA)	**100**
Distribution of marks for CIA	
Field Survey	20
Problem Statement / Problem Identification and Social Relevance	20
Approach to the Problem / Methodology	20
Presentation / Seminar	10
Sustainable solutions and Future Plans	10
Report	10

Novelty	10
Total Marks	**100**

XIV STARTUP MANAGEMENT

Component	**Applicable till academic year 2023-2024**	**Applicable from academic year 2024-2025 onwards**
	Marks	**Marks**
Continuous Internal Assessment (CIA)	**100**	**50**
Distribution of marks for CIA		
Conduct of Fieldwork / Case Studies & Report	60	25
Model Examination	40	-
Assignments / Experiments & Report	-	25
Semester End Examinations (SEE)	**-**	**50**
Total Marks	**100**	**100**

XV THEORY COURSES

Component	**Marks**
Continuous Internal Assessment (CIA)	**40**
Distribution of marks for CIA	
Periodical Test I	12
Periodical Test II	12
Innovative Practices	16
Semester End Examinations (SEE)	**60**
Total Marks	**100**

XVI THEORY COURSES WITH LAB COMPONENT

Component	Applicable till academic year 2023-2024*	Applicable from academic year 2024-2025 onwards#
	Marks	**Marks**
Continuous Internal Assessment (CIA)	**50**	**50**
Distribution of marks for CIA		
Periodical Test I	15	25
Periodical Test II	15	
Innovative Practices (Laboratory Assessment & Report)	20	25
Semester End Examinations (SEE) * *(QP pattern as per (I))*	**50**	**50**
Semester End Examinations (SEE) # ***Courses with L T P C: 2 0 2 3*** a. *Theory Examinations* b. *Laboratory Assessment*	**-**	25 25
Semester End Examinations (SEE) # ***Courses with L T P C: 3 0 2 4, 2 1 2 4, 3 1 2 5*** a. *Theory Examinations* b. *Laboratory Assessment*	**-**	35 15
Total Marks	**100**	**100**

XVII VALUE-ADDED / CERTIFICATE COURSES

Component	Marks
Daily Assessment	50
Final Evaluation / Test	50
Total Marks	**100**

Optional Test: A student becomes eligible to appear for an optional test conducted after the Periodical Test II, only under the following circumstances: (i) absent for Test I or Test II or both on account of medical reasons (hospitalization / accident / specific illness), or (ii) participation in the College / University / State / National / International level Sports events with prior permission from the Head of the Institution and (iii) on satisfying the conditions (i) or (ii), the student should have registered for the Optional Test, through the concerned member of faculty who handles the course or through the respective Head of the Department, submitted to the Controller of Examinations. Such Optional Tests are conducted for the courses under the categories I and II courses listed above.

18. FIELD / INDUSTRIAL VISIT / INTERNSHIP

In order to provide the experiential learning to the students, Head of the Department shall take efforts to arrange at least two industrial visits / field visits. The students may also undergo in-plant training / internship during summer / winter vacation between III and VII semesters.

19. PERSONALITY AND CHARACTER DEVELOPMENT

Every student shall be required to undergo a minimum of 40 hours of Personality Development Programmes viz, NSS / NCC / YRC / YOGA / Sports and Games / Technical and Non-technical Club activities. The attendance of the personality and character development courses / events shall be maintained on the regular basis by the club coordinator and made available in the Office of the Controller of Examinations before the commencement of Semester examinations of Semester I to Semester IV.

20. DISCIPLINE

A student is expected to follow the rules and regulations laid down by the Institute and the affiliating University, as published from time to time. Any violations, if any, shall be treated as per the procedures stated thereof.

If a student indulges in malpractice in any of the Semester End Examination / Continuous Assessments, he / she shall be liable for punitive action as prescribed by the Institution / University from time to time.

21. REVISION OF REGULATIONS, CURRICULUM AND SYLLABI

The Institution reserves the right to revise/amend/change the Regulations, Curriculum, Syllabi, Scheme of Examinations through the Academic Council.

CONTENTS

VISION OF THE DEPARTMENT

To be the leader in the field of computer technology, fostering innovative thinking, promoting technological excellence, and driving digital transformation for the benefit of society.

MISSION OF THE DEPARTMENT

- To build an innovative and problem-solving culture, empowering students to create cutting-edge computer technology solutions.
- To equip students for thriving careers in the technology industry through practical, hands-on learning experiences and industry-relevant skill development.
- To develop socially responsible students driving impactful digital transformations for the betterment of individuals, communities, and the environment.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

I. Engineering professionals, innovators, or entrepreneurs engaged in technology development, technology deployment, or engineering system implementation in industry.

II. Capable of interacting with their peers in other disciplines in industry and society and contribute to the economic growth of the country.

III. Successful in pursuing higher studies in engineering or management and pursue career paths in teaching or research.

PROGRAMME OUTCOMES (POs)

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

1. Demonstrate the knowledge and technical skills in software development.
2. Develop practical competencies in Software and Hardware Design

MAPPING OF PEOs AND Pos

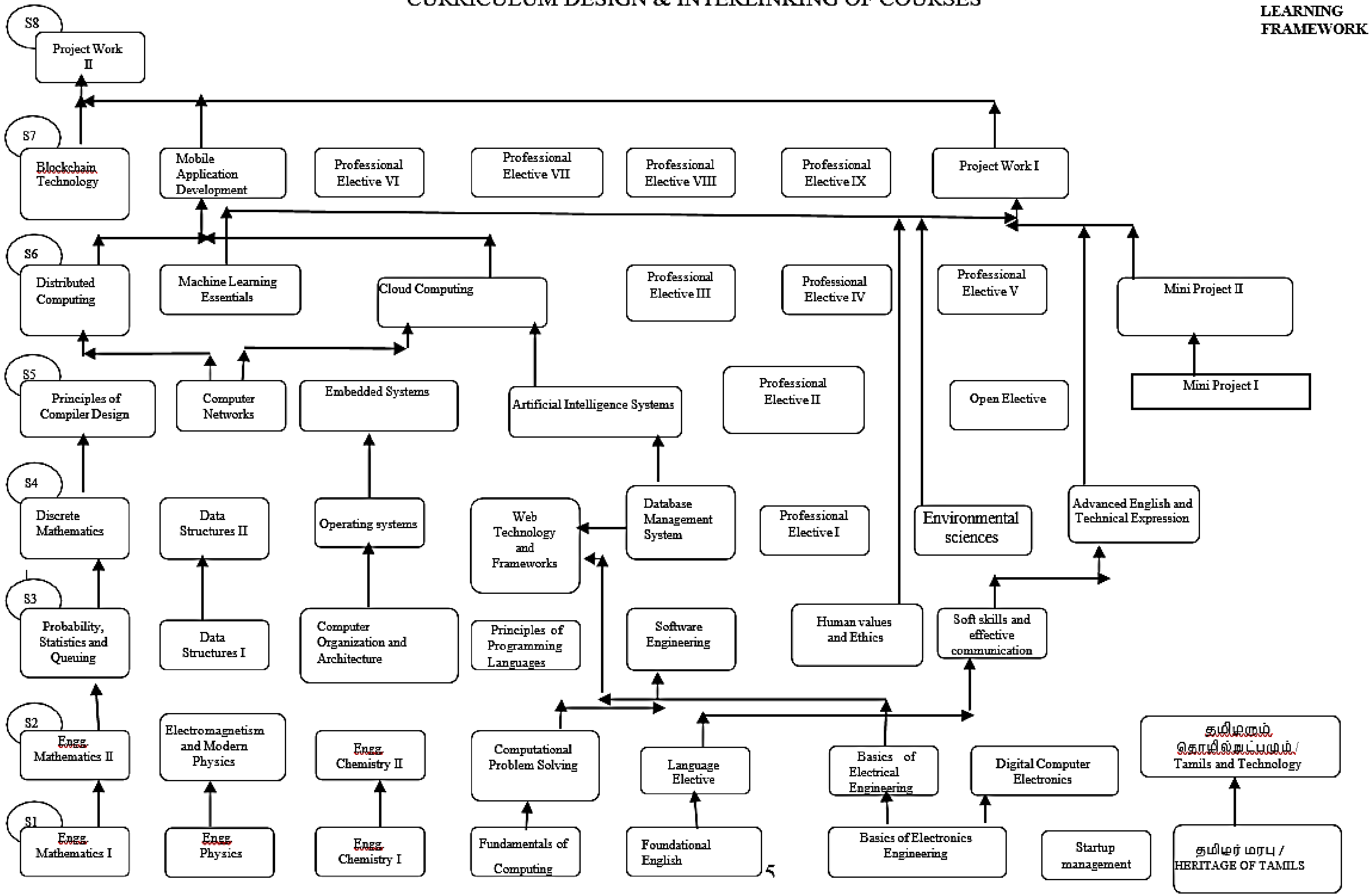
PEO(s)	Programme Outcomes(s)											
	1	2	3	4	5	6	7	8	9	10	11	12
I	X	X	X	X	X	X	X	X	X			
II	X	X	X	X	X	X		X	X	X	X	
III								X	X	X	X	X

CONNECTIVITY CHART

DEPARTMENT OF COMPUTER TECHNOLOGY

CURRICULUM DESIGN & INTERLINKING OF COURSES

360^0 FLEXIBLE LEARNING FRAMEWORK



B.Tech. Computer Technology

Minimum Credits to be Earned: 163

I SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CIA	SEE	Total	
22MA101	ENGINEERING MATHEMATICS I	3	1	0	4	4	40	60	100	BS
22PH102	ENGINEERING PHYSICS	2	0	2	3	4	50	50	100	BS
22CH103	ENGINEERING CHEMISTRY I	2	0	2	3	4	50	50	100	BS
22GE001	FUNDAMENTALS OF COMPUTING	3	0	0	3	3	40	60	100	ES
22HS001	FOUNDATIONAL ENGLISH	1	0	2	2	3	100	0	100	HSS
22GE004	BASICS OF ELECTRONICS ENGINEERING	2	0	2	3	4	50	50	100	ES
22HS002	STARTUP MANAGEMENT	1	0	2	2	3	100	0	100	EEC
22HS003	தமிழர் மரபு HERITAGE OF TAMILS#*	1	0	0	1	1	100	0	100	HSS
22CT108	COMPREHENSIVE WORK$	0	0	2	1$	2	100	0	100	EEC
Total		**15**	**1**	**10**	**21**	**26**	**-**	**-**	**-**	**-**

II SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CIA	SEE	Total	
22MA201	ENGINEERING MATHEMATICS II	3	1	0	4	4	40	60	100	BS
22PH202	ELECTROMAGNETISM AND MODERN PHYSICS	2	0	2	3	4	50	50	100	BS
22CH203	ENGINEERING CHEMISTRY II	2	0	2	3	4	50	50	100	BS
22GE002	COMPUTATIONAL PROBLEM SOLVING	3	0	0	3	3	40	60	100	ES
22GE003	BASICS OF ELECTRICAL ENGINEERING	2	0	2	3	4	50	50	100	ES
22CT206	DIGITAL COMPUTER ELECTRONICS	3	0	2	4	5	50	50	100	ES
	LANGUAGE ELECTIVE	1	0	2	2	3	100	0	100	HSS
22HS006	தமிழரும் ததொழில்நுட்பமும் TAMILS AND TECHNOLOGY*	1	0	0	1	1	100	0	100	HSS
Total		**17**	**1**	**10**	**23**	**28**	**-**	**-**	**-**	**-**

* The lateral entry students have to complete these courses during III and IV semester.
# Students admitted during academic year 2022-2023 studied this course in semester II.
^ Students admitted during academic year 2022-2023 studied this course in semester III.
$ Applicable only for the students admitted during academic year 2022-2023.

III SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CT301	PROBABILITY, STATISTICS AND QUEUING THEORY	3	1	0	4	4	40	60	100	BS
22CT302	DATA STRUCTURES I	3	0	2	4	5	50	50	100	PC
22CT303	COMPUTER ORGANIZATION AND ARCHITECTURE*	3	1	0	4	4	40	60	100	ES
22CT304	PRINCIPLES OF PROGRAMMING LANGUAGES	3	0	2	4	5	50	50	100	PC
22CT305	SOFTWARE ENGINEERING	3	0	0	3	3	40	60	100	PC
22HS004	HUMAN VALUES AND ETHICS	2	0	0	2	2	40	60	100	HSS
22HS005	SOFT SKILLS AND EFFECTIVE COMMUNICATION	0	0	2	1	2	60	40	100	HSS
Total		**17**	**2**	**6**	**22**	**25**	**-**	**-**	**-**	**-**

IV SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CT401	DISCRETE MATHEMATICS	3	1	0	4	4	40	60	100	ES
22CT402	DATA STRUCTURES II	3	0	2	4	5	50	50	100	PC
22CT403	OPERATING SYSTEMS	3	1	0	4	4	40	60	100	PC
22CT404	WEB TECHNOLOGY AND FRAMEWORKS	2	0	2	3	4	50	50	100	PC
22CT405	DATABASE MANAGEMENT SYSTEM	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE I	-	-	-	3	-	-	-	100	PE
22HS007	ENVIRONMENTAL SCIENCE	2	0	0	-	2	100	0	100	HSS
22HS008	ADVANCED ENGLISH AND TECHNICAL EXPRESSION	0	0	2	1	2	60	40	100	EEC
Total		**-**	**-**	**-**	**23**	**-**	**-**	**-**	**-**	**-**

* LTPC for this course is 3 0 0 3 for the students admitted during academic year 2022-2023.

V SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**HOURS /WEEK**	**Maximum Marks**			**Category**
							CIA	**SEE**	**TOTAL**	
22CT501	PRINCIPLES OF COMPILER DESIGN	3	1	0	4	4	40	60	100	PC
22CT502	COMPUTER NETWORKS	3	0	2	4	5	50	50	100	PC
22CT503	EMBEDDED SYSTEMS	3	0	0	3	3	40	60	100	ES
22CT504	ARTIFICIAL INTELLIGENCE SYSTEMS	2	0	2	3	4	50	50	100	PC
	PROFESSIONAL ELECTIVE II	-	-	-	3	-	-	-	100	PE
	OPEN ELECTIVE	3	0	0	3	3	40	60	100	PE
22CT507	MINI PROJECT I	0	0	2	1	2	60	40	100	EEC
Total		**-**	**-**	**-**	**21**	**-**	**-**	**-**	**-**	**-**

VI SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**HOURS /WEEK**	**Maximum Marks**			**Category**
							CIA	**SEE**	**TOTAL**	
22CT601	DISTRIBUTED COMPUTING	3	0	0	3	3	40	60	100	PC
22CT602	MACHINE LEARNING ESSENTIALS	3	0	2	4	5	50	50	100	PC
22CT603	CLOUD COMPUTING	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE III	-	-	-	3	-	-	-	100	PE
	PROFESSIONAL ELECTIVE IV	-	-	-	3	-	-	-	100	PE
	PROFESSIONAL ELECTIVE V	-	-	-	3	-	-	-	100	PE
22CT607	MINI PROJECT II	0	0	2	1	2	60	40	100	EEC
Total		**-**	**-**	**-**	**21**	**-**	**-**	**-**	**-**	**-**

VII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CT701	BLOCKCHAIN TECHNOLOGY	3	0	2	4	5	50	50	100	PC
22CT702	MOBILE APPLICATION DEVELOPMENT	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE VI	-	-	-	3	-	-	-	100	PE
	PROFESSIONAL ELECTIVE VII	-	-	-	3	-	-	-	100	PE
	PROFESSIONAL ELECTIVE VIII	-	-	-	3	-	-	-	100	PE
	PROFESSIONAL ELECTIVE IX	-	-	-	3	-	-	-	100	PE
22CT707	PROJECT WORK I	0	0	4	2	4	60	40	100	EEC
Total		**-**	**-**	**-**	**22**	**-**	**-**	**-**	**-**	**-**

VIII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CT801	PROJECT WORK II	0	0	20	10	20	60	40	100	EEC
Total		**0**	**0**	**20**	**10**	**20**	**-**	**-**	**-**	**-**

ELECTIVES										
LANGUAGE ELECTIVE										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22HS201	COMMUNICATIVE ENGLISH II	1	0	2	2	3	100	0	100	HSS
22HSH01	HINDI	1	0	2	2	3	100	0	100	HSS
22HSG01	GERMAN	1	0	2	2	3	100	0	100	HSS
22HSJ01	JAPANESE	1	0	2	2	3	100	0	100	HSS
22HSF01	FRENCH	1	0	2	2	3	100	0	100	HSS

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CIA	SEE	Total	
ELECTIVES										
PROFESSIONAL ELECTIVES										
VERTICAL I: DATA SCIENCE										
22CT001	EXPLORATORY DATA ANALYSIS	2	0	2	3	4	50	50	100	PE
22CT002	RECOMMENDER SYSTEMS	3	0	0	3	3	40	60	100	PE
22CT003	BIG DATA ANALYTICS	3	0	0	3	3	40	60	100	PE
22CT004	NEURAL NETWORKS AND DEEP LEARNING	2	0	2	3	4	50	50	100	PE
22CT005	NATURAL LANGUAGE PROCESSING	2	0	2	3	4	50	50	100	PE
22CT006	COMPUTER VISION	2	0	2	3	4	50	50	100	PE
VERTICAL II: FULL STACK DEVELOPMENT										
22CT007	AGILE SOFTWARE DEVELOPMENT	3	0	0	3	3	40	60	100	PE
22CT008	UI AND UX DESIGN	3	0	0	3	3	40	60	100	PE
22CT009	WEB FRAMEWORKS	3	0	0	3	3	40	60	100	PE
22CT010	WEB APPLICATION SECURITY	2	0	2	3	4	50	50	100	PE
22CT011	SOFTWARE TESTING AND AUTOMATION	3	0	0	3	3	40	60	100	PE
22CT012	DevOps	3	0	0	3	3	40	60	100	PE
VERTICAL III: CLOUD COMPUTING AND DATA CENTER TECHNOLOGIES										
22CT013	VIRTUALIZATION IN CLOUD COMPUTING	3	0	0	3	3	40	60	100	PE
22CT014	CLOUD SERVICES AND DATA MANAGEMENT	3	0	0	3	3	40	60	100	PE
22CT015	CLOUD STORAGE TECHNOLOGIES	3	0	0	3	3	40	60	100	PE
22CT016	CLOUD AUTOMATION TOOLS AND APPLICATIONS	3	0	0	3	3	40	60	100	PE
22CT017	SOFTWARE DEFINED NETWORKS	2	0	2	3	4	50	50	100	PE
22CT018	SECURITY AND PRIVACY IN CLOUD	3	0	0	3	3	40	60	100	PE

VERTICAL IV: CYBER SECURITY AND DATA PRIVACY										
22CT019	CYBER SECURITY	3	0	0	3	3	40	60	100	PE
22CT020	MODERN CRYPTOGRAPHY	3	0	0	3	3	40	60	100	PE
22CT021	CYBER FORENSICS	3	0	0	3	3	40	60	100	PE
22CT022	ETHICAL HACKING	3	0	0	3	3	40	60	100	PE
22CT023	SECURE SOFTWARE SYSTEMS	2	0	2	3	4	50	50	100	PE
22CT024	MALWARE ANALYSIS	3	0	0	3	3	40	60	100	PE
VERTICAL V: CREATIVE MEDIA										
22CT025	MULTIMEDIA AND ANIMATION	2	0	2	3	4	50	50	100	PE
22CT008	UI AND UX DESIGN	3	0	0	3	3	40	60	100	PE
22CT026	AUGMENTED REALITY AND VIRTUAL REALITY	2	0	2	3	4	50	50	100	PE
22CT027	GAME DEVELOPMENT	2	0	2	3	4	50	50	100	PE
22CT028	VIDEO CREATION AND EDITING	2	0	2	3	4	50	50	100	PE
22CT029	DIGITAL MARKETING	3	0	0	3	3	40	60	100	PE
VERTICAL VI: EMBEDDED TECHNOLOGIES										
22CT030	REAL TIME OPERATING SYSTEM	3	0	0	3	3	40	60	100	PE
22CT031	WIRELESS AND MOBILE COMMUNICATION	3	0	0	3	3	40	60	100	PE
22CT032	DESIGN OF EMBEDDED SYSTEMS	2	0	2	3	4	50	50	100	PE
22CT033	EMBEDDED SYSTEM NETWORKING	3	0	0	3	3	40	60	100	PE
22CT034	EMBEDDED SECURITY	3	0	0	3	3	40	60	100	PE
22CT035	EMBEDDED PROCESSOR DEVELOPMENT	3	0	0	3	3	40	60	100	PE

VERTICAL VII: DIVERSIFIED COURSES										
22CT036	XML AND WEB SERVICES	3	0	0	3	3	40	60	100	PE
22CT037	SOFTWARE PROJECT MANAGEMENT	3	0	0	3	3	40	60	100	PE
22CT038	HUMAN COMPUTER INTERACTION	3	0	0	3	3	40	60	100	PE
22CT039	VISUAL EFFECTS	3	0	0	3	3	40	60	100	PE
22CT040	BUSINESS ANALYTICS	3	0	0	3	3	40	60	100	PE
22CT041	IoT AND USE CASES	3	0	0	3	3	40	60	100	PE

HONOUR VERTICAL										
VERTICAL I: DATA SCIENCE										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CTH01	EXPLORATORY DATA ANALYSIS	2	0	2	3	4	50	50	100	PE
22CTH02	RECOMMENDER SYSTEMS	3	0	0	3	3	40	60	100	PE
22CTH03	BIG DATA ANALYTICS	3	0	0	3	3	40	60	100	PE
22CTH04	NEURAL NETWORKS AND DEEP LEARNING	2	0	2	3	4	50	50	100	PE
22CTH05	NATURAL LANGUAGE PROCESSING	2	0	2	3	4	50	50	100	PE
22CTH06	COMPUTER VISION	2	0	2	3	4	50	50	100	PE
MINOR VERTICAL (Other than AI&DS, AIML, CSBS, CSD, CSE, CT, ISE, IT, ECE & EIE Students)										
VERTICAL VIII – SOFTWARE PROGRAMMING										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CTM42	PROBLEM SOLVING USING PYTHON	2	0	2	3	4	50	50	100	PE
22CTM43	DATA STRUCTURES AND ALGORITHMS USING PYTHON	3	0	0	3	3	40	60	100	PE
22CTM44	RELATIONAL DATABASE SYSTEMS	3	0	0	3	3	40	60	100	PE
22CTM45	OBJECT ORIENTED PROGRAMMING USING JAVA	2	0	2	3	4	50	50	100	PE
22CTM46	FUNDAMENTALS OF COMPUTER NETWORKS AND OPERATING SYSTEMS	3	0	0	3	3	40	60	100	PE
22CTM47	SOFTWARE ANALYSIS AND DESIGN	3	0	0	3	3	40	60	100	PE
22CTM48	DATA VISUALIZATION WITH PYTHON	2	0	2	3	4	50	50	100	PE
22CTM49	DATA ANALYTICS FOR DECISION SUPPORT SYSTEMS	3	0	0	3	3	40	60	100	PE

OPEN ELECTIVES										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22OCE01	ENERGY CONSERVATION AND MANAGEMENT	3	0	0	3	3	40	60	100	OE
22OEC02	MICROCONTROLLER PROGRAMMING	3	0	0	3	3	40	60	100	OE
22OEC03	PRINCIPLES OF COMMUNICATION SYSTEMS	3	0	0	3	3	40	60	100	OE
22OEI01	PROGRAMMABLE LOGIC CONTROLLER	3	0	0	3	3	40	60	100	OE
22OEI02	SENSOR TECHNOLOGY	3	0	0	3	3	40	60	100	OE
22OEI03	FUNDAMENTALS OF VIRTUAL INSTRUMENTATION	3	0	0	3	3	40	60	100	OE
22OEI04	OPTOELECTRONICS AND LASER INSTRUMENTATION	3	0	0	3	3	40	60	100	OE
22OME01	DIGITAL MANUFACTURING	3	0	0	3	3	40	60	100	OE
22OME02	INDUSTRIAL PROCESS ENGINEERING	3	0	0	3	3	40	60	100	OE
22OME03	MAINTENANCE ENGINEERING	3	0	0	3	3	40	60	100	OE
22OME04	SAFETY ENGINEERING	3	0	0	3	3	40	60	100	OE
22OBT01	BIOFUELS	3	0	0	3	3	40	60	100	OE
22OFD01	TRADITIONAL FOODS	3	0	0	3	3	40	60	100	OE
22OFD02	FOOD LAWS AND REGULATIONS	3	0	0	3	3	40	60	100	OE
22OFD03	POST HARVEST TECHNOLOGY OF FRUITS AND VEGETABLES	3	0	0	3	3	40	60	100	OE
22OFD04	CEREAL, PULSES AND OIL SEED TECHNOLOGY	3	0	0	3	3	40	60	100	OE
22OFT01	FASHION CRAFTSMANSHIP	3	0	0	3	3	40	60	100	OE
22OFT02	INTERIOR DESIGN IN FASHION	3	0	0	3	3	40	60	100	OE
22OFT03	SURFACE ORNAMENTATION	3	0	0	3	3	40	60	100	OE
22OPH01	NANOMATERIALS SCIENCE	3	0	0	3	3	40	60	100	OE
22OPH02	SEMICONDUCTOR PHYSICS AND DEVICES	3	0	0	3	3	40	60	100	OE
22OPH03	APPLIED LASER SCIENCE	3	0	0	3	3	40	60	100	OE
22OPH04	BIOPHOTONICS	3	0	0	3	3	40	60	100	OE
22OPH05	PHYSICS OF SOFT MATTER	3	0	0	3	3	40	60	100	OE
22OCH01	CORROSION SCIENCE AND ENGINEERING	3	0	0	3	3	40	60	100	OE
22OCH02	POLYMER SCIENCE	3	0	0	3	3	40	60	100	OE
22OCH03	ENERGY STORING DEVICES	3	0	0	3	3	40	60	100	OE
22OGE01	PRINCIPLES OF MANAGEMENT	3	0	0	3	3	40	60	100	OE

22OGE02	ENTREPRENEURSHIP DEVELOPMENT I	3	0	0	3	3	40	60	100	OE
22OGE03	ENTREPRENEURSHIP DEVELOPMENT II	3	0	0	3	3	40	60	100	OE
22OGE04	NATION BUILDING, LEADERSHIP AND SOCIAL RESPONSIBILITY	3	0	0	3	3	40	60	100	OE
22OBM01	OCCUPATIONAL SAFETY AND HEALTH IN PUBLIC HEALTH EMERGENCIES	3	0	0	3	3	40	60	100	OE
22OBM02	AMBULANCE AND EMERGENCY MEDICAL SERVICE MANAGEMENT	3	0	0	3	3	40	60	100	OE
22OBM03	HOSPITAL AUTOMATION	3	0	0	3	3	40	60	100	OE
22OAG01	RAIN WATER HARVESTING TECHNIQUES	3	0	0	3	3	40	60	100	OE
22OEE01	VALUE ENGINEERING	3	0	0	3	3	40	60	100	OE
22OEE02	ELECTRICAL SAFETY	3	0	0	3	3	40	60	100	OE
22OCB01	INTERNATIONAL BUSINESS MANAGEMENT	3	0	0	3	3	40	60	100	OE

ONE CREDIT COURSES										
22CT0XA	MEAN STACK FOR DYNAMIC WEB APP DEVELOPMENT	1	0	0	1	-	100	0	100	EEC
22CT0XB	COMPONENT BASED UI DEVELOPMENT	1	0	0	1	-	100	0	100	EEC
22CT0XC	DATA ANALYSIS USING R PROGRAMMING	1	0	0	1	-	100	0	100	EEC
22CT0XD	RAPID API DEVELOPMENT WITH FastAPI	1	0	0	1	-	100	0	100	EEC
22CT0XE	STATISTICS FOR DATA SCIENCE AND BUSINESS ANALYSIS	1	0	0	1	-	100	0	100	EEC

SUMMARY OF CREDIT DISTRIBUTION

S.No	CATEGORY	CREDITS PER SEMESTER								TOTAL CREDIT	CREDITS in %	Range of Total Credits	
		I	II	III	IV	V	VI	VII	VIII			Min	Max
1	BS	10	10	4						24	15	15%	20%
2	ES	6	10	4	4	3				27	17	15%	20%
3	HSS	3	3	3						9	6	5%	10%
4	PC			11	15	11	11	8		56	34	30%	40%
5	PE				3	6	9	12		30	18	10%	15%
6	EEC	2			1	1	1	2	10	17	10	10%	15%
Total		21	23	22	23	21	21	22	10	163	100	-	-

BS - Basic Sciences
ES - Engineering Sciences
HSS - Humanities and Social Sciences
PC - Professional Core
PE - Professional Elective
EEC - Employability Enhancement Course
CA - Continuous Assessment
ES - End Semester Examinatio

22MA101 ENGINEERING MATHEMATICS I 3 1 0 4

Course Objectives

- To impart mathematical modeling to describe and explore real-world phenomena and data.
- To provide basic understanding on Linear, quadratic, power and polynomial, exponential, and multi variable models
- Summarize and apply the methodologies involved in framing the real world problems related to fundamental principles of polynomial equations

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Implement the concepts of mathematical modeling based on linear functions in Engineering.
2. Formulate the real-world problems as a quadratic function model
3. Demonstrate the real-world phenomena and data into Power and Polynomial functions
4. Apply the concept of mathematical modeling of exponential functions in Engineering
5. Develop the identification of multivariable functions in the physical dynamical problems

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	-	-	-	-	-	-	-	-	-	-	2	-
2	2	2	-	-	-	-	-	-	-	-	-	-	2	-
3	2	1	-	-	-	-	-	-	-	-	-	-	2	-
4	2	2	-	-	-	-	-	-	-	-	-	-	2	-
5	1	2	-	-	-	-	-	-	-	-	-	-	2	-

UNIT I 9 Hours

MATHEMATICS MODELING OF LINEAR FUNCTIONS

The geometry of linear equations - Formation of linear equations: Method of least squares and method of regression - Vector spaces: Basic concepts with examples - Linear combination - Eigen values and vectors

UNIT II 9 Hours

MATHEMATICAL MODELING OF QUADRATIC FUNCTIONS

General form of a quadratic function - Basic relationships between the equation and graph of a quadratic function - Sum of squares error and the quadratic function of best fit - Quadratic forms: Matrix form - Orhtogonality - Canonical form and its nature

UNIT III **9 Hours**

MATHEMATICAL MODELING OF POWER AND POLYNOMIAL FUNCTIONS

Characteristics of the graphs of power and polynomial functions - Fitting of power and polynomial functions using the method of least squares - Local maxima and local minima of power and polynomial functions - Power series of functions with real variables, Taylors series, radius and interval of convergence - Tests of convergence for series of positive terms - comparison test, ratio test

UNIT IV **9 Hours**

MATHEMATICAL MODELING OF EXPONENTIAL FUNCTIONS

Concept of exponential growth - Graphs of exponential functions - Relationship between the growth factor and exponential growth or decline - Exponential equations have a variable as an exponent and take the form y= abx through least square approximation - Calculus of exponential functions - Exponential series - Characteristics

UNIT V **9 Hours**

MATHEMATICAL MODELING OF MULTIVARIABLE FUNCTIONS

Graphing of functions of two variables -Partial derivatives - Total derivatives - Jacobians - Optimization of multivariable functions with constraints - Optimization of multivariable functions without constraints

Total: 45+15=60 Hours

Reference(s)

1. Erwin Kreyszig , Advanced Engineering Mathematics, Tenth Edition, Wiley India Private Limited, New Delhi 2016
2. B. S. Grewal, Numerical Methods in Engineering & Science: With Programs in C, C++ & MATLAB, Khanna, 2014
3. S.C. Gupta, V.K. Kapoor, Fundamentals of Mathematical Statistics ,Sultan Chand & Sons2020
4. Thomas and Finney, Calculus and analytic Geometry, Fourteenth Edition, By Pearson Paperback, 2018

22PH102 **ENGINEERING PHYSICS** **2 0 2 3**

Course Objectives

- Understand the concept and principle of energy possessed by mechanical system
- Exemplify the propagation and exchange of energy
- Identify the properties of materials based on the energy possession

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Illustrate the concept and principles of energy to understand mechanical systems
2. Exemplify the types of mechanical oscillations based on vibrational energy
3. Infer the concept of propagation of energy as transverse and longitudinal waves
4. Analyze the exchange of energy and work between the systems using thermodynamic principles
5. Apply the concept of energy and entropy to understand the mechanical properties of materials

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	-	-	-	-	-	-	2	-	-	-	-	-
2	2	1	-	-	-	-	-	-	2	-	-	-	-	-
3	2	1	-	-	-	-	-	-	2	-	-	-	-	-
4	2	1	-	-	-	-	-	-	2	-	-	-	-	-
5	2	1	-	-	-	-	-	-	2	-	-	-	-	-

UNIT I **6 Hours**

CONSERVATION OF ENERGY

Concept of energy - types of energy-conservation of energy. Mechanical energy: - translation - rotation - vibration - Kinetic and potential energies - conservation - work and energy - laws of motion - minimization of potential energy - equilibrium - dissipative systems - friction

UNIT II **5 Hours**

VIBRATIONAL ENERGY

Periodic Motion - Simple Harmonic Motion - Energy of the SHM - Pendulum types - Damped oscillations

- forced oscillations - natural frequency – resonance

UNIT III **6 Hours**

PROPAGATION OF ENERGY

Transfer of energy - material medium - Transverse wave - Longitudinal wave - standing wave - interference
- Doppler effect. Sound waves and its types - characteristics - human voice - reflection - refraction-beats

UNIT IV **7 Hours**

EXCHANGE OF ENERGY

Energy in transit - heat - Temperature - measurement - specific heat capacity and water - thermal expansion –Heat transfer processes-Thermodynamics: Thermodynamic systems and processes - Laws of thermodynamics - Entropy - entropy on a microscopic scale -maximization of entropy

UNIT V **6 Hours**

ENERGY IN MATERIALS

Elastic energy - Structure and bonding - Stress - strain - Tension and compression - elastic limit - Elastic Modulus - Stress - strain diagram - ductility - brittleness - rubber elasticity and entropy

EXPERIMENT 1 5 Hours

Assess the physical parameters of different materials for engineering applications like radius, thickness and diameter to design the electrical wires, bridges and clothes.

EXPERIMENT 2 5 Hours

Evaluate the elastic nature of different solid materials for modern industrial applications like shock absorbers of vehicles.

EXPERIMENT 3 5 Hours

Analyze the photonic behavior of thin materials for advanced optoelectronic applications like adjusting a patients head, chest and neck positions as a medical tool

EXPERIMENT 4 5 Hours

Investigate the phonon behavior of poor conductors for thermionic applications like polymer materials and textile materials.

EXPERIMENT 5 5 Hours

Assess the elongation of different solid materials for industrial applications like buildings, bridges and vehicles

EXPERIMENT 6 5 Hours

Measure the compressibility of different liquids for modern industrial applications like navigation, medicine and imaging

Total:30+30= 60 Hours

Reference(s)

1. C J Fischer, The energy of Physics Part I: Classical Mechanics and Thermodynamics, Cognella Academic Publishing, 2019.
2. P G Hewitt, Conceptual Physics, Pearson education, 2017
3. R A Serway and J W Jewitt, Physics for Scientists and Engineers, Thomson Brooks/Cole, 2019
4. J Walker, D Halliday and R Resnick, Principles of Physics, John Wiley and Sons, Inc, 2018
5. H C Verma, Concepts of Physics (Vol I & II), Bharathi Bhawan Publishers & Distributors, New Delhi, 2017

22CH103 ENGINEERING CHEMISTRY I 2 0 2 3

Course Objectives

- Understand the origin of elements from the universe
- Outline the properties of elements in the periodic table
- Analyse the different types of bond formed during chemical reactions and its reaction thermodynamics
- Summarize different states of matter based on atomic arrangement

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Understand nuclear transmutation reactions that lead to the formation of elements in the universe
2. Illustrate atomic structure of elements in the periodic table and interpret the periodic trends in properties of elements with its anomaly
3. Apply the conditions for the formation of different types of chemical bonds and predict the minimum energy required for a reaction to occur
4. Analyse endothermic and exothermic processes and exchange of energy during chemical reactions
5. Analyse whether the given matter is a solid, liquid, gas, or plasma and interpret the arrangement of atoms

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	-	-	-	-	-	-	-	-	-	-	-	-
2	2	1	-	-	-	-	-	-	-	-	-	-	-	-
3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
4	2	1	-	-	-	-	-	-	-	-	-	-	-	-
5	2	1	-	-	-	-	-	-	-	-	-	-	-	-

UNIT I **5 Hours**

ORIGIN OF ELEMENTS

Hydrogen - Elements and Sun - fusion - hypernova - supernova - dying stars - man-made elements

UNIT II **7 Hours**

ATOMIC STRUCTURE AND PERIODICITY

Atomic Structure - Electronic configuration - Periodic Table - Periodic trends in properties of elements - Anomalous behaviour in periodicity

UNIT III **6 Hours**

CHEMICAL BONDING

Octet rule & its limitations - types of chemical bonds - bond energy - bond cleavage - activation energy of reactions

UNIT IV **6 Hours**

REACTION THERMODYNAMICS

Conservation of energy - Endothermic reactions & exothermic reactions - Exchange of energy involved in chemical reactions

UNIT V **6 Hours**

STATES OF MATTER

Solid - liquid - gas - plasma - arrangement of atoms/ions/molecules in different phases

EXPERIMENT 1 **2 Hours**

Lab safety rules and guidelines for students - OSHA Guidelines

EXPERIMENT 2 **4 Hours**

Evaluate the dissolved oxygen (DO) levels in effluent samples collected from sewage treatment plant in BIT. Ensure the suitability of outlet water for the growth of aquatic animals (fishes).

EXPERIMENT 3 **4 Hours**

Investigate the amount of Iron (Fe2+) in a mild steel alloy sample using a spectrophotometer.

EXPERIMENT 4 **4 Hours**

Estimate the amount of chromium present in industry effluent samples and bottled beverages.

EXPERIMENT 5 **4 Hours**

Ensure the suitability of drinking water in the RO water supply in BIT based on the presence of chloride ions.

EXPERIMENT 6 **4 Hours**

Assess the acidic nature of effluent water from industries using the conductometric titration method.

EXPERIMENT 7 **4 Hours**

Measure the stain removal efficiency of the prepared soaps from stained clothes.

EXPERIMENT 8 **4 Hours**

Assess the purity of commercially available active pharmaceutical ingredients (aspirin) as per the government-prescribed standards.

Total:30+30= 60 Hours

Reference(s)

1. Peter Atkins, Physical Chemistry, Oxford university press, 2019
2. Rose Marie Gallagher and Author Paul Ingram, Complete Chemistry Cambridge IGCSE, Oxford university press, 2020
3. P L Soni, Text book of inorganic chemistry, Chand publishers, New Delhi, 2017
4. J.D. Lee, Concise inorganic chemistry, Blackman Science Ltd, France, Wiley-India, 5th edition (Reprint), 2016
5. Gareth Price, Thermodynamics of chemical processes, Oxford university press, 2019
6. D Tabor, Gases, liquids and solids and other states of matter, Oxford University press, 2018

22GE001 FUNDAMENTALS OF COMPUTING 3 0 0 3

Course Objectives

- Understand the fundamental digital logics behind computations of computer systems.
- Develop simple assembly language programs with respect to arithmetic operations.
- Understand the program execution process and basics of software development methodologies.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PSO1: Demonstrate the knowledge and technical skills in software development. PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Infer the hidden languages and inner structures of computer hardware and software through codes and combinations.
2. Interpret the organizational and architectural issues of a digital computer with concepts of various data transfer techniques in digital computers and the I/O interfaces.
3. Analyze programming problems and apply assembly instructions to solve simple problems.
4. Infer the fundamentals of operating system and System programs basics.
5. Apply the software development methodologies to various real life scenarios.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1	1	-	-	-	-	-	-	-	-	1	2
2	3	3	3	1	-	-	-	-	-	-	-	-	1	2
3	2	2	2	1	-	-	-	-	-	-	-	-	2	-
4	2	2	2	1	-	-	-	-	-	-	-	-	2	-
5	2	2	2	1	-	-	-	-	-	-	-	-	3	-

UNIT I 8 Hours

CODES AND COMBINATIONS

Communication using Mores and Braille binary codes - Digitizing letters, numbers and objects using binary codes - Performing simple operations: addition through binary codes.

UNIT II **9 Hours**

COMPUTATION USING COMPUTER

Communication to computing devices through various input sources - Computational operation - its flow, functions and control - communication to output devices - Basic communication protocol.

UNIT III **11 Hours**

ASSEMBLY LANGUAGE PROGRAMMING

Little Man Computing (LMC) Model - Instruction Set - Labels - Calculation -Branching - Input-Output - Loops - Simple programs.

UNIT IV **9 Hours**

OPERATING SYSTEM AND APPLICATION GENERATION

BIOS - Device Drivers - Resources - Scheduler - Applications Generation and Creation - Stages of Compilation - Linkers, Loaders and Libraries.

UNIT V **8 Hours**

SOFTWARE DEVELOPMENT

Phases of application life cycle management - Software Development Methodologies - Web Page development.

Total: 45 Hours

Reference(s)

1. Charles Petzold, "Code: The Hidden Language of Computer Hardware and Software", Microsoft Press books, 2009.
2. David D. Riley, Kennya. Hunt, "Computational thinking for the modern problem Solver", CRC Press Taylor & Francis Group, 2014.
3. Andrew Eliaz, "Little Man Computer Programming: For the Perplexed from the Ground Up", The Internet Technical Bookshop; 1st edition, 2016.
4. Abraham Silberschatz, "Peter Baer Galvin and Greg Gagne, Operating System Concepts", 9th Edition, John Wiley & Sons Pvt. Ltd, 2015.
5. Roger S.Pressman, "Software Engineering: A Practitioner's Approach", McGraw Hill International edition, Seventh edition, 2010

22HS001 FOUNDATIONAL ENGLISH 1 0 2 2

Course Objectives

- Heighten awareness of grammar in oral and written expression
- Improve speaking potential in formal and informal contexts
- Improve reading fluency and increased vocabulary
- Prowess in interpreting complex texts
- Fluency and comprehensibility in self-expression
- Develope abilities as critical readers and writers
- Improve ability to summarize information from longer text, and distinguish between primary and supporting ideas

Programme Outcomes (POs)

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Express themselves in a professional manner using error-free language
2. Express in both descriptive and narrative formats
3. Understand and make effective use of the English Language in Business contexts
4. Actively read and comprehend authentic text
5. Express opinions and communicate experiences.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	-	-	-	2	3	-	2	1	-
2	-	-	-	-	-	-	-	-	2	3	-	2	1	-
3	-	-	-	-	-	-	-	-	2	3	-	2	1	-
4	-	-	-	-	-	-	-	-	2	3	-	2	1	-
5	-	-	-	-	-	-	-	-	2	3	-	2	1	-

UNIT I **15 Hours**

UNIT 1 - SELF-EXPRESSION

Lesson Plan 1: Self-Introduction-Recreating Interview Scenarios (with a focus on verbal communication) –Subject Verb Concord – Tenses – Common Errors in verbal communication-Be-verbs Lesson Plan 2: Self-Introduction-Recreating interview scenarios-Haptics-Gestures-Proxemics-Facial expressions-Paralinguistics/Vocalics- Body Language- Appearance-Eye Contact-Artefacts Lesson Plan 3: Self-Introduction-Powerful openings and closings at the interview-Effective stock phrases - Modified for spontaneity and individuality-Question tags, framing questions including WH-questions- Prepositions-Listening to Ted talks-Listening for specific information

UNIT II **15 Hours**

UNIT 2 - CREATIVE EXPRESSION

Lesson Plan 4: Descriptive Expression-Picture Description and Blog Writing -Vocabulary-One word substitution-Adjectives-Similes, Metaphors, Imagery & Idioms – Link words - Inclusive language Lesson Plan 5: Narrative Expression- Travelogue and Minutes of Meeting -Verbal analogy-Sequence & Time order words - Jumbled paragraph, sentences, Sequencing-Text & Paragraph completion-Past tense - Using quotation marks

UNIT III **15 Hours**

UNIT 3 - FORMAL EXPRESSION

Lesson Plan 6: Formal Letters and Emails-Writing: E-mails and Letters of apology, Requisition and Explanation, and Letters to newspapers-Speaking: Tendering verbal apologies, and explanations, persuading a listener/ audience-Hierarchy in Business correspondence- Subject of a mail, Header, Body (Salutation) and Footer of a mail. Conjunctional clause Punctuation-Formal Idioms-Phrases-Articles - Definite & Indefinite-Types of sentences-Modal verbs

Lesson Plan 7: Precision in comprehension, Summary writing, Selective summary-Reading: Active reading- short paragraphs, excerpts, articles and editorials-Skimming and Scanning Reading comprehension & analysis - Tenses, QP/ PQ approach. Identifying the central themes/ crux- Interpreting tone - formal/informal/semi-formal-Note-taking-Listening: Listening for data, for specific information, for opinion-Active and passive Listening-Transcription-Paraphrasing and summarizing information-Agreeing & disagreeing-Note-taking-Writing: Summary writing, selective summary, paraphrasing, note-making, opinion pieces-Finding synonyms in the context-Paraphrasing-Sentence Transformation - simple, compound, complex. Sentence substitution-Sentence completion- Interpreting paragraphs

Total:15+30= 45 Hours

Reference(s)

1. Sasikumar, V, et.al. A Course in Listening & Speaking Foundation Books, 2005.
2. Murphy, Raymond. English Grammar in Use: A Self-Study Reference and Practice Book for Intermediate Students: with Answers. Cambridge: Cambridge University Press, 1985.
3. Prasad, Hari Mohan. A Handbook of Spotting Errors. Mcgraw Hill Education, 2010
4. Reynolds, John. Cambridge IGCSEÃ‚Â® First Language English. 2018th ed., Hodder Education, 2018.
5. Wiggins, Grant P., and Jay McTighe. Understanding by Design. Association for Supervision and Curriculum Development, 2008.

22GE004 BASICS OF ELECTRONICS ENGINEERING 2 0 2 3

Course Objectives

- To understand the concept of energy transmission through mechanical, electrical and electromagnetic form.
- To analyze the use of PN Junction Diode and BJT for signal conditioning.
- To apply the working principle of PN Junction Diode and BJT for the design of basic Digital Logic.
- To analyze the working and characteristics of Special Purpose Semiconductor Electronic Devices.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Understand the need for electrical and electromagnetic signal transmission.
2. Analyze the working principle and characteristics of PN junction diode.
3. Analyze the working principle and characteristics of Bipolar Junction Transistor.
4. Apply the working principle of PN Junction diode and BJT for designing basic Digital Logic functions.
5. Analyze the energy conversion needs and working principle of Special purpose electronic devices.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2	2	-	-	-	-	-	-	-	-	-	2
2	3	2	3	-	-	-	-	-	-	-	-	-	-	2
3	2	3	3	-	-	-	-	-	-	-	-	-	-	2
4	2	3	3	3	-	-	-	-	-	-	-	-	-	2
5	1	2	3	2	-	-	-	-	-	-	-	-	-	2

UNIT I 6 Hours

ENERGY TRANSFER AND SIGNALS

Energy Transmission through Mechanical, Electrical and Electromagnetic means, Signal as Energy Transmission, Complexity in signal transmission (Volume of Information, Distance and Time taken), Limitations of Mechanical Energy Transmission, Electrical and Electromagnetic Signal Transmission, Need for Conversion between Electrical and Mechanical Signals.

UNIT II **8 Hours**

SIGNAL CONDITIONING USING DIODE

Need for Vacuum Tubes in the Evolution of Electronics, Overview of Vacuum Tubes, Diode and Triode, Limitations of Vacuum Tubes. Semiconductor Group in Periodic Table, Overview of Semiconductor Materials, Flow of electrical energy through PN Junction Diode, Signal Clipping, Signal Clamping and Signal Multiplication using PN Junction Diode, Limitations of PN Junction Diode.

UNIT III **6 Hours**

SIGNAL CONDITIONING USING TRANSISTOR

Need for controlling electrical signals, Principle of Bipolar Junction Transistor operation, Signal Switching and Amplification using BJT, Limitations of BJT, Principle of Field Effect Transistor operation.

UNIT IV **6 Hours**

LOGIC SYNTHESIS USING DIODE AND TRANSISTORS

Overview of Logic Gates, PN Junction and BJT as electronic switches, Digital Logic Synthesis using Diode and Transistor: Diode Logic, Resistor Transistor Logic, Diode Transistor Logic, Transistor Logic.

UNIT V **4 Hours**

DEVICES FOR SPECIAL REQUIREMENTS

Voltage Regulation using Zener Diode, Variable Capacitance using Varactor Diode, Electrical Energy to Light Energy conversion using Light Emitting Diode, Light to Energy to Electrical Energy conversion using Solar Cell.

EXPERIMENT 1 4 Hours

Design and Implement a simple device to communicate basic information between two different small distance points using wired and wireless methods.

EXPERIMENT 2 6 Hours

Design and implement different wave shaping Circuits using PN Junction Diodes.

EXPERIMENT 3 4 Hours

Design and Implement Voltage Multiplier Circuit using PN Junction Diodes and Capacitors.

EXPERIMENT 4 4 Hours

Design and Implement t a three Stage Circuit to convert 220V 50Hz AC mains supply to 12V DC supply.

EXPERIMENT 5 4 Hours

Design and Implement a BJT Amplifier Circuit to amplify audio input signal.

EXPERIMENT 6 **4 Hours**

Design and Implement Basic Logic Gates using PN Junction Diodes.

EXPERIMENT 7 **4 Hours**

Design and Implement Basic Logic Gates using BJTs.

Total:30+30= 60 Hours

Reference(s)

1. Thomas L. Floyd, Electronic Devices: Electron Flow Version, Ninth Edition, Prentice Hall, 2012.
2. J Millman, C. Halkias & Satyabrata JIT, Electronic Devices and Circuits, Tata McGraw-Hill, 2007.
3. L Robert Boylestead, Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson Education 2006.
4. David A. Bell, Electronic Devices and Circuits, Prentice Hall of India, 2003.
5. Adel S. Sedra & Kenneth C. Smith, Micro Electronic Circuits Theory and Applications, Sixth Edition, Oxford University Press, 2013.
6. Behzad Razavi, Microelectronics, Wiley India Pvt. Ltd.; 2nd edition (2018)

22HS002 **STARTUP MANAGEMENT** **1 0 2 2**

Course Objectives

- Promote entrepreneurial spirit and motivate to build startups
- Provide insights on markets and the dynamics of buyer behaviour
- Train to develop prototypes and refine them to a viable market offering
- Support in developing marketing strategies and financial outlay
- Enable to scale up the porotypes to commercial market offering

Programme Outcomes (POs)

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PSO1: Demonstrate the knowledge and technical skills in software development. PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Generate valid and feasible business ideas
2. Create Business Model Canvas and formulate positioning statement
3. Invent prototypes that fulfills an unmet market need
4. Formulate business strategies and create pitch decks
5. Choose appropriate strategies for commercialization

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	-	-	-	2	2	-	-	2	2
2	-	-	-	-	-	-	-	-	3	3	-	-	2	2
3	-	-	-	-	-	-	-	-	3	3	-	-	2	2
4	-	-	-	-	-	-	-	-	3	3	-	-	2	2
5	-	-	-	-	-	-	-	-	3	3	-	-	2	2

UNIT I **3 Hours**
BUSINESS MODELS AND IDEATION
Startups: Introduction, Types of Business Modes for Startups. Ideation: Sources of Ideas, Assessing Ideas, Validating Ideas, Tools for validating ideas, Role of Innovation and Design Thinking

UNIT II **3 Hours**
UNDERSTANDING CUSTOMERS
Buyer Decision Process, Buyer Behaviour, Building Buyer Personas, Segmenting, Targeting and Positioning, Value Proposition (Business Model Canvas), Information Sourcing on Markets, Customer Validation

UNIT III **3 Hours**

DEVELOPING PROTOTYPES

Prototyping: Methods-Paper and Digital, Customer Involvement in Prototyping, Product Design Sprints, Refining Prototypes

UNIT IV **3 Hours**

BUSINESS STRATEGIES AND PITCHING

Design of Marketing Strategies and Campaigns, Go-To-Market Strategy, Financial KPIs Financial Planning and Budgeting, Assessing Funding Alternatives, Pitching, Preparing Pitch Decks

UNIT V **3 Hours**

COMMERCIALIZATION

Implementation: Prototype to Commercialization, Test Markets, Institutional Support, Registration Process, IP Laws and Protection, Legal Requirements, Type of Ownership, Building and Managing Teams, Defining role of investors

EXPERIMENT 1 **1 Hours**

Analysis of various business sectors

EXPERIMENT 2 **2 Hours**

Developing a Design Thinking Output Chart

EXPERIMENT 3 **1 Hours**

Creating Buyer Personas

EXPERIMENT 4 **3 Hours**

Undertake Market Study to understand market needs and assess market potential

EXPERIMENT 5 **2 Hours**

Preparation of Business Model Canvas

EXPERIMENT 6 **15 Hours**

Developing Prototypes

EXPERIMENT 7 **2 Hours**

Organizing Product Design Sprints

EXPERIMENT 8 **2 Hours**

Preparation of Business Plans

EXPERIMENT 9 **2 Hours**

Preparation of Pitch Decks

Total:15+30= 45 Hours

Reference(s)

1. Rashmi Bansal, Connect the Dots, Westland and Tranquebar Press, 2012
2. Pavan Soni, Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem- solving, Penguin Random House India, 2020
3. Ronnie Screwvala, Dream with Your Eyes Open: An Entrepreneurial Journey, Rupa Publications, 2015
4. Stephen Carter, The Seed Tree: Money Management and Wealth Building Lessons for Teens, Seed Tree Group, 2021
5. Kotler Philip, Marketing Management, Pearson Education India, 15th Edition
6. Elizabeth Verkey and Jithin Saji Isaac, Intellectual Property, Eastern Book Company, 2nd Edition, 2021

22HS003 **தமிழர் மரபு** **1 0 0 1**

பாடத்திட்டத்தின் ந ாக்கம்

1. இந்திய மமொழிக்குடும்பத்Fள் திரொவிட மமொழிகள் தனித்F இயங்கும் தன்மமமய அதன் சிறப்புகள் வழி அறிதல்.
2. மதொன்றுமதொட்டு தமிழர், கமலயில் அமடந்த வளர்ச்சிமய இயம்புதல்.
3. சங்ககொல தமிழரின் கற்றல் திறத்மத இலக்கியங்கள் வழி ஆரொய்தல்.

கற்றலின் விளைவு

1. இந்திய மமொழிக்குடும்பத்Fள் திரொவிட மமொழிகள் தனித்F இயங்கும் தன்மமமய அதன் சிறப்புகள் வழி அறிதல்.
2. மதொன்றுமதொட்டு தமிழர், கமலயில் அமடந்த வளர்ச்சிமய இயம்புதல்.
3. சங்ககொல தமிழரின் கற்றல் திறத்மத இலக்கியங்கள் வழி ஆரொய்தல்.
4. தமிழ் மமொழியின் சிறப்புகமள அதன் பமடப்பிலக்கியங்கள் மூலம் அறிந்F மகொள்ளுதல்.
5. கற்கொலம் மதொடங்கி, இக்கொலம் வமர சிற்பக்கமல அமடந்த வளர்ச்சிமய கண்டுமகொள்ளல் .
6. தமிழர் தம் வொழ்வில் எங்கனம் இயற்மகமய வணங்கி பபொற்றினர் என்பமத திமண பகொட்பொட்டின் வழி மதளிதல்.
7. இந்திய விடுதமல பபொரில் தமிழர் ஆற்றிய பங்கிமன மதரிந்F மகொள்ளுதல்.

அலகு I மொழி மற்றும் இலக்கியம்: **3**

இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் – தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை: **3**

நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள்– பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளுவர் சிலை – இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்: 3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு IV தமிழர்களின் திணைக் கோட்பாடுகள்: 3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்ககால நகரங்களும் துறை முகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு: 3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

22HS003 HERITAGE OF TAMILS 1 0 0 1

Course Objectives

1. Describe the linguistic diversity in India, highlighting Dravidian languages and their features.
2. Summarize the evolution of art, highlighting key transitions from rock art to modern sculptures.
3. Examine the role of sports and games in promoting cultural values and community bonding.
4. Discuss the education and literacy systems during the Sangam Age and their impact.
5. Outline the importance of inscriptions, manuscripts, and the print history of Tamil books in preserving knowledge and culture.

Programme Outcomes (POs)

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Understand the concept of language families in India, with a focus on Dravidian languages.
2. Trace the evolution of art from ancient rock art to modern sculptures in Tamil heritage.
3. Identify and differentiate various forms of folk and martial arts in Tamil heritage.
4. Understand the concepts of Flora and Fauna in Tamil culture and literature.
5. Evaluate the contributions of Tamils to the Indian Freedom Struggle.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	-	-	-	2	3	-	-	-	-
2	-	-	-	-	-	-	-	-	2	3	-	-	-	-
3	-	-	-	-	-	-	-	-	2	3	-	-	-	-
4	-	-	-	-	-	-	-	-	2	3	-	-	-	-
5	-	-	-	-	-	-	-	-	2	3	-	-	-	-

UNIT I 3 Hours

LANGUAGE AND LITERATURE

Language Families in India - Dravidian Languages – Tamil as a Classical Language – Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

UNIT II 3 Hours

HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

UNIT III **3 Hours**

FOLK AND MARTIAL ARTS

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT IV **3 Hours**

THINAI CONCEPT OF TAMILS

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT V **3 Hours**

CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

Total: 15 Hours

Reference(s)

1. Dr.K.K.Pillay , Social Life of Tamils, A joint publication of TNTB & ESC and RMRL.
2. Dr.S.Singaravelu, Social Life of the Tamils - The Classical Period, International Institute of Tamil Studies.
3. Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu, Historical Heritage of the Tamils,
4. International Institute of Tamil Studies.
5. Dr.M.Valarmathi, The Contributions of the Tamils to Indian Culture, International Institute of Tamil Studies.
6. Keeladi, Sangam City Civilization on the banks of river Vaigai, Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu
7. Dr.K.K.Pillay, Studies in the History of India with Special Reference to Tamil Nadu.
8. Porunai Civilization, Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu
9. R.Balakrishnan, Journey of Civilization Indus to Vaigai, RMRL.

22MA201 ENGINEERING MATHEMATICS II 3 1 0 4

Course Objectives

- To impart and analyze the concepts of differential equations to describe in real-world phenomena
- To provide basic understanding on differential equation models and vector field models
- Summarize and apply the methodologies involved in framing the real world problems related to fundamental principles of complex functions

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Interpret the concept of differential equations through mathematical modeling and analyze its applications in engineering
2. Formulate the real world problems as second order linear differential equations and give solutions for the same
3. Demonstrate the real-world phenomena with magnitude and direction in the form of vector functions
4. Apply the concept of vector fields and line integrals through mathematical modeling in engineering
5. Determine complex functions and apply them to formulate problems arising in engineering

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	-	-	-	-	-	-	-	-	-	-	2	-
2	2	2	-	-	-	-	-	-	-	-	-	-	2	-
3	2	2	-	-	-	-	-	-	-	-	-	-	2	-
4	2	1	-	-	-	-	-	-	-	-	-	-	2	-
5	1	2	-	-	-	-	-	-	-	-	-	-	2	-

UNIT I 9 Hours

FIRST ORDER LINEAR DIFFERENTIAL EQUATIONS

Formation of differential equations- Solutions of first order linear ODE: Leibnitzs and method of separation of variables- Cooling/Heating of an object - A falling object- Modeling of electric circuits: RL and RC circuits - Modeling of population dynamics: Exponential growth and decay - Logistic growth model

UNIT II 9 Hours

SECOND ORDER LINEAR DIFFERENTIAL EQUATIONS

Methods of solving second order linear ordinary differential equations -Models for linear oscillators: Simple harmonic motion - Mechanical vibrations with and without damping - Electric circuit system: RLC circuits

UNIT III **9 Hours**

VECTOR DIFFERENTIAL CALCULUS

Vector and scalar functions - Fields - Derivative of vector function and geometrical interpretation- Velocity and acceleration - Gradient and its properties- Tangent and normal vectors - Directional derivative- Divergence of a vector field - Curl of a vector field - Projectile motion

UNIT IV **9 Hours**

VECTOR INTEGRAL CALCULUS

Line integrals of vector point functions - Surface integral of vector point functions - Applications of line and surface integrals - Greens theorem in a plane - Stokes theorem - Gauss divergence theorem

UNIT V **9 Hours**

COMPLEX FUNCTIONS

Basic concepts of Complex numbers Geometrical representation of complex number - Analytic functions and its properties - Construction of Analytic functions: Fluid flow Electric flow - Mapping of complex functions

Total: 45+15=60 Hours

Reference(s)

1. Richard E. Williamson, Introduction to Differential Equations and Dynamical Systems, McGraw Hill Companies. Inc, 1997
2. Michael Greenberg, Advanced Engineering Mathematics, 2/e, Pearson, 2018
3. George B.Thomas, Maurice D. Weir and Joel Hass Thomas Calculus, 13/e, Pearson Publishers, 2013
4. Erwin Kreyszig, Advanced Engineering Mathematics Wiley, 10th editi5. J. Stewart, Essential Calculus, Cengage, 2nd edition, 2017on ,2015
5. J. Stewart, Essential Calculus, Cengage, 2nd edition, 2017

22PH202 ELECTROMAGNETISM AND MODERN PHYSICS 2 0 2 3

Course Objectives

- Understand the principles and mechanisms of electricity and magnetism
- Infer the classification of electromagnetic waves
- Analyze the theory of relativity and energy bands

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Understand the principles and mechanism of electrostatics and current
2. Illustrate the principles and mechanism of magneto statics
3. Classify electromagnetic waves and infer the characteristics of visible light
4. Outline the importance of theory of relativity and analyze the wave nature of particles
5. Exemplify the electrical properties of semiconductor based on the band theory

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	-	-	-	-	-	-	2	-	-	-	-	-
2	2	1	-	-	-	-	-	-	2	-	-	-	-	-
3	2	1	-	-	-	-	-	-	2	-	-	-	-	-
4	2	1	-	-	-	-	-	-		-	-	-	-	-
5	2	1	-	-	-	-	-	-	2	-	-	-	-	-

UNIT I 6 Hours

ELECTRICITY

Electric monopoles - Electric field- Electric flux - Electric potential - electrical energy- capacitor-conductors and insulators-Electric dipole and polarization - electric current -voltage sources- resistance

UNIT II 6 Hours

MAGNETISM

Sources of magnetism- monopoles-magnetic field and force-magnetic field and current distribution-magnetic dipole-magnetic potential energy-inductor- electric and magnetic field comparison

UNIT III **6 Hours**

ELECTROMAGNETIC WAVES AND LIGHT

Electromagnetism: basic laws-electromagnetic energy-radiation. Electromagnetic waves: origin, nature and spectrum-visible light Principle of least time- geometrical optics-Human eye - Diffraction - Interference - polarization-LASER

UNIT IV **6 Hours**

MODERN PHYSICS

Special theory of relativity - simultaneity and time dilation - length contraction - relativistic mass variation. Matter waves - de-Broglie hypothesis - wave nature of particles

UNIT V **6 Hours**

ENERGY BANDS IN SOLIDS

Band theory of solids - classification of materials - semiconductors - direct and indirect semiconductor - fermi energy -Intrinsic and extrinsic semiconductor - carrier concentration - electrical conductivity

EXPERIMENT 1 **5 Hours**

Analysis of I-V characteristics of a solar cell for domestic applications

EXPERIMENT 2 **5 Hours**

Determine the carrier concentration of charge carriers in semiconductors for automotive applications.

EXPERIMENT 3 **5 Hours**

Investigate the photonic behavior of laser source for photo copier device

EXPERIMENT 4 **5 Hours**

Implement the principle of stimulated emission of laser for grain size distribution in sediment samples

EXPERIMENT 5 **5 Hours**

Assess the variation of refractive index of glass and water for optical communication

EXPERIMENT 6 **5 Hours**

Evaluate the band gap energy of semiconducting materials for display device applications

Total:30+30= 60 Hours

Reference(s)

1. C J Fischer, The energy of Physics Part II: Electricity and Magnetism, Cognella Academic Publishing, 2019
2. P G Hewitt, Conceptual Physics, Pearson education, 2017
3. R A Serway and J W Jewitt, Physics for Scientists and Engineers, Thomson Brooks/Cole, 2019
4. J Walker, D Halliday and R Resnick, Principles of Physics, John Wiley and Sons, Inc, 2018
5. H C Verma, Concepts of Physics (Vol I & II), Bharathi Bhawan Publishers & Distributors, New Delhi, 2017

22CH203 ENGINEERING CHEMISTRY II 2 0 2 3

Course Objectives

- Understand the concept of electrochemistry for determination of electrode potential, pH and applications as energy storage devices
- Outline the chemistry of metal corrosion and analyze the methods of corrosion control
- Understand how catalyst increases the reaction rate
- Summarize the variation in properties and reactivity of isotopes

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Apply the electrochemical principles to determine the electrode potential of a metal
2. Analyze the construction, cell reactions and working of energy storage devices
3. Analyze the specific operating conditions under which corrosion occurs and suggest a method to control corrosion
4. Illustrate reaction mechanisms and assess the role of catalyst in a chemical reaction
5. Analyze various types of nuclear transmutation including decay reactions

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	-	-	-	-	-	-	-	-	-	-	-	-
2	2	1	-	-	-	-	-	-	-	-	-	-	-	-
3	2	1	-	-	-	-	1	-	-	-	-	-	-	-
4	2	1	-	-	-	-	-	-	-	-	-	-	-	-
5	2	1	-	-	-	-	-	-	-	-	-	-	-	-

UNIT I 6 Hours

ELECTROCHEMISTRY

Origin of potential - electromotive force - electrical double layer - transport of charge within the cell - cell description - prediction of cell potentials

UNIT II **6 Hours**

ENERGY STORING DEVICES

Relation between electrical energy and energy content of a cell - reversible and irreversible cell - charging and discharging reactions in a reversible cell - current challenges in energy storage technologies

UNIT III **6 Hours**

METAL CORROSION AND ITS PREVENTION

Oxidation of metals: Electrochemical origin of corrosion - electromigration - electron transfer in the presence and absence of moisture - galvanic series. Strategies for corrosion control: Galvanic anode and impressed current.

UNIT IV **6 Hours**

CATALYSIS

Energy profile diagram for a chemical reaction - activation energy - role of catalyst - homogeneous and heterogeneous catalysis - types

UNIT V **6 Hours**

NUCLEAR REACTIONS

Radioactive and stable isotopes - variation in properties between isotopes - radioactive decay (alpha, beta and gamma) - half-life period - nuclear reactions - radiocarbondating

EXPERIMENT 1 **4 Hours**

Measure industrial effluent water pH and assess water quality against allowed standards

EXPERIMENT 2 **4 Hours**

Iron (Fe2) in Bhavani River water: Potentiometric Analysis

EXPERIMENT 3 **4 Hours**

Construct a Zn-Cu electrochemical cell and validate the output by connecting the LED light.

EXPERIMENT 4 **5 Hours**

Evaluate the corrosion percentage in concrete TMT bars

EXPERIMENT 5 **4 Hours**

Determination of the percentage of corrosion inhibition in plain-carbon steel using natural inhibitors.

EXPERIMENT 6 **4 Hours**

Electroplating of copper metal on iron vessels for domestic application.

EXPERIMENT 7 **5 Hours**

Determination of acid-catalyzed hydrolysis kinetics in locally sourced fruit extracts

Total: 30+30=60 Hours

Reference(s)

1. Jain and Jain, Engineering Chemistry, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, 2013.
2. P.H. Rieger, Electrochemistry, Second Edition (Reprint), Springer, Netherland, 2012
3. E.McCafferty, Introduction to Corrosion Science, Springer; 2010 Edition, January 2010
4. S. Vairam, Engineering Chemistry, John Wiley &Sons, 2014
5. H.J. Arnikar, Essentials of Nuclear Chemistry, 4th edition, (revised) New Age International Publishers, 2011
6. U. Hanefeld, L. Lefferts, Catalysis: An Integrated Textbook for Students, Wiley- VCH, 2017

22GE002 COMPUTATIONAL PROBLEM SOLVING 3 0 0 3

Course Objectives

- Analyze the algorithm design techniques and development principles in solving the real life problems.
- Illustrate the different ways of organizing and storing the data in computing systems.
- Understand the basic network configuration and setup connections among different device systems.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PSO1: Demonstrate the knowledge and technical skills in software development. PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Analyze a problem and formulate algorithms, pseudocodes and flowcharts.
2. Develop algorithmic solutions to simple computational problems and explore algorithmic approaches to problem solving.
3. Design and apply appropriate data structures for solving computing problems.
4. Compare the various storage devices used in a computer system.
5. Analyze the requirements for a given organizational structure and establish the connection between two or more computers to form a network.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1	2	-	-	-	-	-	-	-	-	3	-
2	3	3	3	3	-	-	-	-	-	-	-	-	3	-
3	2	2	2	3	-	-	-	-	-	-	-	-	3	-
4	2	2	2	2	-	-	-	-	-	-	-	-	-	-
5	2	2	2	2	-	-	-	-	-	-	-	-	1	2

UNIT I **6 Hours**

VISUAL PROCESS MODELING

Scenario decomposition - logical sequencing - drawing flowchart - preparing visual process model.

UNIT II **12 Hours**

ALGORITHMIC DESIGN THINKING

Analysis - Verification - Brute force - Divide and conquer - Greedy - Backtracking.

UNIT III **12 Hours**

DATA ORGANIZATION

Elementary Data Organization - Abstract Data Types - Fundamentals of Linear and Non Linear Data Structures.

UNIT IV **7 Hours**

DATA STORAGE

Flat File and Relational database- Data Read & Write in Local Storage, Server Storage and Cloud storage - Database Query Methods.

UNIT V 8 Hours

NETWORKING ESSENTIALS

Networking Components and Services - IP Addressing - Configuring and Managing the Campus Network-Network Security - Firewalls.

Total: 45 Hours

Reference(s)

1. David D. Riley, Kennya. Hunt, "Computational thinking for the modern problem Solver", CRC Press Taylor & Francis Group, 2014.
2. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education Asia, 2011.
3. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education,2016.
4. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, "Database System Concepts", McGraw Hill, 2015.
5. Behrouz A.Forouzan, "Data Communication and Networking", 5th Edition, Tata McGraw-Hill, 2014.

22GE003 BASICS OF ELECTRICAL ENGINEERING 2 0 2 3

Course Objectives

- To understand the basic concepts of electrical charge and its properties
- To interpret the formation of electric field due to electric charges
- To illustrate the concept of magnetic fields due to revolving electron
- To illustrate the force on moving charges in electric and magnetic field
- To understand the energy transfer in electro mechanical conversion

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Interpret the behavior of electric charges in different medium using coulombs law.
2. Analyse the electric field due to different charge distributions.
3. Analyse the magnetic field intensity due to long conductor, solenoid, toroid and magnetic dipoles.
4. Analyze the force on conductors due to the moving charges.
5. Interpret the energy conversion concepts in electromagnetic fields.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	-	1	-	-	-	-	-	-	-	-	-	2
2	3	2	-	1	-	-	-	-	-	-	-	-	-	2
3	1	1	3	-	-	-	-	-	-	-	-	-	-	2
4	2	1	-	3	-	-	-	-	-	-	-	-	-	2
5	3	2	-	1	-	-	-	-	-	-	-	-	-	2

UNIT I **5 Hours**
ELECTRIC CHARGE
Properties of charge, additivity of charges, quantization of charge, conservation of charge, Forces between multiple charges, Electric charge in conductors, Drift of Electrons, Charges in Clouds.

UNIT II **7 Hours**

ELECTRIC FIELD

Electric field due to system of charges, Significance of Electric field line. Electric Dipole and its significance, Continuous charge distribution, Field in infinite long uniform straight conductors, field in uniform charged uniform infinite plane sheet, field due to uniform thin spherical sheet.

UNIT III **7 Hours**

MAGNETIC FIELDS

Concept of magnetic field, magnetic fields in infinitely long straight wire, straight and toroidal solenoids, Magnetic dipole moment of a revolving electron, Magnetic field intensity due to a magnetic dipole (bar magnet) along its axis and perpendicular to axis, Induced Electric field due to changing Magnetic Field.

UNIT IV **6 Hours**

FORCE ON CHARGES

Force on a moving charge in uniform magnetic and electric fields, Force on a current carrying conductor in a uniform magnetic field, Force between two parallel current carrying conductors.

UNIT V **5 Hours**

ELECTRO MECHANICAL ENERGY CONVERSION

Energy transfer in electromagnetic fields, Energy storage in magnetic field, Electromagnetic induction, induced emf, Eddy currents. Self and mutual inductance Linear Momentum and Angular Momentum carried by Electromagnetic Fields.

EXPERIMENT 1 **7 Hours**

Analysis The Behavior of a Fixed Resistor in An Electric Heater.

EXPERIMENT 2 **7 Hours**

Construct An Electrical Wiring Layout for a Basic Household Applications.

EXPERIMENT 3 **8 Hours**

Analysis The Self and Mutual Induction in A Domestic Fan.

EXPERIMENT 4 **8 Hours**

Design A Transistor-Based
Electronic Switch

Total:30+30= 60 Hours

Reference(s)

1. Mathew N. O. Sadiku, Principles of Electromagnetics, 6th Edition, Oxford University 2020
2. William H. Hayt and John A. Buck, Engineering Electromagnetics, McGraw Hill 2020
3. Kraus and Fleisch, Electromagnetics with Applications, McGraw Hill International Editions, 2017
4. S.P.Ghosh, Lipika Datta, Electromagnetic Field Theory, First Edition, McGraw Hill Education(India) Private Limited 2017

22CT206 DIGITAL COMPUTER ELECTRONICS 3 0 2 4

Course Objectives

- Understand the operation of Arithmetic Logic unit in Microprocessors
- Interpret Data retrieval from Memory by Microprocessors
- Analyze the role of Control Unit in Microprocessors
- Analyze Instruction execution in Microprocessors

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PSO1: Demonstrate the knowledge and technical skills in software development. PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Analyze the Design of Arithmetic and Logic Unit in Microprocessors
2. Analyze the Data Storage and Retrieval from Random Access Memory
3. Analyze the working mechanism of Control Unit in Microprocessors
4. Analyze the execution of Arithmetic and Logical Instructions
5. Analyze the execution of Jump and Memory related Instructions

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2	-	-	-	-	-	-	-	-	-	-	-
2	2	2	2	-	-	-	-	-	-	-	-	-	2	3
3	2	2	2	-	-	-	-	-	-	-	-	-	-	-
4	2	2	-	-	-	-	-	-	-	-	-	-	1	2
5	2	2	-	-	-	-	-	-	-	-	-	-	2	2

UNIT I 9 Hours

BINARY SYSTEM AND DESIGN OF ALU

Conversion of Decimal, Hexadecimal, Octal and Binary Numbers - Representation of Negative Numbers in Binary - Design of Binary Arithmetic Logic Modules - Magnitude Comparator - Encoder - Decoder - Multiplexer - Demultiplexer - Design of Arithmetic and Logic Unit (ALU)

UNIT II **9 Hours**

SYNCHRONOUS CIRCUIT AND DESIGN OF RAM

Latches and Flip Flops - Clock - Registers - Counters - Shift Registers - Storage and Retrieval of Binary Numbers from Registers - Design of Random Access Memory (RAM) - Encoding and Decoding of Memory address locations

UNIT III **9 Hours**

DESIGN OF CONTROL UNIT

Design of Control Unit - Mechanism of Instruction Read, Data Read, Instruction Decode, Instruction Execute and Data Write.

UNIT IV **9 Hours**

BASIC INSTRUCTION EXECUTION

Arithmetic Instructions - Increments, Decrements and Rotate Instructions - Logic Instructions - Arithmetic and Logic instructions

UNIT V **9 Hours**

ADVANCED INSTRUCTION EXECUTION

Memory Reference Instructions - Register Instructions - Jump and Call Instructions - Concept of Flag - Extended Register Instructions - Indirect Instructions - Stack Instructions

EXPERIMENT 1 **5 Hours**

Buzzer Alarm System: Logic Circuit for Intruder Detection

EXPERIMENT 2 **5 Hours**

Binary Calculator: Design and Simulation of a Basic Arithmetic Unit.

EXPERIMENT 3 **5 Hours**

Binary Comparator: Designing a Circuit to Compare Binary Numbers

EXPERIMENT 4 **5 Hours**

Digital Lock System: With the combination of Flip-Flops and Logic Gates.

EXPERIMENT 5 **5 Hours**

Digital Alarm Clock: Timekeeping with Counters and Decoders

EXPERIMENT 6 **5 Hours**

Elevator Control System: Implementing Logic for Floor Selection

Total:45+30=75 Hours

Reference(s)

1. Digital Logic & Computer Design, Morris Mano Pearson Education India, 2019
2. Digital Computer Electronics, Albert Paul Malvino and Jerald A Brown (3rd Edition), McGraw Hill Education India, 2001
3. Digital Design and Computer Architecture, David Money Harris and Sarah L Harris, Elsevier, 2007
4. But how do it know? The Basic Principles of Computers for Everyone, John C Schott, John C Scott Publishers, 2009
5. Code: The Hidden Language of Computer Hardware and Software (2nd Edition), Petzold Charles, Microsoft Press, 2022
6. Digital Computer Fundamentals (6th Edition), Thomas C Bartee, Tata Mcgraw Hill Education, 2011

22HS006 **தமிழரும் ததாழில்நுட்பமும்** **1 0 0 1**

பாடத்திட்டத்தின் ந ோக்கம்

1. சங்க கொலத்தில் வரலொறு மற்றும் கலொச்சொர ஆவணங்களின் ஒரு வடிவமொக, மட்பொண்டங்கள் மீதொன கிரொஃபிட்டிமய பகுப்பொய்வு மசய்தல்.
2. சிலப்பதிகொரத்தில் கட்டப்பட்ட பமமட கட்டுமொனங்களின் விவரங்கமளயும் அவற்றின் கலொச்சொர முக்கியத்Fவத்மதயும் பகுப்பொய்வு மசய்வதன் மூலம், சங்க கொலத்தில் மொவீரர் கற்களின் கட்டுமொனப் மபொருட்கள் மற்றும் வரலொற்று சூழமல ஆரொய்தல்.
3. சமுத்திரங்கள் பற்றிய பண்மடய அறிமவயும், தமிழ் சமூகத்தில் அதன் தொக்கத்மதயும் ஆரொய்வF ஆகியமவ இப்பொடத்திட்டத்தின் பநொக்கம் ஆகும்.

கற்றலின் விளைவு

1. சங்க கொலத்தில் மநசவுத் மதொழிலின் முக்கியத்Fவத்மதயும் அதன் கலொச்சொர முக்கியத்Fவத்மதயும் புரிந்F மகொள்ளல்.
2. பசொழர் கொல விவசொய மற்றும் நீர்ப்பொசன நமடமுமறகளில் அமமணகள், குளங்கள் மற்றும் மதகுகளின் முக்கியத்Fவத்மதப் புரிந்F மகொள்ளல்.
3. சங்க கொலத்தில் வீட்டுப் மபொருட்களில் பயன்படுத்தப்பட்ட கட்டடக்கமல வடிவமமப்புகள் மற்றும் கட்டமமப்பு கட்டுமொன முமறகமள ஆரொய்தல்.
4. பண்மடய தமிழ் கலொச்சொரத்தில், கப்பல் கட்டும் கமல, கடல் வர்த்தகம் மற்றும் பபொக்குவரத்தில் அதன் பங்மக ஆரொய்தல்.
5. தமிழ் மமொழியில் அறிவியல் மசொற்களஞ்சியம் மற்றும் மசொல்லகரொதியின் வளர்ச்சிமயக் கண்டறிதல்.

அலகு I நெசவு மற்றும் பானைத் தொழில்நுட்பம்: **3**

சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு II வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்: **3**

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு- சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக் கலை.

அலகு III <u>உற்பத்தித் தொழில் நுட்பம்</u>: **3**

கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத்துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு IV <u>வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்</u>: **3**

அணை, ஏரி, குளங்கள், மதகு – சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.

அலகு V <u>அறிவியல் தமிழ் மற்றும் கணித்தமிழ்</u>: **3**

அறிவியல் தமிழின் வளர்ச்சி –கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.

TOTAL : 15 PERIODS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

22HS006 TAMILS AND TECHNOLOGY 1 0 0 1

Course Objectives

- Analyse graffiti on potteries as a form of historical and cultural documentation during the Sangam Age.
- Investigate the building materials and the historical context of Hero stones during the Sangam Age by Analysing the details of stage constructions in Silappathikaram and their cultural significance.
- Examine ancient knowledge of oceans and its impact on Tamil society.

Programme Outcomes (POs)

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Understand the significance of the weaving industry during the Sangam Age and its cultural importance.
2. Understand the significance of dams, tanks, ponds, and sluices in the agricultural and irrigation practices of the Chola Period.
3. Explore the architectural designs and structural construction methods used in household materials during the Sangam Age.
4. Explore the art of shipbuilding in ancient Tamil culture and its role in maritime trade and transportation.
5. Trace the development of scientific terminology and vocabulary in Tamil language.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	-	-	-	2	3	-	-	-	-
2	-	-	-	-	-	-	-	-	2	3	-	-	-	-
3	-	-	-	-	-	-	-	-	2	3	-	-	-	-
4	-	-	-	-	-	-	-	-	2	3	-	-	-	-
5	-	-	-	-	-	-	-	-	2	3	-	-	-	-

UNIT I 3 Hours

WEAVING AND CERAMIC TECHNOLOGY

Weaving Industry during Sangam Age - Ceramic technology - Black and Red Ware Potteries (BRW) - Graffiti on Potteries.

UNIT II 3 Hours

DESIGN AND CONSTRUCTION TECHNOLOGY

Designing and Structural construction House and designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age - Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple) - Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period

UNIT III 3 Hours

MANUFACTURING TECHNOLOGY

Art of Ship Building-Metallurgical studies-Iron industry-Iron smelting,steel-Copper and gold-Coins as source of history-Minting of Coins-Beads making-industries Stone beads -Glass beads-Terracotta beads- Shell beads-bone beats-Archeological evidences-Gem stone types described in Silappathikaram.

UNIT IV **3 Hours**

AGRICULTURE AND IRRIGATION TECHNOLOGY

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry-Wells designed for cattle use- Agriculture and Agro Processing-Knowledge of Sea-Fisheries-Pearl-Conche diving-Ancient Knowledge of Ocean-Knowledge Specific Society.

UNIT V **3 Hours**

SCIENTIFIC TAMIL

Development of Scientific Tamil-Tamil computing-Digitalization of Tamil Books-Development of Tamil Software-Tamil Virtual Academy-Tamil Digital Library-Online Tamil Dictionaries-Sorkuvai Project.

Total: 15 Hours

Reference(s)

1. Dr. K. K. Pillay , Social Life of Tamils, A joint publication of TNTB & ESC and RMRL
2. Dr. S. Singaravelu, Social Life of the Tamils - The Classical Period, International Institute of Tamil Studies.
3. Dr. S. V. Subatamanian , Dr.K.D. Thirunavukkarasu, Historical Heritage of the Tamils, International Institute of Tamil Studies.
4. Dr. M. Valarmathi, The Contributions of the Tamils to Indian Culture, International Institute of Tamil Studies
5. Keeladi - Sangam City Civilization on the banks of river Vaigai, Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu
6. Dr. K. K. Pillay, Studies in the History of India withSpecial Reference to Tamil Nadu.

22CT301 PROBABILITY, STATISTICS AND QUEUING THEORY 3 1 0 4

Course Objectives

- The students will be able to understand the basic concepts of probability and the distributions with characteristics and also two dimensional random variables
- Summarize and apply the methodologies of the statistics and queuing theory
- Develop enough confidence to identify and model mathematical patterns in real world and offer appropriate solutions, using the skills learned in their interactive and supporting environment

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Demonstrate and apply the basic probability axioms and concepts in the core areas.
2. Apply the concepts of probability distributions in an appropriate place of computers and Engineering.
3. Implement basic statistical inference techniques for engineering problems.
4. Design an experiment using ANOVA technique and summarize the measurements for statistical quality control.
5. Identify and apply the queuing methodologies to optimize the result of the waiting line.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	-	-	-	-	-	-	-	-	-	-	2	-
2	1	2	-	-	-	-	-	-	-	-	-	-	2	-
3	1	2	-	-	-	-	-	-	-	-	-	-	2	-
4	1	2	-	-	-	-	-	-	-	-	-	-	2	-
5	1	2	-	-	-	-	-	-	-	-	-	-	2	-

UNIT I **9 Hours**

PROBABILITY AND RANDOM VARIABLE

Axioms of probability-Conditional probability-Total probability-Bayes theorem-Random variable-Probability mass function-Probability density functions-Properties-Moments - Moment generating functions and their properties.

UNIT II **9 Hours**

STANDARD DISTRIBUTIONS

Discrete distributions: Binomial - Poisson - Negative Binomial - Continuous distributions: Uniform - Exponential - Gamma - Normal distributions and their properties.

UNIT III **9 Hours**

TESTING OF HYPOTHESIS

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample test based on normal distribution for single mean and difference of means -Small sample tests: t-test for mean -F- test - Chi-square test for Goodness of fit and Independence of attributes.

UNIT IV **9 Hours**

DESIGN OF EXPERIMENTS AND CONTROL CHART

One-way and two-way classifications - Completely Randomized Design - Randomized Block Design - Latin Square Design - Control charts for measurements (X and R charts) - Control charts for attributes (p, c, and np charts).

UNIT V **9 Hours**

QUEUING THEORY

Pure Birth and Death Process -Characteristics of Queuing models- Kendalls notation- Single and multi server Markovian queuing models- M/M/1 and M/M/C (Finite and infinite capacity)- Pollaczek-Khinchine formula.

Total:45+15= 60 Hours

Reference(s)

1. Richard A Johnson, Miller & Freund"s Probability and Statistics for Engineers, PHL Publisher, 1996.
2. Kishore S Trivedi, Probability and Statistics with Reliability Queuing and Computer Science Applications, John Wiley and Sons, Second Edition, 2012.
3. Arnold O Allen, Probability Statistics and Queuing Theory with Computer Applications, New Age International, 2003.
4. Jay L Devore, Probability and Statistics for Engineering and The Sciences, Thomson Learning, Seventh Edition, 2002.
5. Sheldon M Ross, Introduction to Probability and Statistics for Engineers and Scientists,

22CT302 DATA STRUCTURES I 3 0 2 4

Course Objectives

- Implement array and hash data structure for real world applications.
- Apply the different linear and non-linear data structures to problem solutions.
- Critically analyze the performance of various data structures using asymptotic notations

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Implement the array data structure and its types for searching and sorting operations
2. Outline the algorithm efficiency with different asymptotic notations for optimizing the code.
3. Implement the linear node-based data structure for real world applications.
4. Evaluate the performance of Hash over arrays and list in memory access.
5. Analyze the tree traversal algorithms for various non-linear data structures.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2	2	2	-	-	-	-	-	2	2	2	-
2	2	2	2	2	2	-	-	-	-	-	2	2	3	-
3	2	3	3	2	2	-	-	-	-	-	2	2	3	-
4	3	3	3	3	2	-	-	-	-	-	3	3	2	-
5	3	2	3	3	3	-	-	-	-	-	3	3	2	-

UNIT I **10 Hours**

FOUNDATIONAL DATA STRUCTURES

Algorithms and Data Structures - Data Structures hierarchy -Types of Data- Singular Data and Plural Data
- Position indexing : Array - Sets - Ordered Arrays - Searching over Arrays and Ordered Arrays.

UNIT II **7 Hours**

ALGORITHM EFFICIENCY

Algorithm efficiency using Asymptotic Notations - Optimizing code with and without Big O Notation - Optimizing for optimistic scenarios - Trade- offs between Time and Space.

UNIT III **10 Hours**

ADT AND NODE BASED DATA STRUCTURES

ADT : Stacks - Queues - Recursion - Recursive Algorithms for Speed - Node Based Data Structures : Linked list - Need of Linked List - Arrays vs Linked List - Types of Linked List and its operations - Skip Lists.

UNIT IV **8 Hours**

FAST LOOKUP WITH HASH

Hash Table - Hash functions - Internal implementation of Hash - Iteration over Hash - Hash operations - Hash of Hash - Array of Hash - Hash of Array.

UNIT V **10 Hours**

TREES

Tree - Binary Tree - Binary Search Tree - Tree traversal - AVL Tree - Red Black Tree - B Tree - B+ Tree
- Heap.

EXPERIMENT 1 **8 Hours**

Implement a python program for the supermarket application using Stack and Queue for basket storage and checkout respectively.

EXPERIMENT 2 **4 Hours**

Implement a python program for using a singly linked list. managing a train station and need to keep track of passengers on a particular train.

EXPERIMENT 3 **4 Hours**

Create a python program that allows users to search for a person's phone number quickly in the phone directory.

EXPERIMENT 4 **2 Hours**

Implement a Python program to sort the student grades for the quiz competition.

EXPERIMENT 5 **2 Hours**

Implement a digital signature generator and verifier using hash functions and public-key cryptography. Users can sign documents and verify the authenticity of signed documents.

EXPERIMENT 6 **10 Hours**

Implement a python program to give a direction for a Stranger. Landmark will be considered as a node and the path between the two landmark is the link

Total:45+30=75 Hours

Reference(s)

1. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, Data Structures & Algorithms in Python, Wiley, 2013.
2. Larry Wall, Tom Christiansen & Randal L. Schwartz, Progrmaming Perl, O""Reilly, 3rd edition, 2000.
3. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson Education, 2016.
4. Richard F. Gilberg, and Behrouz A. Forouzan, Data Structures - A Pseudocode Approach with C, Thomson 2011.
5. Anany Levitin, Introduction to the Design and Analysis of Algorithms, Third Edition, Pearson Education Asia, 2011.
6. T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, Introduction to Algorithms, PHI Pvt. Ltd., 2009.

22CT303 COMPUTER ORGANIZATION AND ARCHITECTURE 3 1 0 4

Course Objectives

- Understand the computer architecture concepts related to design of processors, memory management and I/O system.
- Explore the GPU computing architecture and develop an environment for creating high performance GPU-accelerated applications using CUDA programming.
- Gain knowledge on modern processor architecture to design the best processor/computing system.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO2: Develop practical competencies in Software and Hardware Design.

Course Outcomes (COs)

1. Analyze the processor architecture and instruction sets of x86/x64 and ARM architecture.
2. Design a data path for a simple processor and compare the various techniques related to simultaneous execution of multiple instructions from a program.
3. Organize the computer memory to speed up the performance and facilitate the transfer of data between the computers central processing unit and the external devices.
4. Analyze the GPU computing architecture and develop applications to run on NVIDIA GPUs using the CUDA programming environment
5. Analyze the modern processor architectures and instruction sets and implement a RISC-V processor in a low-cost FPGA board.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	2	2	-	-	-	-	-	-	-	2	-	3
2	3	3	2	2	-	-	-	-	-	-	-	2	-	3
3	2	2	2	-	-	-	-	-	-	-	-	2	-	3
4	2	2	2	2	3	-	-	-	-	-	-	2	-	3
5	2	2	2	2	-	-	-	-	-	-	-	2	-	3

UNIT I **9 Hours**

UNDERSTANDING PROCESSOR ARCHITECTURE AND INSTRUCTION SETS

Basic Computer Organization and Design - Instruction Set principles - x86 and x64 architecture & instruction sets - 32 bit and 64 bit ARM architecture & instruction sets

UNIT II **9 Hours**

PROCESSOR DESIGN

Designing a Data path for a Simple Processor - DLX Pipeline - Super Pipelining - Super scalar processor - Instruction level parallelism (ILP) - Speculative Execution - Side channel attack (Spectre and Meltdown)

UNIT III **9 Hours**

MEMORY UNIT AND I/O ORGANIZATION

Memory Hierarchy - Cache Architectures - Levels in Cache - Improving Cache Performance - Memory Prefetch - Tera MTA - Connecting I/O Devices to the Processor.

UNIT IV **8 Hours**

EXPLORING GPU ARCHITECTURE

GPU Vs CPU architecture - GPU Architecture Basics - NVIDIA""s CUDA Toolkit - CUDA Programming

UNIT V **10 Hours**

MODERN COMPUTER ARCHITECTURE

Domain-Specific Computer Architectures - Sony PlayStation design PS3/PS5, MAC M1 chip, Xbox, Cerebas - Wafer Scale Computing, Accelerators (FPGA, ASIC) - RISC-V Architecture and Instruction Set-Implementing RISC-V in a field-programmable gate array (FPGA).

Total:45+15= 60 Hours

Reference(s)

1. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, Computer Organization, McGraw-Hill,Third Reprint, 2015.
2. David A, Patterson and John L, Hennessy, Computer Organization and Design: The hardware/ software interface, MorganKaufmann,4th edition, 2014.
3. Jim Ledin, Modern Computer Architecture and Organization - Learn x86, ARM, and RISC-V architectures and the design of smartphones, PCs, and cloud servers - Second Edition,2022.

22CT304 PRINCIPLES OF PROGRAMMING LANGUAGES 3 0 2 4

Course Objectives

- Understand the history and evolution of programming language.
- Gain knowledge about the different data types and control flow statements.
- Impart knowledge about the subprograms, functions, debugging and error handling mechanisms.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Outline the programming paradigms and the basic structure of programming language.
2. Assess the implementation of different types of data, variable and types system.
3. Analyze suitable conditional statements and control structures for real world applications.
4. Develop programs using subprograms and explore their types for problem solving.
5. Determine the tools for error handling and event handling in Programming.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	1	1	3	-	-	-	-	-	1	2	2	-
2	2	3	3	1	3	-	-	-	-	-	2	2	3	-
3	1	2	3	1	3	-	-	-	-	-	2	2	3	-
4	1	2	3	1	3	-	-	-	-	-	2	2	3	-
5	1	2	3	1	3	-	-	-	-	-	2	2	3	-

UNIT I **8 Hours**

UNDERSTANDING PROGRAMMING PARADIGMS

Natural Vs Artificial language - Common Programming Paradigms - Syntax and semantics - Language Evaluation Criteria - Programming Language Grammar.

UNIT II **10 Hours**

VARIABLES AND DATA TYPES

Variable Declarations - Guidelines for Initializing Variables - Power of Variable names - Fundamental Data types - Type Systems - Type Inference and Polymorphism.

UNIT III **10 Hours**

STATEMENTS

Expressions and Assignment statements - Organizing straight-line code - Using conditionals - Controlling loops - Unusual control structures - General control issues.

UNIT IV **9 Hours**

SUBPROGRAMS

Fundamentals of Subprograms - Design issues - Parameter passing methods - Overloaded subprograms - Generic subprograms - Implementing subprograms.

UNIT V **8 Hours**

DEBUGGING AND ERROR HANDLING

Debugging - Debugging Strategies - Debugging Tools - Error Messages - Documentation - Test cases - Debugging with print statements - Debugging with comments and questions - Exception handling and Event handling

EXPERIMENT 1 **6 Hours**

Online shopping cart: Develop an application to implement online shopping cart and generate bill for the purchased products.

EXPERIMENT 2 **3 Hours**

Pocket Bazaar: Develop an application to manage an inventory of products for grocery stores.

EXPERIMENT 3 **3 Hours**

Vacation Destination Decision Maker: Create an application program that helps a user decide on their next vacation destination based on their preferences.

EXPERIMENT 4 **3 Hours**

Temperature monitor: Develop an application for temperature monitoring system and provide an alert message.

EXPERIMENT 5 **3 Hours**

Develop an access control system that simulates the granting access to authorized personnel based on their credentials, such as ID cards and PIN codes.

EXPERIMENT 6 **6 Hours**

Math Quiz Generator: Design a math quiz generator that generates questions of various difficulty levels and arithmetic operations.

EXPERIMENT 7 **6 Hours**

Build a maze solver application that finds a path from the entrance to the exit of a maze.

Total:45+30= 75 Hours

Reference(s)

1. Steve McConnell, Code Complete, Microsoft Press, 2004.
2. Robert. W. Sebesta,Concepts of Programming Languages, 10/E, Pearson Education.
3. D. A. Watt, Programming Language Design Concepts, Wiley Dreamtech, 2007.
4. A.B. Tucker, R. E. Noonan, Programming Languages, 2nd Edition, TMH.
5. K. C. Louden, Programming Languages, 2nd Edition, Thomson, 2003

22CT305 SOFTWARE ENGINEERING 3 0 0 3

Course Objectives

- Understand the systematic approach related to the design, development and maintenance of a software system
- Analyze the limitations of manual testing process and provide a succinct summary of those limitations with the help of automated testing tools.
- Understand the Enterprise Architecture (EA) framework that provides the building blocks for successful digital business transformation.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Apply the software development methodologies to various real-life scenarios.
2. Apply modern tools and techniques to develop scalable, maintainable, and reliable software systems.
3. Analyze the coding strategies and techniques to write well-structured, efficient, and error-free code.
4. Apply specific modern testing tools to ensure the quality and reliability of software products.
5. Analyze the elements, structure, and positioning of an Enterprise Architecture framework used for successful digital business transformation.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	2	2	-	-	2		2	-	2	2	2	-
2	3	3	2	2	3	-	2		2	-	-	2	3	-
3	2	2	2	-	-	-	2		2	-	-	2	3	-
4	2	2	2	-	3	-	2		2	-	-	2	3	-
5	2	2	2	-	-	-	-	-	2	-	-	-	-	-

UNIT I **9 Hours**

SOFTWARE DEVELOPMENT PROCESS

Phases in Software Development - Traditional Software Development Models - Agile Methodologies - Agile Scaling Frameworks - Lean Software Development - Software Requirements Specification(SRS) - Project Scheduling and Estimation.

UNIT II **10 Hours**

TOOLS AND TECHNIQUES FOR SOFTWARE DEVELOPMENT

DevOps - Version control with Git - Containerization Using Docker and Kubernetes- Application Performance Monitoring (APM) - Continuous Integration Continuous deployment (CICD) - Clean Room build.

UNIT III **9 Hours**

CODE QUALITY

Software Metaphors - Upstream Prerequisites - Key Construction Decisions - Defensive Programming - Code Tuning Strategies and Techniques.

UNIT IV **9 Hours**

TESTING

Writing good test cases - Test driven development - Test Automation - Testing using Selenium tool - Continuous Testing - Exploratory Testing - Testing in Agile and DevOps Environments.

UNIT V **8 Hours**

ENTERPRISE ARCHITECTURE AND MODELING

Enterprise Architecture (EA) in Digital Transformation - Agility in Digital Business - Measuring EA: Metrics, KPIs and Risks.

Total: 45 Hours

Reference(s)

1. Roger S.Pressman, Software Engineering: A Practitioners Approach, McGraw Hill International edition, Seventh edition, 2020.
2. Steve Mc Connell, Code Complete - A practical handbook of software construction, Second Edition, 2004.
3. Tushar K Hazra, Bhuvan Unhelker, Enterprise Architecture for Digital Business -Integrated Transformation Strategies- Integrated Transformation strategies, First edition, 2021.
4. Gene Kim, Kevin Behr, and George Spafford, The Phoenix Project: A Novel About IT, DevOps, and Helping Your Business Win, IT Revolution Press, 2018.

22HS004 HUMAN VALUES AND ETHICS 2 0 0 2

Course Objectives

- Understand the concept of good values and comprehend the importance of value-based living.
- Recognize the culture of peace through education.
- Identify and apply the practices for value development and clarification.

Programme Outcomes (POs)

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PSO1: Demonstrate the knowledge and technical skills in software development.

PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Understand the importance of human values and ethics in life.
2. Execute the importance of harmonious living in a diverse society.
3. Analyze the sensitivity to the crying needs of society such as ungodliness, corruption, poverty, and suffering, and play a vital role in eradicating them.
4. Plan intellectually mature, morally upright, ethically correct, and spiritually inspired decisions.
5. Execute a correct balance between professional excellence and social commitment.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	-	-	3	2	1	-	-	1	1
2	-	-	-	-	-	-	-	3	2	1	-	-	1	1
3	-	-	-	-	-	-	-	3	2	1	-	-	1	1
4	-	-	-	-	-	-	-	3	2	1	-	-	1	1
5	-	-	-	-	-	-	-	3	2	1	-	-	1	1

UNIT I 6 Hours

COURSE INTRODUCTION - NEED, BASIC GUIDELINES AND ANALYSIS

Importance of Human Values & Ethics in 21st Century - Understanding the theory of basic human values and ethics -Openness to change -Self enhancement -Conservation -Self transcendence - Schwartz Value Survey: Self-Assessment

UNIT II **6 Hours**

EMBRACING THE COMMON ETIQUETTE

Altruism- Integrity-Freedom-Justice-Honesty-Truthfulness-Responsibility-Compassion

UNIT III **6 Hours**

CONTINUOUS HAPPINESS AND PROSPERITY

An overview on basic Human Aspirations- Understanding and living in harmony at various levels of life- Embracing self-love and wellness-Understanding harmony in the family and society

UNIT IV **6 Hours**

UNIVERSAL HUMAN VALUES AND PROFESSIONAL ETHICS

Reflection on growing global multifold problems: poverty, pollution, hunger, disease, unemployment, caste system, child labour, gender equality, politics and violence. Understanding the challenges in cultural, personal, social, political, and economic environment

UNIT V **6 Hours**

UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE - WHOLE EXISTENCE AS CO-EXISTENCE

Understanding the harmony in the Nature- Holistic perception of harmony at all levels of existence-Practice Exercises and Case Studies will be taken up in Practice Sessions

Total: 30 Hours

Reference(s)

1. Martin, G. The Little Book of Ethics: A Human Values Approach. Australia: G.P. Martin. 2011.
2. Gupta, N. L. Human Values For The 21St Century. India: Anmol Publications Pvt. Limited. 2002.
3. Mishra, A. Happiness Is All We Want. India: Bloomsbury Publishing.2017.
4. Universal Human Values. (n.p.): Booksclinic Publishing. 2023.
5. A Textbook on Professional Ethics And Human Values. India: New Age International (P) Limited.2007.

22HS005 SOFT SKILLS AND EFFECTIVE COMMUNICATION 0 0 2 1

Course Objectives

- Communicate proficiently in formal discussions at the workplace.
- Describe experiences and events, and briefly give reasons and explanations for opinions and plans.
- Interact with a degree of fluency and spontaneity that results in efficacious communication
- Convey agreement and disagreement in a polite but firm manner
- Communicate with coherence and imagination in both written and spoken formats

Programme Outcomes (POs)

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PSO1: Demonstrate the knowledge and technical skills in software development.

PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Enhance confidence in expressing thoughts in grammatically proper language and etiquette in waiting for the opportunity to provide input
2. Effectively communicate in English on formal occasions and proficiency in the use of link words and other discourse markers
3. Provide constructive feedback and file logical complaints
4. Analyse the understanding of oral and written communication in real-world situations.
5. Apply the improved spelling and punctuation in writing and heightened understanding of tone, pitch and stress in oral formats.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	-	-	-	2	3	-	-	1	1
2	-	-	-	-	-	-	-	-	2	3	-	-	1	1
3	-	-	-	-	-	-	-	-	2	3	-	-	1	1
4	-	-	-	-	-	-	-	-	2	3	-	-	1	1
5	-	-	-	-	-	-	-	-	2	3	-	-	1	1

UNIT – I - SELF-EXPRESSION **10 Hours**

Group discussion/ Peer discussion - Communicating decisions and opinions - Tone, Pitch, Stress - Agreeing, Disagreeing, Suggesting, Speculating - Comparing and Contrasting - Comparatives and Superlatives - Discourse markers – Interjections - Decision making - Synthesis - Higher order thinking Group discussion/Peer discussion - Effective Communication Types of communication - Written vs Spoken
- Contractions Intonation Stress Active voice - Question tags - Confidence and body language Guided writing- Outlining Main Points - Group discussion/Peer discussion - Avoiding common errors Reduction of MTI - Common errors - Barriers to communication Accent

UNIT – II - CREATIVE EXPRESSION **10 Hours**

JAM, Debate, Review writing, Social media posts Synonyms - Antonyms Cloze test Phrasal verbs Spotting errors Collocation - Commonly mispronounced

UNIT – III - FORMAL EXPRESSION **10 Hours**

Writing: Giving written feedback, Review writing, and Letter of complaint. Speaking: Giving constructive feedback and offering suggestions, asking for inputs, commenting politely on appropriate phrases - Giving written feedback, Review writing, and Letter of complaint. Critical reasoning - Modal verbs - Polite ways to express negatives

Total: 30 Hours

Reference(s)

1. Norman Lewis, Word Power Made Easy, W. R. Goyal Pub. & Distributors, 2009.
2. Sasikumar, V, et al., A Course in Listening & Speaking Foundation Books, 2005.
3. Murphy, Raymond. English Grammar in Use: A Self-Study Reference and Practice Book for Intermediate Students: with Answers. Cambridge: Cambridge University Press, 1985.
4. Prasad, Hari Mohan. A Handbook of Spotting Errors, Mcgraw Hill Education, 2010.
5. Barun K. Mitra, Personality Development & Soft Skills, Oxford University Press, 2012
6. Ken Taylor, Business English, Orient Blackswan, 2011

22CT401 **DISCRETE MATHEMATICS** **3 1 0 4**

Course Objectives

- Implement the definitions of relevant vocabulary from graph theory and combinatorics and be able to perform related calculations
- Understand and use the terms Cardinality, finite, countably infinite and uncountably infinite, and determine which of these characteristics is associated with a given set
- Develop enough confidence to identify and model mathematical patterns in real world and offer appropriate solutions, using the skills learned in their interactive and supporting environment

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PSO1: Demonstrate the knowledge and technical skills in software development.

PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Understand and apply the concepts of Boolean algebra and characteristics in computers.
2. Apply formalized arguments to classify and assess real-world arguments.
3. Represent the characteristics of predicate logic in computer engineering.
4. Apply different properties of injection, surjection, bijection, composition and inverse functions in software engineering.
5. Interpret the concepts of Permutations, Combinations and Mathematical induction in the phenomena of real world.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	-	-	-	-	-	-	-	-	-	-	2	2
2	1	1	-	-	-	-	-	-	-	-	-	-	2	2
3	1	2	-	-	-	-	-	-	-	-	-	-	2	2
4	2	2	-	-	-	-	-	-	-	-	-	-	2	1
5	1	2	-	-	-	-	-	-	-	-	-	-	2	1

UNIT I **9 Hours**

BOOLEAN ALGEBRA

Introduction of Boolean algebra - Truth table - Basic logic gate - Basic postulates of Boolean algebra - Principle of duality- Canonical form - Karnaugh map.

UNIT II **9 Hours**

PROPOSITIONAL CALCULUS

Propositions- Logical connectives-Compound propositions-Conditional and biconditional propositions-Truth tables - Tautologies and Contradictions - Logical and equivalences and implications-DeMorgans Laws-Normal forms-Principal conjunctive and disjunctive normal forms -Rules of inference-Arguments-Validity of arguments.

UNIT III **9 Hours**

PREDICATE CALCULUS

Predicates-Statement Function - Variables-free and bound variables- Quantifiers-Universe of discourse-Logical equivalences and implications for quantified statements- Theory of inference- The rules of universal specification and generalization-Validity of arguments.

UNIT IV **9 Hours**

SET THEORY AND FUNCTIONS

Set Operations-properties-Power set-Relations-Graph and matrix of a relation- Partial Ordering-Equivalence relations-Partitions- Functions -Types of Functions- composition of relation and functions-inverse functions.

UNIT V **9 Hours**

COMBINATORICS

Basics of Counting - Counting arguments- Pigeonhole Principle- Permutations and Combinations-Recursion and recurrence relations-Generating Functions- Mathematical Induction- Inclusion -Exclusion

Total:45+15= 60 Hours

Reference(s)

1. Trembly J P and Manohar R, Discrete Mathematical Structures with Applications to computer Science, Tata McGraw Hill Publications Co. Ltd., New Delhi 30th Re-print 2007.
2. Alan Doerr and Kenneth Levasseur, Applied Discrete Structures for Computer Science, Galgotia Publications Pvt. Ltd. Delhi. 2010.
3. Ralph P Girmaldi and Ramana B.V. Discrete and Combinatorial Mathematics: An Applied Introduction, Fifth Edition, Pearson Education Asia, Delhi, 2007.
4. Kolman Busby Ross, Discrete Mathematical Structures , Prentice-Hall India, New Delhi, Fifth Edition, 2007.
5. Rosen K.H Discrete Mathematics and its Applications, Tata McGraw Hill Publications, New Delhi. 7th Edition, 2011.

22CT402 DATA STRUCTURES II 3 0 2 4

Course Objectives

- Understand and use the various major modern data structures like Trie, Rope, Segment tree and Octree.
- Apply the graph data structure and tree traversal algorithms for solving real time problems.
- Analyze the performance of algorithm design techniques with different data structures.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO1: Demonstrate the knowledge and technical skills in software development.

PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Implement the Trie data structure and its basic search operations.
2. Outline the traversal algorithm and its types with graph data structure.
3. Implement Minimum Spanning tree algorithms and analyze their performance.
4. Design and implement different problems using the backtracking and branch and bound techniques and analyze the time complexities of them.
5. Implement modern data structures like Segment tree, Quadtree and Octree for real world applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2	2	2	-	-	-	-	-	2	2	2	2
2	2	2	2	2	2	-	-	-	-	-	2	2	2	2
3	2	3	3	2	2	-	-	-	-	-	2	2	2	2
4	3	3	3	3	2	-	-	-	-	-	3	3	3	3
5	3	2	3	3	3	-	-	-	-	-	3	3	3	3

UNIT I
TRIE DATA STRUCTURES **9 Hours**
Trie Structure - Types - Prefix-Based Search - Space Efficiency - Time Complexity - Compact Tries - Applications - Suffix Array and Suffix Tree - Rope.

UNIT II
GRAPH **9 Hours**
Graph representation - Breadth-first traversal - Depth-first traversal - Shortest Path Algorithms: Unweighted Shortest Paths - Dijkstra's Algorithm - Travelling Salesman Problem - Analysis of shortest path algorithms.

UNIT III
GRAPH MST **9 Hours**
Minimum Spanning Tree: Prim's Algorithm - Kruskal's Algorithm- Disjoint-Set Union (Union-Find) - A* algorithm - Flood filling algorithm - Analysis of MST algorithms.

UNIT IV
ALGORITHM DESIGN TECHNIQUES **9 Hours**
NP Complete problems- Backtracking: N-Queens Problem and Subset-Sum problem - Branch and bound: Knapsack problem - Approximation algorithms for NP hard problems: Traveling salesman - P, NP, NP-Complete and NP-Hard Problems.

UNIT V
MODERN DATA STRUCTURES **9 Hours**
Segment Tree - Interval Tree - Fenwick Tree - K-D Tree - Quadtree and Octree - Circular Buffer (Ring Buffer) - Marshaling / Unmarshalling - JSON - benefits - Schema - limitations - Protobuf.

LAB EXPERIMENTS

4 Hours

EXPERIMENT 1
Implement a trie data structure to efficiently support autocomplete suggestions based on user input in google docs.

4 Hours

EXPERIMENT 2
Implement an Algorithm to find the shortest route and travel time between two locations within a city's transportation network.

10 Hours

EXPERIMENT 3
Design a cost-efficient telecommunication network to connect multiple cities using Kruskal's algorithm

EXPERIMENT 4 **4 Hours**
Implement a chess game application using backtracking.

EXPERIMENT 5 **4 Hours**
Implementing Segment Tree for Range Sum Query in a Real-time Data Analytics Platform for student management system.

4 Hours

EXPERIMENT 6
Implement a geographic information system (GIS) for locating a city as node using quadtree

Total: 45+30=75 Hours

Reference(s)

1. Michael H. Goldwasser, Data Structures and Algorithms in Python, Wiley publications, 2013.
2. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson Education,2016.
3. Richard F. Gilberg, and Behrouz A. Forouzan, Data Structures - A Pseudocode Approach with C, Thomson 2011.
4. Aho, J.E.Hopcroft and J.D.Ullman, Data Structures and Algorithms, Pearson education, Asia, 2010.
5. Reema Thareja, Data Structures Using C, Second Edition , Oxford University Press, 2011

22CT403 OPERATING SYSTEMS 3 1 0 4

Course Objectives

- Establish a solid foundation in the introductory concepts of operating systems and gain insights into the structures, services, and roles of operating systems in computing environments.
- To apply process scheduling algorithms in a multi-programming environment and implement the various deadlock strategies effectively to prevent each other from accessing the computer resources
- To gain knowledge on the operations of memory management and File management.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO1: Demonstrate the knowledge and technical skills in software development.

PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Analyze the basic structure and architectural components of the operating system and interpret how application programs interact with the operating system through APIs.
2. Apply the various scheduling algorithms and synchronization techniques to achieve better performance of a computer system.
3. Analyze memory allocation and deallocation mechanisms involved in memory management for a specific system.
4. Apply the various file handling strategies to manage files on a secondary storage structure and in a distributed environment.
5. Analyze the virtualization technologies and their types to simulate hardware functionality and create a virtual computer system.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	2	2	-	-	2	-	2	-	2	2	2	-
2	3	3	2	2	3	-	2	-	2	-	-	2	2	-
3	2	2	2	-	-	-	2	-	2	-	-	2	2	-
4	2	2	2	-	3	-	2	-	2	-	-	2	2	1
5	2	2	2	-	-	-	-	-	2	-	-	-	2	2

UNIT I **8 Hours**

INTRODUCTION TO OPERATING SYSTEMS

Basic Operating System Concepts - Operating System Structure and Components - Operating System Services and Interfaces - Role of the Kernel and User Space - System calls and System Programs - Open Source and Closed source operating systems.

UNIT II **12 Hours**

PROCESS MANAGEMENT

Processes and Threads - Process Scheduling and CPU Scheduling Algorithms - Process Synchronization and Concurrency Control - Deadlocks and Handling Strategies - Inter-Process Communication (IPC) - Multi-Core and Multi-Processor Management

UNIT III **9 Hours**

MEMORY MANAGEMENT

Memory Hierarchy - Address Spaces and Memory Allocation - Paging and Segmentation - Page Replacement Algorithms - NUMA (Non-Uniform Memory Access) - Memory Compression - Memory Tiering.

UNIT IV **8 Hours**

FILE SYSTEM DESIGN AND IMPROVEMENTS

File System Structures - Storage Technologies - SSD and Flash Storage Optimization - Copy-on-Write (CoW) File Systems - File System Journaling - Distributed File Systems and Cloud Storage - File System Monitoring and Analytics.

UNIT V **8 Hours**

VIRTUALIZATION AND RECENT DEVELOPMENTS

Virtualization Principles and Types (Hardware, Software, Network, Storage) - Hypervisors and Virtual Machine Monitors - Microkernels and Exokernels - Security and Integrity in Virtualized Environments - Security in Operating Systems - Operating Systems for Quantum Computers - Cross-Platform Compatibility.

Total: 45+15=60 Hours

Reference(s)

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, 9th Edition, John Wiley & Sons Pvt. Ltd, 2015
2. Andrew S. Tanenbaum, Modern Operating Systems, Fourth Edition, Prentice Hall of India Pvt. Ltd, 2014
3. William Stallings, Operating System, Seventh Edition Prentice Hall of India, 2012
4. Harvey M. DeitelM, Operating Systems, Pearson Education Pvt. Ltd, 2007.
5. Distributed file system for cloud: A Clear and Concise Reference Kindle Edition by Gerardus Blokdyk
6. https://www.redhat.com/en/topics/virtualization

22CT404 WEB TECHNOLOGY AND FRAMEWORKS 2 0 2 3

Course Objectives

- Understand the Web Application Architectures and trace the evolution of the web and introduce concepts like Web 3.0 and Decentralized Web.
- Familiar with the different Web development Frameworks and Full stack development.
- Explore the emerging web technologies and implement best practices for making web applications accessible to all users

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Analyze the architecture of various web applications and develop simple use cases for the real time web applications
2. Implement web applications using client-side scripting language and server-side scripting languages.
3. Integrate the web applications with databases using Web frameworks.
4. Develop a complete, functional web application that incorporates both front-end and back-end components.
5. Implement the emerging web technologies in web application development projects.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2	2	2	-	-	-	-	-	2	2	2	-
2	2	2	2	2	2	-	-	-	-	-	2	2	2	-
3	2	3	3	2	2	-	-	-	-	-	2	2	2	-
4	3	3	3	3	2	-	-	-	-	-	3	3	3	-
5	3	2	3	3	3	-	-	-	-	-	3	3	3	-

UNIT I **5 Hours**
INTRODUCTION TO WEB APPLICATIONS
Evolution of the web - Understanding Web Application Architectures: Server Side Rendered Applications- Single Page Application (SPA) - Mobile Application Development – Comparison of Monolithic and Microservice architectures - Serverless computing - HTTP Protocol and Methods - Web Browsers and Rendering Engines - Use cases of various web applications, including Flipkart, BIT Discourse, BIP, Wiki and Moodle.

UNIT II **7 Hours**
SCRIPTING LANGUAGES
Client-side Scripting vs Server-Side Scripting - Client-side Scripting: Execution Location - Languages: JavaScript Fundamentals - Document Object Model (DOM).
Server-Side Scripting: Execution Location - Language(s) - PHP Programming fundamentals.

UNIT III **6 Hours**
WEB DEVELOPMENT FRAMEWORKS
Introduction to Web Development Frameworks - MVC Architecture - Building APIs with a Framework - RESTful APIs and API Design - Building a RESTful API - Database Integration with ORM/ODM - Building a Basic Front-End Application.

UNIT IV **6 Hours**
FULL STACK DEVELOPMENT
Full-Stack Development - Combining Front-End and Back-End Technologies - Building a Full-Stack Web Application- 12 factor application model - Deployment and Hosting Options - Continuous Integration and Continuous Deployment (CI/CD) - Performance Optimization and Scalability.

UNIT V **6 Hours**
EMERGING WEB TECHNOLOGIES
Emerging Web Technologies: Progressive Web Apps (PWAs) - WebAssembly and WebRTC - Web Security Best Practices – Open Web Application Security Project (OWASP) - Web Accessibility and Inclusive Design - Web Performance Optimization.

EXPERIMENT 1 **6 Hours**

Create a Multipage Website that serves as a personal portfolio using the browser's developer tools and CSS to enhance the web page.

EXPERIMENT 2 **3 Hours**

Implement an animated web application for Rock, Paper, Scissors game to handle input validation ensuring that the user's choice is one of Rock, Paper, or Scissors.

EXPERIMENT 3 **3 Hours**

Create a simple inventory management system to generate QR code for each product thereby allowing user validation using PHP.

EXPERIMENT 4 **3 Hours**

Develop a secure online banking system using a server-side framework like Flask, Django, or Ruby to avoid risk to financial systems.

EXPERIMENT 5 **7 Hours**

Develop a Full Stack Web Application for task management system in a Corporate Environment for tracking project progress and streamlining work assignments.

EXPERIMENT 6 **4 Hours**

Create a RESTful API for an online store used to manage different products using Node.js or Express.

EXPERIMENT 7 **4 Hours**

Develop a real-time chat application with a continuous integration and continuous deployment (CI/CD) pipeline and set up monitoring to ensure optimal performance

Total: 30+30=60 Hours

Reference(s)

1. P.J. Deitel and H.M. Deitel, Internet and World Wide Web - How to Program, Pearson Education,2009.
2. James Gillies and Robert Cailliau, How the Web Was Born: The Story of the World Wide Web, 2000
3. D Crockford , JavaScript: The Good Parts, O Reilly , 2009
4. Mark Masse , REST API Design Book,O Reilly,2011
5. Matti Luukkainen and Jarkko Moilanen , Fullstack Open: Deep Dive Into Modern Web Development"
6. Michal Zalewski , The Tangled Web: A Guide to Securing Modern Web Applications" 2011
7. https://www.theodinproject.com/lessons/foundations.

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22CT405 DATABASE MANAGEMENT SYSTEM 3 0 2 4

Course Objectives

- Analyze the data models, conceptualize, and design a database system using E-R diagrams.
- Gain knowledge on the design principles of relational and modern database systems like SQL, NoSQL and NewSQL.
- Impart knowledge in transaction processing, concurrency control and recovery techniques.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Analyze the data models and the types of data used in databases.
2. Implement SQL queries for creating databases and performing the relational operations.
3. Apply the normalization theory in relational databases for removing anomalies.
4. Analyze the basic issues of transaction processing, concurrency control, deadlock and its recovery schemes.
5. Analyze the performance of NoSQL and NewSQL databases related to design..

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2	2	2	-	-	-	-	-	2	2	2	-
2	2	2	2	2	2	-	-	-	-	-	2	2	2	-
3	2	3	3	2	2	-	-	-	-	-	2	2	2	-
4	3	3	3	3	2	-	-	-	-	-	3	3	3	-
5	3	2	3	3	3	-	-	-	-	-	3	3	3	-

UNIT I **8 Hours**
INTRODUCTION TO DATABASES AND DBMS
Understanding Data and Information - Database vs DBMS - Modern Databases - DBMS Architecture and Components - Data Models - Relational Model - Codd's 12 Rules - Object-Relational Mapping (ORM).

UNIT II **10 Hours**
STRUCTURED QUERY LANGUAGE (SQL)
SQL Basic Commands - Constraints - Database Objects - SQL Functions - Subqueries- Correlated Subqueries- Nested subqueries - Recursive queries - Common Table Expressions (CTEs) - Triggers and Stored procedures.

UNIT III **9 Hours**
DATABASE DESIGN AND NORMALIZATION
Database Design fundamentals - Entity-Relationship Diagrams (ERD) - ERD to tables - Functional Dependencies and Normal Forms: 1NF, 2 NF, 3 NF, BCNF, 4 NF, 5NF and 6 NF - Domain-Key Normal Form (DKNF) - Nested Normal Form (NNF) - Denormalization and Trade-offs - Emerging trends in Database Design - Dealing with real-world complexities in Database Design- CASE Tools for Database Design.

UNIT IV **9 Hours**
QUERY OPTIMIZATION AND TRANSACTION MANAGEMENT
Query Optimization and Execution Plans -Optimization Visualization Tool - DB Sharding - Vitess – Vitess vs MySQL- Table partitioning - Transaction Management and ACID Properties - Concurrency Control: Lock based protocols -Deadlock handling – Multi version concurrency control (MVCC) - Transaction isolation.

UNIT V **9 Hours**
NOSQL AND NEWSQL DATABASES
NoSQL Vs NewSQL- NoSQLDatabases: MongoDB and Cassandra - NewSQL databases: Redis and NuoDB -Selection of NoSQL or NewSQL over RDBMS - CAP Theorem and BASE Properties - HeidiSQL - In-Memory Databases and Caching - Database Security and Encryption - Database Performance Tuning

EXPERIMENT 1 **4 Hours**
Create a relational database with tables for storing employee details and perform CRUD operations.

EXPERIMENT 2 **6 Hours**

Create a relational database for e-commerce applications and add primary key, foreign key, check constraints and triggers.

EXPERIMENT 3 **6 Hours**

Create an ER diagram for the library management system and implement the database schema in RDBMS.

EXPERIMENT 4 **3 Hours**

Create a MongoDB database for an event management system.

EXPERIMENT 5 **4 Hours**

Design a distributed database for an e-commerce platform to handle order processing.

EXPERIMENT 6 **4 Hours**

Develop an in-memory caching solution using Redis for a content publishing platform (Blog).

EXPERIMENT 7 **3 Hours**

Develop a secure RDBMS solution for a banking financial transactions system.

Total: 45+30=75 Hours

Reference(s)

1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts, McGraw
   -Hill, Sixth Edition, 2018
2. Ramez Elmasri and Shamkant B. Navathe, Fundamental Database Systems,Pearson Education, Seventh Edition, 2016
3. Peter Rob and Corlos Coronel, Database System, Design, Implementation and Management, Thompson Learning Course Technology, Ninth edition, 2011
4. Guy Harrison , Next Generation Databases: NoSQLand Big Data, Apress.

22HS007 ENVIRONMENTAL SCIENCE 2 0 0 0

Course Objectives

- Understand the interdisciplinary and holistic nature of the environment
- Identify the significance of natural resources and environment on the quality of life and stimulate the quest for sustainable development
- Assess the socio-economic, political and ethical issues in environmental science

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Examine the importance of interdisciplinary nature of environment studies, uses and exploitation of natural resources
2. Analyze the different types of ecosystems and biodiversity, its values and also role of professionals in protecting the environment from degradation
3. Impact the existing environmental challenges related to pollution and its management
4. Select suitable strategies for sustainable management of components of environmental science
5. Correlate the impacts of population and human activities on environment

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	-	-	-	-	-	-	-	-	-	-	-	-
2	1	1	-	-	-	-	-	-	-	-	-	-	-	-
3	2	2	-	-	-	-	1	-	-	-	-	-	-	-
4	1	-	-	-	-	-	-	-	-	-	-	-	-	-
5	2	-	-	-	-	-	-	-	-	-	-	-	-	-

UNIT I 6 Hours

NATURAL RESOURCES

Forest resources: Use - over exploitation - deforestation - case studies. Water resources: Use - over utilization of surface and ground water - conflicts over water. Mineral resources: Use - exploitation - environmental effects of extracting and using mineral resources - case studies. Food resources: Effects of modern agriculture - fertilizer-pesticide problems (eutrophication, blue baby syndrome, biomagnification). Energy resources: renewable (solar, wind, and hydro).

UNIT II **6 Hours**

ECOSYSTEMS AND BIODIVERSITY

Concept of an ecosystem: Structure and function of an ecosystem - producers - consumers - decomposers - food chains - food webs and ecological pyramids - Types of ecosystem: Introduction - characteristic features: desert ecosystem. Biodiversity - value of biodiversity - threats to biodiversity - endangered and endemic species - Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

UNIT III **6 Hours**

ENVIRONMENTAL POLLUTION

Pollution: Definition - causes - effects - control measures of air pollution - water pollution : (Sewage water treatment by activated sludge and trickling filter process) - noise pollution- thermal pollution. Disaster management: causes - effects - control measures of floods - earthquake

UNIT IV **7 Hours**

SOCIAL ISSUES AND ENVIRONMENT

Sustainable development : Definition - Unsustainable to sustainable development - solid waste management - causes - effects - 5R Principles (landfills, incineration, composting). Water conservation - rain water harvesting - watershed management. Climate change - global warming - acid rain - ozone layer depletion. E-waste

UNIT V **5 Hours**

HUMAN POPULATION AND ENVIRONMENT

Human population: Population growth - characteristics - variation among nations - population explosion - value education - HIV / AIDS. Role of information technology in environment and human health - occupational safety and health administration (OSHA)

Total: 30 Hours

Reference(s)

1. Anubha Kaushik, C.P. Kaushik, Environmental Science and Engineering , 4th Multi Colour Edtion, New Age International Publishers, New Delhi, 2014
2. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. Environment. 8th edition. John Wiley & Sons
3. T. G. Jr. Miller, S. Spoolman, New Environmental Science, 14th Edition, Wadsworth Publishing Co, New Delhi, 2014
4. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press
5. A. K. De, Environmental Chemistry, 7th Edition , New age international publishers, New Delhi, 2014

22HS008 ADVANCED ENGLISH AND TECHNICAL EXPRESSION 0 0 2 1

Course Objectives

- To enable students to achieve proficiency in academic writing
- effectively use the language to persuade others
- appreciate the nuances of the language and engage an audience
- use advanced tools of language to improve communicative competence
- prepare for professional demands at the workplace
- give concrete expression to the plans and goals

Programme Outcomes (POs)

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Understand the clarity in articulating the objectives and aims and improved proficiency in using the English language
2. Communicate effectively and with good interpersonal skills; speak in public, engage the audience, and lead a group discussion
3. Critically evaluate the ethics of persuasive appeals and confidence to influence opinion
4. Analyse a specific piece of information; take in what is read, and use good writing techniques with proper grammar and syntax in all formal situations
5. Create awareness and empathy to emotional signals in communication

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	-	-	-	2	3	-	-	1	-
2	-	-	-	-	-	-	-	-	2	3	-	-	1	-
3	-	-	-	-	-	-	-	-	2	3	-	-	1	-
4	-	-	-	-	-	-	-	-	2	3	-	-	1	-
5	-	-	-	-	-	-	-	-	2	3	-	-	1	-

UNIT – 1 - CREATIVE EXPRESSION 15 Hours

Proposals & Grant applications, Argumentative essays & editorials, Sales Pitches, Campaigning, Commercials/advertisements, effectively answering the famous interview question: 'Why should we hire you?' Sentence and paragraph formation - Rhetorical questions - Emphasis & effective repetition - Empathetic expression, knowing the audience, capturing attention - Creating Memes, Comic Strips, Stand-up comedy, Caption writing, and Limericks, Vocabulary and slang words for comedy - Similes & Metaphors - Homophones, homonyms, alliteration, wordplay

UNIT 2 - FORMAL EXPRESSION **15 Hours**

Writing: Action plans, Cover letters, Mind-Mapping, Paragraph writing Logical reasoning SVA - Advanced level - Style: Clarity, Concision, Coherence, Evocativeness, Efficacious Vocabulary - Conditional Clause - Be verbs- Tenses- advanced - Opening and closing sentences - Action plans, Anecdotal references, order of communication/ narration, complete communication- Wh-questions - Effective beginning and closing - Rhetorical questions - Appraising target audience - Pronunciation, Enunciation, Tone, Pace and Volume. - Writing: SOPs, Research Objectives, Thesis Statement, Indexing, Scholarly Articles, Academic Writing, Executive Summary, Survey Questionnaires, Citations and Bibliography - Reading: Quantitative & qualitative analysis, Analysis and paraphrasing of reference materials Speaking: Commentate live events, give instructions to operate machines/ conduct experiments Listening: Informational listening, Reflective listening, - Discriminative listening - Connective words - Prefixes and Suffixes - Quoting and paraphrasing Proofreading - Directed writing and writing formats - Note taking - Active verbs

Total: 30 Hours

Reference(s)

1. Sangeeta Sharma et.al. Communication Skills for Engineers and Scientists, PHI Learning Pvt. Ltd, 2011
2. Murphy, Raymond. English Grammar in Use: A Self-Study Reference and Practice Book for Intermediate Students: with Answers. Cambridge: Cambridge University Press, 1985.
3. Prof. R.C. Sharma & Krishna Mohan, Business Correspondence and Report Writing Tata McGraw Hill & Co. Ltd., 2001
4. Personality Development, Harold R. Wallace &L.Ann Masters, Cengage Learning, New Delhi
5. Krishna Mohan, Meera Bannerji, Developing Communication Skills, Macmillan India Ltd. 1990, Delhi
6. N.K.Agrawal & F.T.Wood, English Grammar, Composition and Usage Macmillan India Ltd., New Delhi

22CT501 PRINCIPLES OF COMPILER DESIGN 3 1 0 4

Course Objectives

- Understand the principles, algorithms, and data structures involved in the design and construction of compilers
- Acquire knowledge in construction of scanners, parsers and in intermediate code generation.
- Familiar with the code generation schemes and optimization methods.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and the cultural, societal, and environmental considerations.

PO5: Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice

PO9: Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO12: Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO1. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

Course Outcomes (COs)

1. Analyze the role of each phase of a compiler and the compiler construction tools.
2. Apply finite automata to design lexical analyzers.
3. Implement parsers for context-free grammars.
4. Develop intermediate code using syntax-directed translation.
5. Apply optimization techniques to enhance code efficiency.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	2	-	2	2	-	-	2	2	-	1	1	-
2	3	3	2	-	1	2	-	-	2	2	-	1	2	-
3	2	2	23	-	2	2	-	-	2	1	-	2	2	-
4	1	2	2	-	1	2	-	-	2	2	-	1	1	-
5	1	2	2	-	2	1	-	-	2	2	-	2	1	-

UNIT I **8 Hours**

INTRODUCTION TO FORMAL LANGUAGES AND COMPILERS

Formal Language - Elements of Language - Formal Grammar - Chomsky Classification. Compilers: Language Processors - Structure of a Compiler - Grouping of Phases into Passes - Compiler Construction Tools.

UNIT II **9 Hours**

LEXICAL ANALYSIS

Lexical Analysis: Role of Lexical Analyzer - Input Buffering - Specification of tokens - Recognition of Tokens. Finite automata - Regular expression to finite automata- Optimization of DFA based Pattern Matches-Lexical Analyzer Generator Lex.

UNIT III **11 Hours**

SYNTAX ANALYSIS

Introduction-Role of the parser - Context-Free Grammars -Writing a Grammar-Top Down parsing - LL(1) Grammars- Non-recursive Predictive Parsing - Bottom-up parsing - Shift Reduce Parsing-LR Parsers: Simple LR Parser - Canonical LR Parser - LALR Parser - Parser Generator YACC

UNIT IV **8 Hours**

INTERMEDIATE CODE GENERATION

Variants of Syntax Trees- Three-Address Code - Types and Declarations - Translation of Expressions - Control Flow - Switch-Statements - Backpatching

UNIT V **9 Hours**

CODE OPTIMIZATION

Issues in the Design of a Code Generator - The Target Language - Basic Blocks and Flow Graphs- Optimization of Basic Blocks - A Simple Code Generator- Principal Sources of Optimization

Total: 45+15=60 Hours

Reference(s)

1. Alfred V. Aho, Ravi Sethi and Jeffrey D. Ullman Compilers: Principles, Techniques and Tools, 2nd Edition, Pearson, 2012.
2. Torbengidius Mogensen, Basics of Compiler Design, Springer, 2011.
3. Charles N, Ron K Cytron, Richard J LeBlanc Jr., Crafting a Complier, Pearson Education, 2010
4. D. Grune, H.E. Bal, C.J.H. Jacobs, K.G. Langendoen, Modern Compiler Design, Wiley, 2008
5. Kennath C. Louden, Compiler Construction Principles and Practice. New Delhi: Vikas publishing House, 2006.
6. Allen I. Holub, Compiler Design in C, Prentice Hall of India, 2007.

22CT502 COMPUTER NETWORKS 3 0 2 4

Course Objectives

- To understand the division of network functionality into layers and to familiarize the functions and protocols of each layer of TCP/IP protocol suite
- To understand the components required to build different types of network and to learn concepts related to network addressing.
- To understand the flow of information from one node to another node in the network and to learn the application layer utilities

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PSO1: Demonstrate the knowledge and technical skills in software development.

PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Apply OSI model with TCP/IP protocol suite and design a network based on four different topologies.
2. Apply and analyze error and flow control algorithms for communication between adjacent nodes in a network.
3. Evaluate and apply the suitable routing algorithms for the given network.
4. Evaluate a client/server application using TCP/UDP and design algorithms for end-end communication
5. Create the capabilities of application layer utilities and replicate the same for new applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	3	-	-	-	-	-	-	-	-	-	2	2
2	1	2	3	1	1	-	-	-	-	-	-	-	2	2
3	3	2	2	-	-	-	-	-	-	-	-	-	2	1
4	1	3	2	-	-	-	-	-	-	-	-	-	2	-
5	3	2	-	-	-	-	-	-	-	-	-	-	2	-

UNIT I **9 Hours**

DATA COMMUNICATIONS

Introduction: Data Communications, Networks, Network Types, Protocol Layering, TCP/IP Protocol Suite, OSI Model - Physical Layer: Introduction to Physical Layer - Transmission Media: Guided Media, Unguided Media.

UNIT II **9 Hours**

DATA LINK AYER

Introduction to Data Link Layer: Link Layer Addressing - Error Detection and Correction: Block Coding, Cyclic Codes, Checksum, Forward Error Correction - Data Link Control: DLC services, Data-Link Layer Protocols, HDLC, Point-to-Point Protocol - Media Access Control: Random Access and Controlled Access

UNIT III **9 Hours**

NETWORK LAYER

Network Layer Services - Packet Switching - IPV4 Addresses - Forwarding of IP Packets - Network Layer Protocols: IP, ICMPv4 - Routing Algorithms- Unicast Routing Protocols - Next Generation IP: IPv6 Addressing, IPv6 Protocol.

UNIT IV **9 Hours**

TRANSPORT LAYER

Introduction to Transport Layer: Simple Protocol, Stop-and-Wait Protocol, Go-Back-N Protocol, Selective Repeat Protocol, Bidirectional Protocols: Piggybacking - User Datagram Protocol - Transmission Control Protocol - Congestion Control.

UNIT V **9 Hours**

APPLICATION LAYER

Client Server Programming - WWW - HTTP - FTP - DNS - SNMP-DHCP.

EXPERIMENT 1 **5 Hours**

Design a Local area network for organization of 5 laboratories with interdepartmental connectivity and show the simulated output.

EXPERIMENT 2 **5 Hours**

Implement Cyclic Redundancy Check and Checksum algorithms to detect and correct errors while transferring files (.jpeg, .txt, .csv) over unreliable networks.

EXPERIMENT 3 **5 Hours**

Configure routers and switches to manage and optimize network traffic, ensuring reliable internet connectivity and efficient data flow for home or office networks and show the simulated output.

EXPERIMENT 4 **5 Hours**

Configure the network address using Address Resolution Protocol (ARP) to map IP addresses to MAC addresses in a college network, and Reverse ARP (RARP) to obtain their IP addresses from an available server and show the simulated output.

EXPERIMENT 5 **5 Hours**

Implement Distance Vector and Link State Routing algorithms to determine the most efficient path for data transmission across large corporate networks.

EXPERIMENT 6 **5 Hours**

Develop a real-time chat application that uses Transmission Control Protocol (TCP) for reliable, ordered communication and User Datagram Protocol (UDP) for faster, connectionless messaging.

Total: 45+30= 75 Hours

Reference(s)

1. Behrouz A.Forouzan, Data Communication and Networking, 5th Edition, Tata McGraw-Hill, 2014
2. James F.Kurose and Keith W.Ross, Computer Networking: A Top-Down Approach Featuring the Internet, Pearson Education, 2005
3. Larry L.Peterson and Bruce S.Davie, Computer Networks, Elsevier, 2009
4. Andrew S.Tanenbaum, Computer Networks, Pearson Education, 2008
5. William Stallings, Data and Computer Communication, Pearson Education, 2007
6. Douglas E.Comer and M.S.Narayanan, Computer Networks and Internets, Pearson Education, 2008

22CT503 **EMBEDDED SYSTEMS** **3 0 0 3**

Course Objectives

- To understand the basics of Embedded Systems
- Understand the basics of Embedded Hardware and Software.
- Design and analyze embedded systems.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PSO1: Demonstrate the knowledge and technical skills in software development.
PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Apply the concepts of embedded computing with 8051 microcontrollers.
2. Analyze the embedded Hardware concepts.
3. Analyze the embedded Software concepts.
4. Evaluate and analyze the Embedded System.
5. Create embedded systems using case studies

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	-	-	-	-	-	-	-	-	-	-	-	-	3
2	-	3	-	-	-	-	-	-	-	-	-	-	-	3
3	-	3	-	-	-	-	-	-	-	-	-	-	3	-
4	-	-	2	-	-	-	-	-	-	-	-	-	-	2
5	-	-	2	-	-	-	-	-	-	-	-	-	-	2

UNIT I **9 Hours**

INTRODUCTION TO EMBEDDED COMPUTING

Characteristics of Embedded Computing - Challenges of Embedded Systems - Embedded system design process – Architecture Design. Importance - System model -Embedded processors - 8051 Microcontroller, ARM processor - Processor and Memory Organization, Data Operations, Flow of Control.

UNIT II **9 Hours**

EMBEDDED HARDWARE

The Embedded Board and the Von-Neumann Model - Basic Hardware Materials: Embedded Processors
- ISA Architecture Models - Internal processor design - Processor Performance - Memory - Board I/O
- Board Buses - Component Interfacing.

UNIT III **9 Hours**

EMBEDDED SOFTWARE

Device Drivers for Interrupt-Handling - Memory Device Drivers - Onboard Bus Device Drivers - Board I/O Driver Examples - Embedded Operating Systems - Process - Multitasking and Process Management - I/O and File System Management - Middleware and Application Software

UNIT IV **9 Hours**

PROGRAM DESIGN AND ANALYSIS

Models of Programs - Basic Compilation Techniques - Program Optimization - Program-Level Performance Analysis - Software Performance Optimization - Program Validation and Testing, Clear-Box Testing, Black-Box Testing, Evaluating Function Tests

UNIT V **9 Hours**

EMBEDDED SYSTEM DEVELOPMENT

Design issues and techniques - Design Methodologies, System Analysis, and Architecture Design, Quality Assurance - Case studies - Complete design of example embedded systems.

Total: 45 Hours

Reference(s)

1. Wayne Wolf, Computers as Components: Principles of Embedded Computer System Design, Elsevier, 2008.
2. Michael J. Pont, Embedded C, Pearson Education , 2007.
3. Tammy Noergaard, “Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers”, Second Edition, Elsevier Embedded Technology Series, Newnes Publication, 2012.
4. Steve Heath, Embedded System Design, Elsevier, 2005.
5. Muhammed Ali Mazidi, Janice Gillispie Mazidi and Rolin D. McKinlay, The 8051 Microcontroller and Embedded Systems, Pearson Education, Second edition, 2007

22CT504 ARTIFICIAL INTELLIGENCE SYSTEMS 2 0 2 3

Course Objectives

- Understand artificial intelligence principles, techniques, and its history
- Apply the basic knowledge representation, problem solving, and learning methods in solving engineering problems
- Develop intelligent systems by assembling solutions to concrete computational Problems.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Apply basic principles of AI in solutions that require problem-solving, inference, perception, knowledge representation and learning.
2. Analyze and illustrate how search algorithms play a vital role in problem-solving.
3. Analyze knowledge of reasoning, uncertainty, and knowledge representation for solving real-world problems.
4. Evaluate Artificial Intelligence (AI) methods and describe their foundations
5. Create Artificial Intelligence techniques to extract data and process the same..

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
2	-	3	-	-	-	-	-	-	-	-	-	-	3	-
3	-	-	3	-	-	-	-	-	-	-	-	-	3	-
4	-	-	-	3	-	-	-	-	-	-	-	-	3	-
5	-	-	-	-	3	-	-	-	2	2	3	3	3	-

UNIT I **6 Hours**

INTRODUCTION

Introduction - Evolution of AI, State of Art - Different Types of Artificial Intelligence - Applications of AI-Subfields of AI - Intelligent Agents - Structure of Intelligent Agents – Environments

UNIT II **6 Hours**

PROBLEM SOLVING BASED ON SEARCHING

Introduction to Problem Solving by searching Methods-State Space search, Uninformed Search Methods – Uniform Cost Search, Breadth First Search- Depth First Search-Depth limited search, Iterative deepening depth-first, Informed Search Methods- Best First Search, A* Search

UNIT III **6 Hours**

LOGIC AND REASONING

Introduction to Logic and Reasoning -Propositional Logic-First Order Logic-Inference in First Order Logic- Unification, Forward Chaining, Backward Chaining, Resolution.

UNIT IV **6 Hours**

PLANNING

Classical planning, Planning as State-space search, Forward search, backward search, Planning graphs, Hierarchical Planning, Planning, and acting in Nondeterministic domains - Sensor-less Planning, Multiagent planning.

UNIT V **6 Hours**

COMMUNICATING, PERCEIVING AND ACTING

Communication-Fundamentals of Language -Probabilistic Language Processing -Information Retrieval- Information Extraction-Perception-Image Formation- Object Recognition

EXPERIMENT 1 **4 Hours**

Implement a program to solve the 8-Queen problem using a constraint module.

EXPERIMENT 2 **4 Hours**

Implement a program to solve the Zebra Puzzle using the python-constraint library.

EXPERIMENT 3 **4 Hours**

Implement Pathfinding in a Maze using A* Search Algorithm

EXPERIMENT 4 **6 Hours**

Build a Tic Tac Toe using Minimax Algorithm with Alpha-Beta Pruning

EXPERIMENT 5 **6 Hours**

Implement a program for Drug Screening probabilities using Bayes' Inference Rule.

EXPERIMENT 6 **6 Hours**

Implement a program for Burglar Alarm Monitoring and Notification System Using Bayesian Networks.

Total: 30+30=60 Hours

REFERENCE(S)

1. Russell, S. and Norvig, P. 2015. Artificial Intelligence - A Modern Approach, 3rd Edition, Prentice Hall.
2. K. R. Chowdhary, Fundamentals of Artificial Intelligence, Springer, 2020.
3. Alpaydin, E. 2010. Introduction to Machine Learning. 2nd Edition, MIT Press.
4. Alex Berson and Stephen J Smith, Data Warehousing, Data Mining, and OLAP, Tata Mcgraw-Hill, 1997.
5. Elaine Rich, Kevin Knight and Shivashankar B Nair, Artificial Intelligence, Tata McGraw Hill,2010.
6. M. Tim Jones, Artificial Intelligence: A Systems Approach, Jones and Bartlett Publisher, 2010.
7. Fabio Bellifemine, Giovanni Caire, Dominic Greenwood, Developing Multi agent Systems with JADE, John Wiley and Sons Ltd, 2007.

22CT507 MINI PROJECT I 0 0 2 1

Course Objectives

- Identify the problem statement and apply the engineering concepts to find the solution.
- Improve the analysing capability of the students.
- Increase the exuberance in finding the solution to various problems.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PSO1: Demonstrate the knowledge and technical skills in software development.

PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Apply a real-world problem, identify the requirement, and develop the design solutions.
2. Analyze technical ideas, strategies and methodologies
3. Analyze the new tools, algorithms, and techniques that contribute to obtaining the solution of the project.
4. Evaluate and validate through conformance of the developed prototype and analysis of the cost- effectiveness.
5. Create the report and present oral demonstrations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1	1	2	-	-	2	2	2	-	-	3	3
2	1	2	1	1	2	-	-	2	2	2	-	-	3	3
3	1	2	1	1	2	-	-	2	2	2	2	-	3	3
4	1	2	1	1	2	-	-	2	2	2	2	-	3	3
5	1	2	-	-	2	-	-	2	2	2	-	-	3	3

22CT601 DISTRIBUTED COMPUTING 3 0 0 3

Course Objectives

- Understand the basic client server communication
- Design and implement a distributed system over other network
- Diagnose the cause of defects in the deadlocks

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PSO1: Demonstrate the knowledge and technical skills in software development. PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Apply the various distributed computing system strategies
2. Apply the inter-process communication and communication between distributed objects.
3. Analyze the concept of distributed transactions and concurrency control.
4. Evaluate the resource management techniques in distributed system.
5. Create the concept of distributed file system, name services and multimedia systems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	-	1	-	1	-	-	-	-	-	-	-	-	2
2	2	-	2	-	2	-	-	-	-	-	-	-	2	-
3	2	-	2	-	2	-	-	-	-	-	-	-	-	2
4	2	-	2	-	2	-	-	-	-	-	-	-	-	2
5	2	-	2	-	2	-	-	-	-	-	-	-	2	-

UNIT I **8 Hours**

BASIC CONCEPTS

Characterization of Distributed Systems - Examples - Resource Sharing and the Web - Challenges - System Models - Architectural and Fundamental Models - Networking and Internetworking - Types of Networks - Network Principles-Internet Protocols.

UNIT II **10 Hours**

INTERPROCESS COMMUNICATION AND DISTRIBUTED OBJECTS

Interprocess Communication - The API for the Internet Protocols - External Data Representation and Marshalling - Client - Server Communication - Group Communication - Case Study - Distributed Objects and Remote Invocation - Communication Between Distributed Objects - Remote Procedure Call - Events and Notifications

UNIT III **9 Hours**

DISTRIBUTED TRANSACTIONS AND CONCURRENCY CONTROL

Transactions - Locks - Optimistic Concurrency Control - Timestamp Ordering - Comparison - Flat and Nested - Distributed Transactions - Atomic Commit Protocols - Concurrency Control in Distributed Transactions - Distributed Deadlocks - Transaction Recovery

UNIT IV **9 Hours**

RESOURCE MANAGEMENT

Time and Global States-Introduction - Clocks, Events and Process states - Synchronizing physical clocks Logical time and logical clocks - Global states-Distributed debugging - Coordination and Agreement- Introduction - Distributed mutual exclusion - Elections Algorithm - Multicast communication - Consensus and related problems.

UNIT V **9 Hours**

DISTRIBUTED FILE SYSTEM AND NAME SERVICES

Distributed File Systems - Introduction - File service architecture - Network File System- Name Services and the Domain Name System - Directory Services. Distributed multimedia systems-characteristics - Quality of service management - Resource management

Total: 45 Hours

Reference(s)

1. George Coulouris, Jean Dollimore and Tim Kindberg, Distributed Systems Concepts and Design, Pearson Education, 2017
2. Andrew S. Tanenbaum, Maartenvan Steen, Distibuted Systems, Principles and Paradigms, Pearson Education, 2014
3. Mugesh Singhal, Niranjan G Shivaratri, Advanced Concepts in Operating Systems, Tata McGraw Hill Edition, 2008
4. M. L. Liu, Distributed Computing Principles and Applications, Pearson Education, 2004

22CT602 **MACHINE LEARNING ESSENTIALS** **3 0 2 4**

Course Objectives

- Define machine learning and problems relevant to machine learning.
- Differentiate supervised, unsupervised and reinforcement learning
- Apply neural networks, Bayes classifier and k nearest neighbor, for problems appear in machine learning.
- Perform statistical analysis of machine learning techniques.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Apply the concept of machine learning to find maximally consistent hypotheses.
2. Apply supervised learning algorithms to solve classification and regression problems.
3. Analyze unsupervised and reinforcement learning algorithms with real time applications.
4. Analyze the representation and algorithms involved in Neural Networks.
5. Apply the advanced machine learning algorithms to design predictive models.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1	2	-	-	-	-	-	-	-	-	2	-
2	1	2	2	2	1	1	-	-	-	-	-	-	2	-
3	1		2	1	1	1	-	-	-	-	-	-	2	-
4	1	2	2	2	-	-	-	-	-	-	-	-	2	-
5	1	2	2	2	-	-	-	-	-	-	-	-	2	-

UNIT I **9 Hours**

INTRODUCTION

Need for Machine Learning- Machine Learning Process - Types of Machine Learning - Concept Learning: Find - S algorithm, Version space, Candidate Elimination algorithm, Inductive Bias

UNIT II **9 Hours**

SUPERVISED LEARNING

Classification Algorithms: Support Vector Machines - Logistic Regression - K-Nearest Neighbors - Naive Bayes Classifier - Decision Trees - Random Forests - Regression Algorithms: Simple Linear Regression - Multiple Linear Regression

UNIT III **9 Hours**

UNSUPERVISED LEARNING AND REINFORCEMENT LEARNING

Clustering algorithm: k-means clustering - Fuzzy c-means clustering - Hierarchical clustering -Gaussian (EM) clustering - Density-based clustering - Reinforcement Learning: Examples -Challenges - Q - Learning Algorithm.

UNIT IV **9 Hours**

NEURAL NETWORKS

Neural Network Basics: Multilayer Perceptron - Feed Forward Neural Networks - Back Propagation - Hyper Parameter Tuning. Convolutional Neural Networks: Image Classification. Recurrent Neural Networks: Long Short - Term Memory

UNIT V **9 Hours**

ADVANCED MODELS

Generative Models - Autoencoders - Recommendation System: Collaborative Filtering Recommendation System - Content Based Recommendation System - Hybrid Recommendation System

EXPERIMENT 1 **5 Hours**

Consider a set of training data examples and implement algorithms to find the most specific hypothesis and set of all hypotheses that are consistent with the training examples

EXPERIMENT 2 **5 Hours**

Apply suitable classification algorithm to classify the iris data set.

EXPERIMENT 3 **5 Hours**

Apply EM algorithm and k-Means algorithm to cluster a set of data. Compare the results of these two algorithms and comment on the quality of clustering

EXPERIMENT 4 **5 Hours**

Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.

EXPERIMENT 5 **5 Hours**

Apply CNN to build computational models consisting of several processing elements to receive inputs and deliver outputs based on activation functions. learning to get the desired output.

EXPERIMENT 6 **5 Hours**

Build a Simple and Content-Based Book Recommendation System

Total: 45+30=75 Hours

Reference(s)

1. Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education.

2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, 2nd edition, Springer Series in Statistics.

3. Ethem Alpaydin, Introduction to Machine Learning, Second edition, MIT press

22CT603 CLOUD COMPUTING 3 0 2 4

Course Objectives

- To provide the ideal solution to manage enterprise resources effectively and efficiently by cloud computing.
- Identify the security and privacy issues in cloud computing.
- To develop the ability to understand and use the architecture of compute and storage cloud, service and delivery models.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Apply the concept of probability to model information and compress text
2. Apply the principles of differential coding to compress speech
3. Analyze the techniques involved in the design of audio and video compression algorithms
4. Apply compression techniques to compress text and images
5. Design algorithms to ensure error-free communication/information retrieval

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	2	3	-	-	-	-	1	-	-	2	2	-
2	-	1	1	3	2	-	-	-	-	-	-	2	1	-
3	-	2	2	1	3	-	-	-	-	-	-	2	2	-
4	1	2	2	1	3	-	-	-	1	-	-	2	2	-
5	1	3	3	-	2	-	-	-	1	-	-	2	3	-

UNIT I **9 Hours**

INTRODUCTION

Introduction to Cloud Computing -Characteristics and Benefits of Cloud Computing- Hardware and software - Evolution of cloud computing - Server virtualization: parallel and vector processing.

UNIT II **9 Hours**

CLOUD SERVICE MODELS

Software as a Service (SaaS) - Infrastructure as a Service (IaaS)- Platform as a Service (PaaS) - Cloud Data Center - Service Oriented Architecture (SoA) - Basic approach to a Data center Based SoA.

UNIT III **9 Hours**

CLOUD DOCKER

Introduction - Docker Architecture -Docker Engine - Docker Containers - Docker Objects - Docker Run - Pipeline - Automation Scripts.

UNIT IV **9 Hours**

CLOUD SECURITY

Securing cloud boundary - Service boundary - Security mapping - Brokered cloud storage access - Storage location and tenancy - Encryption - Establishing the Identity and Presence

UNIT V **9 Hours**

CLOUD APPLICATIONS AND STORAGE

Applications in the cloud - Functionality mapping - Applications attributes - Cloud APIs-Cloud storage definition - Managed and Unmanaged cloud storage - Exploring cloud backup solutions - Cloud storage interoperability.

EXPERIMENT 1 **4 Hours**

Install Virtualbox/VMware Workstation with different flavours of linux or windows OS on top of windows

EXPERIMENT 2 **4 Hours**

Install a C compiler in the virtual machine created using virtual box and execute Simple Programs

EXPERIMENT 3 **4 Hours**

Implement the procedure to transfer the files from one virtual machine to another virtual machine for reliable data access with the help of any open stack virtual machine.

EXPERIMENT 4 **4 Hours**

Install the single node private cloud environment to resource allocation

EXPERIMENT 5 **4 Hours**

Implement the procedure to create and deploy a simple web application in public cloud environment

EXPERIMENT 6 **4 Hours**

Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim

EXPERIMENT 7 **3 Hours**

Create and Deploy applications on Microsoft Windows Azure

EXPERIMENT 8 **3 Hours**

Install Hadoop single node cluster and run simple applications like word count.

Total: 45+30=75 Hours

Reference(s)

1. Rittinghouse, John W., and James F. Ransome, Cloud Computing: Implementation, Management and Security, CRC Press, 2017.

2. Barrie Sosinsky, Cloud Computing Bible, Wiley-India, 2014.

3. Adrian Mouat - Using Docker: Developing and Deploying software with containers, O Reilly Media, 2016.

4. George Reese, Cloud Application Architectures Building Applications and Infrastructure in the Cloud Transactional Systems for EC2 and Beyond (Theory in Practice), O Reilly, 2009., CRC Press, 2017

5. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, - Mastering Cloud Computing, Tata Mcgraw Hill, 2013.

6. IBM Cloud Computing http://www.ibm.com/cloud-computing/us/en

22CT607 **MINI PROJECT II** **0 0 2 1**

Course Objectives

- Identify the problem statement and apply the engineering concepts to find the solution.
- Improve the analysing capability of the students.
- Increase the exuberance in finding the solution to various problems.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PSO1: Demonstrate the knowledge and technical skills in software

development. PSO2: Develop practical competencies in Software and

Hardware Design

Course Outcomes (COs)

1. Apply a real-world problem, identify the requirement, and develop the design solutions.
2. Analyze technical ideas, strategies, and methodologies.
3. Analyze the new tools, algorithms, and techniques that contribute to obtaining the solution of the project.
4. Evaluate and validate through conformance of the developed prototype and analysis of the cost- effectiveness.
5. Create the report and present oral demonstrations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1	1	2	-	-	2	2	2	-	-	3	3
2	1	2	1	1	2	-	-	2	2	2	-	-	3	3
3	1	2	1	1	2	-	-	2	2	2	2	-	3	3
4	1	2	1	1	2	-	-	2	2	2	2	-	3	3
5	1	2	-	-	2	-	-	2	2	2	-	-	3	3

22CT701 BLOCKCHAIN TECHNOLOGY 3 0 2 4

Course Objectives

- Understand the concepts of block chain technology (mainly Bitcoin and Ethereum).
- Develop the models for block chain design for an application.
- Apply the security in block chain applications.
- Apply the concept of implementation support and design the evaluation techniques for block chain
- Analyze the cognitive models and explicate the concept of cognitive architecture.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Analyze the functional/operational aspects of cryptocurrency ECOSYSTEM.
2. Develop the emerging abstract models for block chain Technology.
3. Apply the research challenges and technical gaps existing between theory and practice in cryptocurrency domain.
4. Apply the concept of implementation block chain system by sending and reading transactions.
5. Design, build, and deploy a distributed application.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	-	-	-	-	-	-	-	-	-	-	2	-
2	-	2	2	2	-	-	-	-	-	-	-	-	2	-
3	3	3	3	-	2	-	-	-	-	-	-	-	2	-
4	-	2	2	-	3	-	-	-	-	-	-	-	3	-
5	-	2	3	-	2	-	-	-	-	-	-	-	3	-

UNIT I **9 Hours**

BASICS

The consensus problem - Asynchronous Byzantine Agreement - AAP protocol and its analysis - Nakamoto Consensus on permission-less, nameless, peer-to-peer network - Abstract Models for Blockchain - Garay model - RLA Model - Proof of Work (PoW) as random oracle - formal treatment of consistency, liveness and fairness - Proof of Stake (PoS) based Chains - Hybrid models (PoW + PoS).

UNIT II **9 Hours**

CRYPTOCURRENCY

cryptographic basics for cryptocurrency - short overview of Hashing, signature schemes, encryption schemes and elliptic curve cryptography

UNIT III **9 Hours**

CRYPTOCURRENCY REGULATION

Bitcoin - Wallet - Blocks - Merkley Tree - hardness of mining - transaction verifiability - anonymity - forks

- double spending - mathematical analysis of properties of Bitcoin

UNIT IV **9 Hours**

ETHEREUM

Ethereum - Ethereum Virtual Machine (EVM) - Wallets for Ethereum - Solidity - Smart Contracts - some attacks on smart contracts

UNIT V **9 Hours**

TRENDS AND MODELS

Zero Knowledge proofs and protocols in Blockchain - Succinct non interactive argument for Knowledge (SNARK) - pairing on Elliptic curves - Zcash

EXPERIMENT 1 **4 Hours**

Creating wallets and sending cryptocurrency

EXPERIMENT 2 **4 Hours**

Starting a Wordpress website

EXPERIMENT 3 **4 Hours**

Create blockchain explorer, Introduction to bitcoin (history, distributed P2P network, immutable ledger, forks and Byzantine Fault Tolerance

EXPERIMENT 4 **4 Hours**

Create your own cryptocurrency

EXPERIMENT 5 **4 Hours**

Tokenization and trading cryptocurrencies

EXPERIMENT 6 **4 Hours**

Start your own ICO

EXPERIMENT 7 **6 Hours**

Business applications and assessing blockchain projects

TOTAL: 45+30=75 HOURS

Reference(s)

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.
2. Joseph Bonneau et al, SoK: Research perspectives and challenges for Bitcoin and cryptocurrency, IEEE Symposium on security and Privacy, 2015
3. J.A.Garay et al, The bitcoin backbone protocol - analysis and applications EUROCRYPT 2015 LNCS VOl 9057, (Vol. II), pp 281-310.
4. R.Pass et al, Analysis of Blockchain protocol in Asynchronous networks , EUROCRYPT 2017, (eprint.iacr.org/2016/454) . A significant progress and consolidation of several principles)
5. Dr. Gavin Wood, "ETHEREUM: A Secure Decentralized Transaction Ledger,"Yellow paper.2014.

22CT702 **MOBILE APPLICATION DEVELOPMENT** **3 0 2 4**

Course Objectives
- Understand the basics of mobile application development
- Work with mobile app development platforms

Programme Outcomes (POs)

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)
1. Apply the basics of mobile application development
2. Apply the architecture of android application development
3. Analyze software using android
4. Evaluate applications using components of android framework
5. Create android applications including files and databases

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	2	2	-	-	-	-	-	-	-	-	-	3	-
2	-	2	2	-	-	-	-	-	-	-	-	-	2	-
3	-	3	3	-	-	-	-	-	-	-	-	-	2	-
4	-	2	2	-	-	-	-	-	-	-	-	-	2	-
5	-	2	2	-	-	-	-	-	-	-	-	-	2	-

UNIT I **9 Hours**
INTRODUCTION
Introduction to Android, Android versions and its feature set The various Android devices on the market, The Android Market application store, Android Development Environment - System Requirements, Android SDK, Installing Java, and ADT bundle - Eclipse Integrated Development Environment (IDE), Creating Android Virtual Devices (AVDs)

UNIT II **9 Hours**
ANDROID ARCHITECTURE OVERVIEW
The Android Software Stack, The Linux Kernel, Android Runtime - Dalvik Virtual Machine, Android Runtime Core Libraries, Dalvik VM Specific Libraries, Java Interoperability Libraries, Android Libraries, Application Framework, Creating a New Android Project, Defining the Project Name and SDK Settings, Project Configuration Settings, Configuring the Launcher Icon, Creating an Activity, Running the Application in the AVD, Stopping a Running Application, Modifying the Example Application, Reviewing the Layout and Resource Files

UNIT III **9 Hours**

ANDROID SOFTWARE DEVELOPMENT PLATFORM

Understanding Java SE and the Dalvik Virtual Machine, The Directory Structure of an Android Project, Common Default Resources Folders, The Values Folder, Leveraging Android XML, Screen Sizes, Launching Your Application: The AndroidManifest.xml File, Creating Your First Android Application

UNIT IV **9 Hours**

ANDROID FRAMEWORK OVERVIEW

Android Application Components, Android Activities: Defining the UI, Android Services: Processing in the Background, Broadcast Receivers: Announcements and Notifications Content Providers: Data Management, Android Intent Objects: Messaging for Components,Android Manifest XML: Declaring Your Components, Views and View Groups, Android Layout Managers, The View Hierarchy, Designing an Android User Interface using the Graphical Layout Tool

UNIT V **9 Hours**

FILES, CONTENT PROVIDERS, AND DATABASES

Saving and Loading Files, SQLite Databases, Android Database Design, Exposing Access to a Data Source through a Content Provider, Content Provider Registration, Native Content Providers

EXPERIMENT 1 4 Hours

Installation of Android studio and Development of Hello World Application

EXPERIMENT 2 4 Hours

Create an application that takes the name from a text box and shows hello message along with the name entered in text box, when the user clicks the OK button

EXPERIMENT 3 4 Hours

Create a screen that has input boxes for User Name, Password, Address, Gender (radio buttons for male and female), Age (numeric), Date of Birth (Date Picket), State (Spinner) and a Submit button. On clicking the submit button, print all the data below the Submit Button (use any layout)

EXPERIMENT 4 4 Hours

Design an android application to create page using Intent and one Button and pass the Values from one Activity to second Activity

EXPERIMENT 5 4 Hours

Design an android application Send SMS using Intent

EXPERIMENT 6 **6 Hours**

Create an android application using Fragments, Radio buttons and menu.

EXPERIMENT 7 **4 Hours**

Create a user registration application that stores the user details in a database table.

Total: 45+30=75 Hours

Reference(s)

1. Code Complete: A Practical Handbook of Software Construction, 2nd Edition by Steve McConnell.
2. Mobile Apps Made Simple: The Ultimate Guide to Quickly Creating, Designing and Utilizing Mobile Apps for Your Business, 2nd Edition by Jonathan McCallister
3. Android Application Development Cookbook- Second Edition by Rick Boyer and Kyle Mew

22CT707 **PROJECT WORK I** **0 0 4 2**

Course Objectives

- Work in teams to propose, formulate, and solve a challenging open-ended design problem of significant scope, depth, and breadth.
- Understand and incorporate engineering standards and multiple realistic constraints, within realistic design time, budget, and performance objectives.
- Develop a prototype of the proposed design and demonstrate the prototype in accordance with the specifications.
- Effectively communicate information relating to all aspects of the design process in written, oral, and graphical form.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1: Demonstrate the knowledge and technical skills in software development. PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Apply a real-world problem, identify the requirement and develop the design solutions.
2. Analyze technical ideas, strategies and methodologies.
3. Analyze the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Evaluate and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Create report and present the oral demonstrations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	3	3	1	3	3	3	3	3	-	2	3	3
2	2	2	3	3	1	3	3	3	3	3	-	2	3	3
3	2	2	3	3	3	3	3	3	3	3	2	2	3	3
4	2	2	3	3	3	3	3	3	3	3	2	2	3	3
5	2	2	-	-	2	-	-	3	3	3	-	2	3	3

22CT801 PROJECT WORK II 0 0 20 10

Course Objectives

- Work in teams to propose, formulate, and solve a challenging open-ended design problem of significant scope, depth, and breadth.
- Understand and incorporate engineering standards and multiple realistic constraints, within realistic design time, budget, and performance objectives.
- Develop a prototype of the proposed design and demonstrate the prototype in accordance with the specifications.
- Effectively communicate information relating to all aspects of the design process in written, oral, and graphical form.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
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PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1: Demonstrate the knowledge and technical skills in software development. PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Apply a real world problem, identify the requirement and develop the design solutions.
2. Analyze technical ideas, strategies and methodologies.
3. Analyze the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Evaluate and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Create report and present the oral demonstrations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	3	3	1	3	3	3	3	3	-	2	3	3
2	2	2	3	3	1	3	3	3	3	3	-	2	3	3
3	2	2	3	3	3	3	3	3	3	3	2	2	3	3
4	2	2	3	3	3	3	3	3	3	3	2	2	3	3
5	2	2	-	-	2	-	-	3	3	3	-	2	3	3

22HS201 **COMMUNICATIVE ENGLISH II** **1 0 2 2**

Course Objectives

- Command over the English language for day-to-day transactions.
- Improve listening and reading skills
- Enhance confidence in expressing with clarity and elegance

Programme Outcomes (POs)

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1: Demonstrate the knowledge and technical skills in software development.
PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Engage with the English language in functional contexts
2. Express in both descriptive and narrative formats
3. Understand and make effective use of the English Language in Business contexts
4. Actively read and comprehend authentic text
5. Express opinions and communicate experiences.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									3	3		3	1	1
2									3	3		3	1	1
3									3	3		3	1	1
4									3	3		3	1	1
5									3	3		3	1	1

UNIT I **15 Hours**

SELF-EXPRESSIONRESSION

Personal Goals and Values - Being a Team Player-Expressing strengths and weaknesses-Abstract nouns -Adjectives-Active Listening skills-Note making-Pronunciation and Accent Personal goals and values - Reading for Gist and Details-Professional ethics-Reported Speech- Conjunctions Reading skills - phonemics, word/phrase recognition, sight words Personal Goals and Values-Conditional clauses- Hypothetical questions and answers-Sentence Structure-Simple Present Tense-Perfect tense

UNIT II **15 Hours**

CREATIVE EXPRESSION

Instructive and Expository Expression - Creating brochures, catalogues, and manuals for products/ services, Giving directions, Process writing, Sequencing experiments, Concept explanation-Reported speech-Voice Sentence equivalence-Proofreading

UNIT III **15 Hours**

FORMAL EXPRESSION

Notices and Announcements-Writing: Creating notices and circulars for events, announcing college tours and lost and found-Varied Vocabulary - Gender Sensitive Vocabulary, Non-discriminatory Vocabulary, Concise Vocabulary-Paragraph writing - Effective titles, topics and supporting sentences, calling in registrations and queries. Effective communication- Understanding purpose, reach and target audience, achieving complete communication Punctuation - Capitalization, Numeration, Use of proper nouns and articles-Spelling-Reading: Analyzing and interpreting notices and circulars-Understanding the gist of short real-world notices, and messages. Culling out keywords Information words vs Supporting Words-Interpreting Abbreviations, Acronyms and Short-forms-Listening: Analyzing and interpreting announcements Decoding - Screening for salient points-Note Making-Raising queries for clarification-Speaking: Announcements-Giving complete information-Pronunciation and Enunciation Pace, Intonation, and Pitch-Conducting Events-Speaking: Master of ceremonies, short speeches - welcome speech, the vote of thanks/ valedictory speech, award-acceptance speech Writing: Invitations, Preparation of script/draft after interviewing someone. Adjectives-Pronunciation/ Punctuation Precision and Concision-Politeness markers

Total:15+30= 45 Hours

Reference(s)

1. Sasikumar, V, et.al. A Course in Listening & Speaking FoundationBooks, 2005.
2. Murphy, Raymond. English Grammar in Use: A Self-Study Reference and Practice Book for Intermediate Students: with Answers. Cambridge: Cambridge University Press, 1985.
3. Prasad, Hari Mohan. A Handbook of Spotting Errors. Mcgraw Hill Education, 2010.
4. Reynolds, John. Cambridge First Language English. 2018th ed., Hodder Education, 2018.
5. Wiggins, Grant P., and Jay McTighe. Understanding by Design. Association for Supervision and Curriculum Development, 2008.

22HSH01 **HINDI** **1 0 2 2**

Course Objectives

- To help students acquire the basics of Hindi
- To teach them how to converse in Hindi on simple day- to -day situations
- To help students understand a simple technical text in Hindi

Programme Outcomes (POs)

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Construct simple sentences and use vocabulary required for day- to -day conversation.
2. Distinguish and understand the basic sounds of Hindi language.
3. Apply appropriate grammar to write and speak in Hindi language
4. Comprehend the conversation and give correct meaning
5. Take up Hindi examinations conducted by Dakshin Bharat Hindi Prachar Sabha

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									3	3				
2									3	3				
3									3	3				
4									3	3				
5									3	3				

UNIT I **9 Hours**

VOWELS AND CONSONANTS

Hindi Alphabet: Introduction (Self introduction) - Vowels - Consonants - Plosives - Fricatives - Nasal sounds - Vowel Signs - Chandra Bindu & Visarg -Table of Alphabet -Vocabulary.

UNIT II **9 Hours**

NOUNS

Nouns: Genders -Masculine & Feminine -Reading Exercises

UNIT III **9 Hours**

PRONOUNS AND TENSES

Pronouns and Tenses - Categories of Pronouns - Personal Pronouns - Second person (you & honorific) - Definite & Indefinite pronouns - Relative pronouns - Present tense - Past tense - Future tense - Assertive & Negative Sentences - Interrogative Sentences.

UNIT IV **9 Hours**

CLASSIFIED VOCABULARY

Classified Vocabulary: Parts of body -Relatives Spices Eatables -Fruit & Vegetables -Clothes - Directions -Seasons Professions.

UNIT V **9 Hours**

CONVERSATIONS

Speaking -Telling the times -Saying the Numbers from 1 to 50 Speaking practice for various occasions.

Total: 15+30= 45 Hours

Reference(s)

1. B.R. Kishore, Self Hindi Teacher for Non-Hindi Speaking People, Vee Kumar Publications (P) Ltd., New Delhi, 2009.
2. Hindi Prachar Vahini - 1
3. Videos, Stories, Rhymes and Songs.

22HSG01 **GERMAN** **1 0 2 2**

Course Objectives

- To help students appear for the A1 level Examination
- To teach them how to converse fluently in German in day-to-day scenarios

Programme Outcomes (POs)

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Listen and identify individual sounds of German
2. use basic phonemes and words while speaking
3. read and understand short passages on familiar topics
4. use basic sentence structures while writing
5. understand basic grammar and appropriate vocabulary in completing language tasks

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									3	3				
2									3	3				
3									3	3				
4									3	3				
5									3	3				

UNIT I **9 Hours**

INTRODUCTION

Introduction to the German language-Alphabets-Numbers Greetings -Days and Seasons-Working with Dictionary.

UNIT II **9 Hours**

LANGUAGE AND ITS COMMON USE

Nouns -articles-Speaking about oneself-Listening to CD supplied with books-paying special attention to pronunciation

UNIT III **9 Hours**

TECHNICAL DEUTSCHE

Regular &Irregular verbs -Personal pronouns-family-Introduction to types of sentences

UNIT IV **9 Hours**

INTERROGATION

Question words -Types of Questions -Nominative case-Verb Conjugation -country -nationalities

UNIT V **9 Hours**

IMPLEMENTATION

Verbs to be & to have -conjugation -Hobbies -Framing basic Questions and answers

Total: 15+30= 45 Hours

Reference(s)

1. Kursbuch and Arbeitsbuch, NETZWERK A1 DEUTSCH ALS FREMDSPRACHE, Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2015.
2. Langenscheidt Eurodictionary, German English / English German, Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2009.
3. Grundkurs, DEUTSCH Lehrbuch Hueber Munichen, 2007.

22HSJ01 **JAPANESE** **1 0 2 2**

Course Objectives

- To train students for N5 Level Examination
- To teach them use basic Japanese sentences in day-to-day conversation
- To make students familiar with the Japanese cultural facets and social etiquette

Programme Outcomes (POs)

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Recognize and write Japanese alphabet
2. Speak using basic sounds of the Japanese language
3. Apply appropriate vocabulary needed for simple conversation in Japanese language
4. Apply appropriate grammar to write and speak in Japanese language
5. Comprehend the conversation and give correct meaning

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									3	3				
2									3	3				
3									3	3				
4									3	3				
5									3	3				

UNIT I **9 Hours**

SELF INTRODUCTION / DEMONSTRATIVES / NOUN MODIFIERS

Introduction to Japanese Japanese script - Pronunciation of Japanese(Hiragana (Katakana) Long vowels - Pronunciation of in,tsu,ga -Letters combined with ya,yu,yo - Daily Greetings and Expressions - Numerals. Speaking: Self Introduction -
Listening: Listening to Greetings, Listening to specific information: Numbers, Time

UNIT II **9 Hours**

TIME EXPRESSION / VERBS - PAST

Introduction to time -Introduction of verbs -Listening to specific information

UNIT III **9 Hours**

ADJECTIVES

Word Sentence -Introduction to Adjectives -Technical Japanese Vocabulary -Pair Activity Day to day situational conversation
Listening to Japanese Alphabet Pronunciation -Simple Conversation

UNIT IV **9 Hours**

CONJUGATION OF II ADJECTIVE

Past tense of Noun sentences and Na adjective sentences -Past tense of ii adjective sentences -houga adjective desu -Technical Japanese Vocabulary -Individual Activity - Listening to conversation with related particles

UNIT V **9 Hours**

CONJUGATION OF VERBS - TE FORM / TA FORM / NAI FORM / PLAIN FORM

N gahoshidesu - V masu form tai desu - Verb te form - Technical Japanese Vocabulary -Listening to different Counters, simple conversations with verbs and adjectives

Total: 15+30= 45 Hours

Reference(s)

1. Minna no Nihongo Japanese for Everyone Elementary Main Textbook1-1, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.
2. Minna no Nihongo Japanese for Everyone Elementary Main Textbook 1-2 Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

22HSF01 FRENCH 1 0 2 2

Course Objectives

- To prepare the students for DELF A1 Examination
- To teach them to converse fluently in French in day-to-day scenarios

Programme Outcomes (POs)

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Help students acquire familiarity in the French alphabet & basic vocabulary
2. Listen and identify individual sounds of French
3. Use basic sounds and words while speaking
4. Read and understand short passages on familiar topics
5. Understand and use basic grammar and appropriate vocabulary in completing language tasks

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									3	3				
2									3	3				
3									3	3				
4									3	3				
5									3	3		-		

UNIT I 9 Hours

ENTRER EN CONTACT

La langue franÃƒÂ§aise, alphabets, les numÃƒÂ©ros, les jours, les mois. Grammaire Les verbes s appeler, etre, avoir, les articles definis, indefinis Communication Saluer, s informer sur quelqu un, demander de se presenter Lexique L alphabet, les nationalites, l age, les pays, les couleurs, les jours de la semaine, les mois de l annee, les professions

UNIT II 9 Hours

PARTAGER SON LIEU DE VIE

Les francais et leur habitat, des habitations insolites -Grammaire Verbes Conjugaison Present (Avoir / Etre / ER, IR, RE Regulier et Irregulier) Adjectifs les propositions de lieu Communication Chercher un logement, decrire son voisin, s informer sur un logement - Lexique L habitat, les pieces, l equipement, la description physique

UNIT III **9 Hours**

VIVRE AU QUOTIDIEN LES LOISIRS DES FRANCAIS, LES GOUTS DES AUTRES, LES ACTIVITES QUOTIDIENNES

Grammaire Articles contractes, verbes vouloir, pouvoir, devoir, adjectifs interrogatifs, future proche Communication Exprimer ses gouts, parler de ses loisirs, justifier un choix, exprimer une envie - Lexique le temps libre et les loisirs, les saisons, les activites quotidiennes, le temps (le matin, le soir, la nuit)

UNIT IV **9 Hours**

COMPRENDRE SON ENVIRONNEMENT SOUVRIR A LA CULTURE

Grammaire Verbes Finir, Sortir, les adjectifs demonstratifs, le passe compose, l imparfait Communication Propose a quelqu un de faire quelque chose, raconter une sortie au passe, parler d un film Lexique Les sorties, la famille, l art, les vetements et les accessoires

UNIT V **9 Hours**

GOUTER A LA CAMPAGNE

Grammaire La forme negative, les verbes acheter, manger, payer, articles partitifs, le pronom en de quantite

Communication Accepter et refuser une invitation, donner des instructions, commander au restaurant Lexique Les services et les commerces, les aliments, les ustensiles, l argent

Total: 15+30= 45 Hours

Reference(s)

1. Grammaire Progressive du Francais, CLE International, 2010
2. Saison1, Marie Noelle Cocton et al, Didier, 2014.
3. Preparation a l examen du DELF A1 Hachette
4. Reussir le DELF A1 Bruno Girardeau
5. Website: Francais Linguaphone Linguaphone Institute Ltd., London, 2000.
6. Francais Harrisonburg : The Rosetta Stone : Fairfield Language Technologies, 2001

22CT001/ 22CTH01 EXPLORATORY DATA ANALYSIS 2 0 2 3

Course Objectives

- To outline an overview of exploratory data analysis.
- To implement data cleaning and preparation techniques.
- To perform descriptive statistics and data visualization techniques to present insights from the data.
- To apply univariate, bivariate, multivariate, correlation, and time series data exploration and analysis techniques
- To use dimensionality reduction techniques for simplifying complex datasets and visualize high dimensional data.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Analyze the fundamentals of exploratory data analysis
2. Apply the data cleaning and preparation techniques on the provided dataset.
3. Apply advanced data visualization techniques to explore complex relationships and patterns in the data
4. Analyze the relationships between variables using EDA analysis techniques to gain insights into complex data patterns
5. Apply dimensionality reduction techniques, such as Principal Component Analysis (PCA), to simplify complex datasets and extract essential features

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	3	3	3	-	-	-	-	-	-	-	-	2
2	2	2	2	3	3	-	-	-	-	-	-	-	-	3
3	2	3	2	2	3	-	-	-	-	-	-	-	-	2
4	2	2	2	2	3	-	-	-	-	-	-	-	-	2
5	2	2	3	2	1	-	-	-	-	-	-	-	-	2

UNIT I **6 Hours**

EXPLORATORY DATA ANALYSIS

Overview of Exploratory Data Analysis- importance of EDA - data analysis process: data collection, data cleaning, and data exploration- Introduction to common data types and formats - Introduction to Python - data analysis libraries.

UNIT II **6 Hours**

DATA CLEANING AND PREPARATION

Introduction to data quality issues and common data cleaning techniques - Handling missing data and outliers - Data transformation techniques - Feature engineering and variable creation.

UNIT III **6 Hours**

DESCRIPTIVE STATISTICS AND DATA VISUALIZATION

Descriptive statistics: measures of central tendency, dispersion, and shape - Data visualization principles and best practices - Exploratory data visualization using Matplotlib and Seaborn

UNIT IV **6 Hours**

EXPLORATORY DATA ANALYSIS TECHNIQUES

Univariate analysis: exploring single variables - Bivariate analysis: exploring relationships between variables - Multivariate analysis: analyzing relationships among multiple variables - Exploring time series data.

UNIT V **6 Hours**

DIMENSIONALITY REDUCTION TECHNIQUES

Introduction to dimensionality reduction - Principal Component Analysis (PCA) and its applications - Distributed Stochastic Neighbor Embedding (t-SNE) for visualization.

EXPERIMENT 1 10 Hours

Apply the data preprocessing methods on the given Sstudent test performance dataset and visualize the results.

EXPERIMENT 2 5 Hours

Perform univariate analysis to analyze the distribution of each variable in student’s exam results dataset and visualize the results.

EXPERIMENT 3 5 Hours

Visualize the relationship between the features on students' exam results analysis dataset using bivariate analysis.

EXPERIMENT 4 5 Hours

Visualize the relationship between the features on students' exam results analysis dataset using multivariate analysis.

EXPERIMENT 5 **5 Hours**

Implement the program to reduce the dimensionality of the MNIST dataset and visualize the reduced data using a scatter plot.

Total:30+30= 60 Hours

Reference(s)

1. Provost, Foster, and Tom Fawcett. “Data Science for Business: What you need to know about data mining and data-analytic thinking " O'Reilly Media, Inc.", 2013. (Unit 1)
2. McKinney, Wes. “Python for Data Analysis." O'Reilly Media, Inc.", 2022. (Unit 1, 3, 5)
3. Knaflic, Cole Nussbaumer. “Storytelling with data: A data visualization guide for business professionals”. John Wiley & Sons, 2015. (Unit 2)
4. Kazil, Jacqueline, and Katharine Jarmul. “Data wrangling with python: tips and tools to make your life easier. " O'Reilly Media, Inc.", 2016. (Unit 3)
5. Wickham, Hadley, and Garrett Grolemund. “R for data science: import, tidy, transform, visualize, and model data. " O'Reilly Media, Inc.", 2016. (Unit 4, 5)
6. Matthew O. Ward, Georges Grinstein, Daniel Keim, “Interactive Data Visualization: Foundations, Techniques, and Applications”, 2nd Edition, CRC press, 2015

22CT002 / 22CTH02 RECOMMENDER SYSTEMS 3 0 0 3

Course Objectives

- To understand the foundations of the recommender system.
- To learn the significance of machine learning and data mining algorithms for Recommender Systems
- To learn about collaborative filtering
- To make students design and implement a recommender system.
- To learn collaborative filtering

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Analyze different recommender system types, data mining methods, and dimensionality reduction techniques.
2. Apply content-based filtering by building item and user profiles using similarity and classification methods.
3. Analyze collaborative filtering techniques, including rating normalization, similarity computation, and neighborhood selection.
4. Apply attack detection and robust recommendation strategies to enhance system security.
5. Analyze evaluation metrics and paradigms to assess recommender system performance and limitations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	1	2	1	-	2	1	-	-	-	-	-	2
2	1	2	1	1	1	-	1	1	-	-	-	-	-	2
3	2	3	1	1	1	-	1	1	-	-	-	-	-	3
4	3	2	2	2	1	-	2	1	-	-	-	-	-	2
5	2	2	1	2	1	-	2	1	-	-	-	-	-	2

UNIT I **9 Hours**

INTRODUCTION

Introduction and basic taxonomy of recommender systems - Traditional and non-personalized Recommender Systems - Overview of data mining methods for recommender systems- similarity measures- Dimensionality reduction – Singular Value Decomposition (SVD)

UNIT II **9 Hours**

CONTENT-BASED RECOMMENDATION SYSTEMS

High-level architecture of content-based systems - Item profiles, Representing item profiles, Methods for learning user profiles, Similarity-based retrieval, and Classification algorithms.

UNIT III **9 Hours**

COLLABORATIVE FILTERING

A systematic approach, Nearest-neighbor collaborative filtering (CF), user-based and item-based CF, components of neighborhood methods (rating normalization, similarity weight computation, and neighborhood selection

UNIT IV **9 Hours**

ATTACK-RESISTANT RECOMMENDER SYSTEMS

Introduction – Types of Attacks – Detecting attacks on recommender systems – Individual attack – Group attack – Strategies for robust recommender design - Robust recommendation algorithms.

UNIT V **9 Hours**

EVALUATING RECOMMENDER SYSTEMS

Evaluating Paradigms – User Studies – Online and Offline evaluation – Goals of evaluation design – Design Issues – Accuracy metrics – Limitations of Evaluation measures

Total: 45 Hours

Reference(s)

1. Charu C. Aggarwal, Recommender Systems: The Textbook, Springer, 2016.
2. Dietmar Jannach , Markus Zanker , Alexander Felfernig and Gerhard Friedrich , Recommender Systems: An Introduction, Cambridge University Press (2011), 1st ed.
3. Francesco Ricci , Lior Rokach , Bracha Shapira , Recommender Systems Handbook, 1st ed, Springer (2011),
4. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of massive datasets, 3rd edition, Cambridge University Press, 2020

22CT003 / 22CTH03 BIG DATA ANALYTICS 3 0 0 3

Course Objectives

- Acquire a deep understanding of big data and NoSQL.
- Develop expertise in mapreduce analytics using Hadoop and related tools
- Explore the Hadoop related tools for Big Data Analytics

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1 Analyze the big data technologies and use cases for respective business domains.
2 Analyze the NoSQL databases and its related concepts.
3 Apply Map reduce workflows for web applications.
4 Analyze the basic concepts of Hadoop.
5 Apply Hadoop related tools for Big Data Analytics.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1	-	1	-	2	-	-	-	-	-	2	1
2	2	2	3	-	3	-	2	-	-	-	-	-	2	2
3	1	3	3	-	3	-	1	-	-	-	-	-	2	2
4	2	2	2	-	3	-	2	-	-	-	-	-	1	2
5	2	2	1	-	3	-	2	-	-	-	-	-	1	3

UNIT I **9 Hours**

UNDERSTANDING BIG DATA

Introduction to big data – Convergence of key trends – Unstructured data – Industry examples of big data – Web analytics – Big data applications– Big data technologies – Introduction to Hadoop – Open source technologies – Cloud and big data – Mobile business intelligence – Crowd sourcing analytics – Inter and trans firewall analytics.

UNIT II **9 Hours**

NOSQL DATA MANAGEMENT

Introduction to NoSQL – Aggregate data models – Key-value and document data models –Relationships – Graph databases – Schema less databases – Materialized views – Distribution models – Master-slave replication – Consistency - Cassandra – Cassandra data model – Cassandra examples –Cassandra clients

UNIT III **9 Hours**

MAP REDUCE APPLICATIONS

MapReduce workflows – Unit tests with MRUnit – Test data and local tests – Anatomy of MapReduce job run – Classic Map-reduce – YARN – Failures in classic Map-reduce and YARN – Job scheduling – Shuffle and sort – Task execution – MapReduce types – Input formats – Output formats

UNIT IV **9 Hours**

BASICS OF HADOOP

Data format – Analyzing data with Hadoop – Scaling out – Hadoop streaming – Hadoop pipes – Design of Hadoop distributed file system (HDFS) – HDFS concepts – Java interface – Data flow – Hadoop I/O – Data integrity – Compression – Serialization – Avro – File-based data structures - Cassandra – Hadoop integration.

UNIT V **9 Hours**

HADOOP RELATED TOOLS

Hbase – Data model and implementations – Hbase clients – Hbase examples – Praxis. Pig – Grunt –Pig data model – Pig Latin – Developing and testing Pig Latin scripts. Hive – Data types and file formats – HiveQL data definition – HiveQL data manipulation – HiveQL queries.

Total: 45 Hours

Reference(s)

1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley,2013.
2. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
3. Sadalage, Pramod J. "NoSQL distilled", 2013
4. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
5. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
6. Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010.
7. Alan Gates, "Programming Pig", O'Reilley, 2011.

22CT004 / 22CTH04 NEURAL NETWORKS AND DEEP LEARNING 2 0 2 3

Course Objectives

- To understand the major concepts in deep neural networks.
- To apply Convolutional Neural Network architectures for any real-life applications
- To analyze the key computations underlying deep learning to build and train deep neural networks for various tasks

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1 Build Artificial neural network by analyzing the concept behind the model.
2 Analyze the algorithms used for associative memory and unsupervised learning networks.
3 Apply Convolutional Neural Networks and its variants for web and mobile applications.
4 Build and train the deep learning neural network models.
5 Apply autoencoders and generative models for given application.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1	-	1	-	-	1	-	-	-	-	2	-
2	2	2	3	-	3	-	2	2	-	-	-	-	2	-
3	1	3	3	-	3	-	2	2	-	-	-	-	2	-
4	2	2	2	-	3	-	2	2	-	-	-	-	2	-
5	2	2	1	-	3	-	2	2	-	-	-	-	2	-

UNIT I **6 Hours**

UNDERSTANDING NEURAL NETWORKS

Neural Networks-Application Scope of Neural Networks-Artificial Neural Network: An Introduction Evolution of Neural Networks-Basic Models of Artificial Neural Network- Important Terminologies of ANNs-Supervised Learning Network.

UNIT II **6 Hours**

ASSOCIATIVE MEMORY AND UNSUPERVISED LEARNING NETWORKS

Training Algorithms for Pattern Association-Autoassociative Memory Network-Heteroassociative Memory Network-Bidirectional Associative Memory (BAM)-Hopfield Networks-Kohonen Self-Organizing Feature Maps-Learning Vector Quantization-Counter propagation Networks-Adaptive Resonance Theory Network.

UNIT III **6 Hours**

THIRD-GENERATION NEURAL NETWORKS

Spiking Neural Networks-Convolutional Neural Networks - Deep Learning Neural Networks - Extreme Learning Machine Model - Convolutional Neural Networks: The Convolution Operation - Motivation Pooling - Variants of the basic Convolution Function - Computer Vision.

UNIT IV **6 Hours**

DEEP FEEDFORWARD NETWORKS

History of Deep Learning - A Probabilistic Theory of Deep Learning - Gradient Learning Chain Rule and Backpropagation - Regularization Dataset - Augmentation Noise - Robustness Early Stopping, Bagging and Dropout batch normalization - Transposed convolution, object detection, semantic segmentation.

UNIT V **6 Hours**

RECURRENT NEURAL NETWORKS

Recurrent Neural Networks - Introduction Recursive Neural Networks - Bidirectional RNNs - Deep Recurrent Networks Applications: Image Generation, Image Compression, Natural Language Processing. long-short term memory (LSTM) - Complete Auto encoder - generative adversarial networks – Transfer Learning.

EXPERIMENT 1 — 3 Hours

Implement simple vector addition in TensorFlow.

EXPERIMENT 2 — 3 Hours

Implement a regression model in Keras.

EXPERIMENT 3 — 3 Hours

Implement a perceptron in TensorFlow/Keras Environment.

EXPERIMENT 4 — 3 Hours

Implement a Feed-Forward Network in TensorFlow/Keras.

EXPERIMENT 5 — 3 Hours

Implement an Image Classifier using CNN in TensorFlow/Keras.

EXPERIMENT 6 **3 Hours**

Improve the Deep learning model by fine tuning hyper parameters.

EXPERIMENT 7 **3 Hours**

Implement a Transfer Learning concept in Image Classification.

EXPERIMENT 8 **3 Hours**

Using a pre trained model on Keras for Transfer Learning

EXPERIMENT 9 **3 Hours**

Perform Sentiment Analysis using RNN

EXPERIMENT 10 **3 Hours**

Implement an LSTM based Autoencoder in TensorFlow/Keras.

Total:30+30= 60 Hours

Reference(s)

1. S Rajasekaran, G A Vijayalakshmi Pai, "Neural Networks, FuzzyLogic and Genetic Algorithm, Synthesis and Applications", PHI Learning, 2017
2. Charu C. Aggarwal, "Neural Networks and Deep Learning: A Textbook", Springer International Publishing, 1st Edition, 2018.
3. James A Freeman, David M S Kapura, "Neural Networks Algorithms, Applications, and Programming Techniques", Addison Wesley, 2003.
4. Magnus Ekman, Addison-Wesley, Learning Deep Learning, 2021.
5. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016.
6. Francois Chollet,Deep Learning with Python, Second Edition, Manning Publications, 2021.
7. Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020.

22CT005 / 22CTH05 NATURAL LANGUAGE PROCESSING 2 0 2 3

Course Objectives

- To understand the fundamental concepts for natural language processing and automatic speech recognition
- To understand technologies involved in developing speech and language applications.
- To demonstrate the use of deep learning for building applications in speech and natural language processing

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Understand basic knowledge, theories and methods in natural language processing.
2. Apply text processing and feature representation techniques for text mining.
3. Apply NLP for sentiment classification, named entity recognition, text summarization, machine translation, and modern deep learning models.
4. Apply fundamental principles of speech production and perception and analyze speech signals.
5. Design automatic speech recognition systems and develop applications for speaker recognition

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1	-	1	-	-	-	-	-	-	-	2	-
2	2	2	3	-	3	-	2	2	-	3	-	-	2	-
3	1	3	3	-	3	-	2	2	-	2	-	-	2	-
4	2	2	2	-	3	-	2	2	-	2	-	-	2	-
5	2	2	1	-	3	-	2	2	-	2	-	-	2	-

UNIT I **6 Hours**

INTRODUCTION TO NATURAL LANGUAGE PROCESSING

Overview of NLP - Introduction to Levels of NLP - Morhpology: Derivational & Inflectional Morphology
- POS tagging - Parsing: Shallow and Dependency Parsing, Semantics: Word Level Semantics and Thematic roles.

UNIT II **6 Hours**

TEXT PROCESSING AND FEATURE REPRESENTATION

Introduction to Corpora, Sentence Segmentation, Stemming: Porter Stemmer, Bag of words and Vector Space Model, Topic Modeling, N-gram Language Model, Smoothing, Word Embeddings: Word2Vec, Glove and Fasttext.

UNIT III **6 Hours**

APPLICATIONS OF NLP

Sentiment Classification using ML & DL models, Named Entity Recognition - CRF and LSTMs, Text Summarization - Statistical and Deep Learning models - Machine Translation - Encoder & Decoder Model, Attention Models, Question Answering - Knowledge based Q&A and Deep Learning models for Q&A.

UNIT IV **6 Hours**

SPEECH PROCESSING AND FEATURE REPRESENTATION OF SPEECH SIGNAL

Fundamentals of speech production – Perception of sound – Vocal tract model – Phonetics - Short-Time analysis of the signal – Energy – Zero crossing – Autocorrelation – Short time Fourier analysis - Mel Frequency Cepstral Coeffecients, Perceptual linear prediction (PLP), Linear prediction cepstral coefficients (LPCC), Gammatone Frequency Cepstral Coefficients (GFCC), i-vector.

UNIT V **6 Hours**

AUTOMATIC SPEECH AND SPEAKER RECOGNITION

Automatic Speech recognition formulation: Isolated word recognition – Large vocabulary continuous speech recognition - HMM/GMM based speech recognition – DNN/HMM model -- CNN based speech recognition - RNN language Models – Evaluation metrics, Speaker - recognition model – Alexa/Google assistant based application development.

EXPERIMENT 1 **3 Hours**

POS Tagging and Parsing using various python packages.

EXPERIMENT 2 **3 Hours**

Implementing N-gram language models for next word prediction.

EXPERIMENT 3 **3 Hours**

Implementing Word embedding based text classification.

EXPERIMENT 4 **3 Hours**

Implementing CNN for sentiment analysis.

EXPERIMENT 5 **3 Hours**

Implementing RNN for Named Entity recognition.

EXPERIMENT 6 **3 Hours**

Implementing text summarization using deep learning.

EXPERIMENT 7 **3 Hours**

Implementing chatbot using deep learning.

EXPERIMENT 8 **3 Hours**

Developing speech recognition system to recognize voice commands

EXPERIMENT 9 **3 Hours**

Developing speech recognition system to recognize continuous speech

EXPERIMENT 10 **3 Hours**

Implementing CNN based speech recognition using mel spectal images.

Total:30+30= 60 Hours

REFERENCE(S)

1. Dan Jurafsky, James H. Martin "Speech and Language Processing", Draft of 3rd Edition,Prentice Hall 2022.
2. Jacob Benesty, M. M. Sondhi, Yiteng Huang "Springer Handbook of Speech Processing", Springer, 2008.
3. Uday Kamath, John Liu, James Whitaker "Deep Learning for NLP and Speech Recognition" Springer, ,2019.
4. Steven Bird, Ewan Klein, Edward Loper "Natural Language Processing with Python", O'Reilly Media. 2009.
5. Ben Gold, Nelson Morgan, Dan Ellis "Speech and Audio Signal Processing: Processing and Perception of Speech and Music", John Wiley & Sons, 2011.

22CT006 / 22CTH06 COMPUTER VISION 2 0 2 3

Course Objectives

- To understand the fundamental concepts related to Image formation and processing
- To learn feature detection, matching and detection
- To become familiar with feature based alignment, motion estimation and 3D reconstruction
- To understand image based rendering and recognition.
- To learn to detect and analysis objects from motion or scene

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Understand basic knowledge, theories and methods in image processing and computer vision.
2. Implement image processing techniques in OpenCV.
3. Apply 2D feature-based based image alignment, segmentation, motion estimations and 3D image reconstruction techniques
4. Design and develop innovative image processing and computer vision applications.
5. Apply the concept in understanding the scene and process the background part of the image

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	1	1	1	-	-	-	2	1	3	2	2	-
2	3	3	3	2	3	-	2	-	2	1	2	2	3	-
3	3	3	2	2	3	-	-	-	1	1	2	2	3	-
4	2	3	3	2	3	-	-	-	2	1	2	3	2	-
5	2	3	3	2	2	2	-	-	2	1	2	3	3	-

UNIT I **6 Hours**

INTRODUCTION TO IMAGE FORMATION AND PROCESSING

Computer Vision Geometric primitives and transformations Photometric image formation The digital camera Point operators Linear filtering More neighborhood operators Fourier transforms Pyramids and wavelets Geometric transformations Global optimization.

UNIT II **6 Hours**

FEATURE DETECTION, MATCHING AND SEGMENTATION

Points and patches - Edge detection - Edges Lines Segmentation - Region Based Segmentation - Graph Based segmentation - Active contours - Split and merge Mean shift and mode finding - Normalized cuts Graph cuts and energy-based methods.

UNIT III **6 Hours**

FEATURE-BASED ALIGNMENT AND 3D RECONSTRUCTION

2D and 3D feature-based alignment Pose estimation Geometric intrinsic calibration - Triangulation Two frame structure from motion - Shape from X Active range finding - Surface representations - Point based representations - Volumetric representations - Model based reconstruction.

UNIT IV **6 Hours**

IMAGE-BASED RENDERING AND RECOGNITION

View interpolation Layered depth images Light fields - Video based Rendering - Object detection - Face recognition - Instance recognition - Category recognition Context and scene understanding

UNIT V **6 Hours**

MOTION ANALYSIS AND SCENE ANALYSIS

Optical Flow – Detection and Correspondence of Interest Points - Detection of Motion Patterns – Video Tracking – Motion Models to aid tracking: Kalman Filters - stereo mapping - image fusion - Detection of known objects by linear filters - Detection of unknown objects - Corner detection - image tagging.

EXPERIMENT 1 **3 Hours**

Perform histogram equalization on the image.

EXPERIMENT 2 **3 Hours**

Perform the edge detection process and extract edges from the input image

EXPERIMENT 3 **5 Hours**

Perform segmentation, extract and display the segmented region.

EXPERIMENT 4 **4 Hours**

Program to detect an object from the input frame.

EXPERIMENT 5 **5 Hours**

Program to track the object between two frames from image/video.

EXPERIMENT 6 **5 Hours**

Program to demonstrate to understand a scene and generate caption.

EXPERIMENT 7 **5 Hours**

Program to classify defective object from the correct object.

Total:30+30= 60 Hours

REFERENCE(S)

1. Richard Szeliski, Computer Vision Algorithms and Applications, Springer- Texts in Computer Science, Second Edition, 2022.
2. Computer Vision A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.
3. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
4. Christopher M. Bishop Pattern Recognition and Machine Learning, Springer, 2006.
5. E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.
6. Jurgen Beyerer, Fernando Puente Leon, Christian Frese," Machine Vision Automated Visual Inspection: Theory, Practice and Applications", 2016, Springer
7. AI Bovik, "The Essential Guide to Image Processing", 2009, Academic Press

22CT007 AGILE SOFTWARE DEVELOPMENT 3 0 0 3

Course Objectives

- To provide students with a theoretical as well as practical understanding of agile software development practices.
- To understand the Agile Scrum framework and development practices.
- To apply software design principles and refactoring techniques to achieve agility.
- To understand Agile requirements and perform testing activities within an agile project.
- To understand the benefits and pitfalls of working in an Agile team in terms of qualityassurance.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1: Demonstrate the knowledge and technical skills in software development.
PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Apply the Agile principles and manifesto in the software development.
2. Analyze the working methodology of types of Agile frameworks
3. Apply agility in software development processes.
4. Analyze the impact of agility in requirement engineering.
5. Analyze techniques used by Agile team for improving quality.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	-	2	-	-	-	-	-	-	-	-	2	2	-
2	1	2	2	-	-	2	-	-	-	-	-	-	2	-
3	1	2	2	-	2	2	-	-	-	-	-	2	2	-
4	1	2	2	-	2	2	-	-	-	-	-	2	2	-
5	1	1	1	-	2	2	-	-	-	-	-	2	2	-

UNIT I 9 Hours

AGILE METHODOLOGY

Theories for Agile management – agile software development – traditional model vs. agile model - classification of agile methods – agile manifesto and principles – agile project management – agile team interactions – ethics in agile teams - agility in design, testing – agile documentations – agile drivers, capabilities and values.

UNIT II 9 Hours
AGILE PROCESSES
Extreme Programming: Method overview – lifecycle – work products, roles and practices- Lean production - SCRUM, Crystal, Feature Driven Development, Adaptive SoftwareDevelopment, Kanban model.

UNIT III 9 Hours
AGILITY AND KNOWLEDGE MANAGEMENT
Agile information systems – agile decision making - Earls schools of KM – institutionalknowledge evolution cycle – development, acquisition, refinement, distribution, deployment, leveraging – KM in software engineering – managing software knowledge – challenges of migrating to agile methodologies – agile knowledge sharing – role of story-cards – Story-card Maturity Model (SMM).

UNIT IV 9 Hours
AGILITY AND REQUIREMENTS ENGINEERING
Impact of agile processes in RE – current agile practices – variance – overview of RE using agile– managing unstable requirements – requirements elicitation – agile requirements abstraction model – requirements management in agile environment, agile requirements prioritization – agilerequirements modeling and generation – concurrency in agile requirements generation
UNIT V 9 Hours
AGILITY AND QUALITY ASSURANCE
Agile Interaction Design - Agile product development – Agile Metrics – Feature Driven Development (FDD) – Financial and Production Metrics in FDD – Agile approach to Quality Assurance - Test Driven Development – Pair programming: Issues and Challenges - Agile approach to Global Software Development.

Total: 45 Hours

Reference(s)
1. Dingsoyr, Torgeir, Dyba, Tore, Moe, Nils Brede (Eds.), ―Agile Software Development,Current Research and Future Directions‖, Springer-Verlag Berlin Heidelberg, 2010
2. David J. Anderson; Eli Schragenheim, ―Agile Management for Software Engineering:Applying the Theory of Constraints for Business Results‖, Prentice Hall, 2003
3. Hazza & Dubinsky, ―Agile Software Engineering, Series: Undergraduate Topics inComputer Science‖, Springer, VIII edition, 2009
4. Craig Larman, ―Agile and Iterative Development: A manager's Guide, Addison-Wesley,2004
5. Kevin C. Desouza, ―Agile information systems: conceptualization, construction, and management‖, Butterworth-Heinemann, 2007.

22CT008 UI AND UX DESIGN 3 0 0 3

Course Objectives

- Study about designing web pages and understand the difference between UI and UX Design.
- To understand the concept of UX design and how it has evolved Able o to understand UX designprocess and methodology.
- Learning the Importance and scope of Interaction design, User centered design

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Understand to do user research, persona mapping, customer journey mapping
2. Design of interactive products Methods of interaction design Tools for interaction design
3. Design wireframes on paper and translate paper concepts into digital wireframes.
4. Apply and practice the techniques involved in designing digital wireframes using various UI elements
.
5. Implement the process of conducting usability tests Learning steps for digital products.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	-	-	2	-	-	-	-	-	-	-	1	1
2	1	2	2	-	3	-	-	2	-	-	-	-	2	1
3	1	3	3	-	2	-	-	3	-	-	-	-	2	1
4	1	2	2	-	2	-	-	2	-	-	-	-	1	2
5	1	2	2	-	2	-	-	2	-	-	-	-	1	2

UNIT I 9 Hours

USER-CENTERED DESIGN PROCESS

Scripting Languages – HTML, CSS - Fundamentals of graphics design, principles of visual design - Overview of UI & UX Design - Overview of the UX Design Process - Difference between User Interface (UI) vs User Experience (UX) - Defining problem and vision statement - Persona creation –Primary and Secondary persona - Requirement definition - Creative ideation – brainstorming and ideation techniques- Scenarios and functionality extraction - Information Architecture - Task flows - Wireframe design

UNIT II **9 Hours**

FUNDAMENTALS OF UI, HEURISTICS, AND INTERACTION DESIGN

Design Principles for UX and UI Design - UI Elements-Patterns - Material Design (Google) and Human Interface Design (Apple) guidelines - Interaction Principles & Interaction Behaviour - Masterthe Brand Platforms & Style Guides - comments and current UI patterns - Understand problems and design solutions for e-commerce, social media, message, data, and dashboard design

UNIT III **9 Hours**

ELEMENTARY SKETCHING

Principles of Sketching - Core Responsive Design - Wireframing vs Wireflows - Click through Wireframing Prototyping - Wireflow Creation - Work with different tools – Figma - Low-High Fidelity Design: Inclusive Design and Designing for Accessibility - Building High-Fidelity Mockups - Designing Efficiently with Tools - Interaction Patterns - Designing animations and interactions

UNIT IV **9 Hours**

UNDERSTAND STYLE GUIDES, ELEMENTS, PROTOTYPING

Building a Design System – Style guides, color palette, fonts, grid, iconography, UI elements, photography or imagery, and illustration - Use of grids in UI design - Design animations and interaction patterns for key UI elements

UNIT V **9 Hours**

USABILITY EVALUATION AND PRODUCT DESIGN

Type of usability evaluation – Qualitative & Quantitative evaluation - Guerilla testing, A/B Testing, Unmoderated remote usability testing, Card sorting, Session recording, think aloud - Think aloud – Introduction and advantages - Designing evaluation protocol - Conducting usability evaluation study - Conduct Usability Test explicit - Synthesize Test Findings - practices in corporate World - Product Design : Types of products & solutions - Design Psychology for e-commerce sites , CMS - Design Thinking Life Cycle

Total: 45 Hours

Reference(s)

1. Norman, Donald A. The Design of Everyday Things. Basic Books, 2002. ISBN: 9780465067107.
2. Nielsen, Jakob. Usability Engineering. Morgan Kaufmann, 1993. ISBN: 9780125184069.
3. Mullet, Kevin, and Darrell Sano. Designing Visual Interfaces: Communication Oriented Techniques. Prentice Hall, 1994. ISBN: 9780133033892.
4. Wilbent. O. Galitz,“The Essential Guide To User Interface Design”, John Wiley & Sons, 2001.
5. Ben Sheiderman, “Design the User Interface”, Pearson Education, 1998.
6. Alan Cooper, “The Essential of User Interface Design”, Wiley – Dream Tech Ltd.,2002.

22CT009 **WEB FRAMEWORKS** **3 0 0 3**

Course Objectives

- Understand the architecture behind an Angular application and how to use it
- To understand the significance of using MongoDB as a database system
- To understand the role of React in designing front-end components
- Build a Web Server in Node and understand how it really works
- Develop a web application and API using web frameworks

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Apply modules and components and Animations for creating Forms and developing web pages
2. Create web applications by performing CRUD operations in database using web frameworks
3. Design Progressive Web Application with dynamic HTML web pages using Angular.
4. Design single page applications with reusable UI components using React CSS and SaaS
5. Apply Node Package Manager and Node packages for Server-Side programming.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	2	-	2	-	-	-	2	2	-	-	2	-
2	1	1	1	-	3	-	-	-	2	2	-	-	3	-
3	1	2	2	-	2	-	-	-	2	2	-	-	3	-
4	1	1	1	-	3	-	-	-	2	2	-	-	2	-
5	1	1	1	-	3	-	-	-	1	1	-	-	2	-

UNIT I **9 Hours**
ANGULAR FRONT-END FRAMEWORK

Introduction - Setup - Architecture: Modules, Components, Services and DI fundamentals - Components and Templates – Configuration- Forms - Observables & RxJS - Boot Strapping - NgModules - Dependency Injection - Http Client - Routing and Navigation - Animations

UNIT II **9 Hours**
FRAMEWORKS WITH DATABASES

MongoDB - MongoDB Basics - Documents - Collections - Query Language - Installation - The mongo Shell - Schema Initialization - MongoDB Node.js Driver - Reading from MongoDB - Writing to MongoDB - CRUD operations - projections - Indexing - Aggregation - Replication - Sharding - Creating backup – Deployment

UNIT III **9 Hours**
ANGULAR TECHNIQUES
Service workers & PWA - Server-side rendering - Angular Libraries - Schematics - CLI Builders - Angular Ivy - Web Workers

UNIT IV **9 Hours**
REACT
React Introduction - React ES6 - React Render HTML - React JSX - Components -React Classes - Composing Components - Passing Data - Dynamic Composition - React state - setting State - Async State Initialization - Event Handling Communicating from Child to Parent - Stateless Components - Designing components- React Forms - React CSS - React SaaS

UNIT V **9 Hours**
NODE JS BACK-END FRAMEWORK
Node.js basics - Local and Export Modules - Node Package Manager - Node.js web server - Node.js File system - Node Inspector - Node.js Event Emitter - Frameworks for Node.js -Express.js Web App - Serving static Resource - Node.js Data Access

Total: 45 Hours

Reference(s)

1. Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, andNode, Vasan Subramanian, A Press Publisher, 2019.
2. Christoffer Noring, Pablo Deeleman, Learning Angular, Packt Publishing Limited, 2nd Revised edition edition, 2017.
3. Caleb Dayley Brad Dayley, Brendan Dayley, Node.js, MongoDB and Angular Web Development, 2nd Edition, Pearson, 2018.
4. Shyam Seshadri, Angular: Up and Running- Learning Angular, Step by Step, O'Reilly;First edition, 2018

22CT010 WEB APPLICATION SECURITY 2 0 2 3

Course Objectives

- To understand the fundamentals of web application security
- To focus on wide aspects of secure development and deployment of web applications
- To learn how to build secure APIs
- To learn the basics of vulnerability assessment and penetration testing
- To get an insight about Hacking techniques and Tools

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Build a simple Android application with Android Manifest file.
2. Analyze the essential designs of Android Application with their anatomy and terminologies
3. Apply rapid prototyping techniques to design, develop and deploy the Android Applications
4. Analyze the essentials of User Interface Design in IOS with SQLite Database
5. Design the flutter applications on the Android marketplace for distribution

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	-	1	-	3	1	-	-	-	-	-	-	1	-
2	1	2	2	-	3	2	-	2	-	-	-	-	2	-
3	1	2	2	-	3	2	-	2	-	-	-	-	2	-
4	1	1	2	-	3	2	-	2	-	-	-	-	3	-
5	1	2	2	-	3	2	-	2	-	-	-	-	3	-

UNIT I 6 Hours

FUNDAMENTALS OF WEB APPLICATION SECURITY

The history of Software Security-Recognizing Web Application Security Threats, Web Application

Security, Authentication and Authorization, Secure Socket layer, Transport layer Security, Session Management-Input Validation

UNIT II 5 Hours
SECURE DEVELOPMENT AND DEPLOYMENT
Web Applications Security - Security Testing, Security Incident Response Planning,The Microsoft Security Development Lifecycle (SDL), OWASP Comprehensive Lightweight Application Security Process (CLASP), The Software Assurance Maturity Model (SAMM)

UNIT III **6 Hours**
SECURE API DEVELOPMENT
API Security- Session Cookies, Token Based Authentication, Securing Natter APIs: Addressing threats with Security Controls, Rate Limiting for Availability, Encryption, Audit logging, Securing service-to-service APIs: API Keys , OAuth2, Securing Microservice APIs: Service Mesh, Locking Down Network Connections, Securing Incoming Requests.

UNIT IV **6 Hours**
VULNERABILITY ASSESSMENT AND PENETRATION TESTING
Vulnerability Assessment Lifecycle, Vulnerability Assessment Tools: Cloud-based vulnerability scanners, Host-based vulnerability scanners, Network-based vulnerability scanners, Database based vulnerability scanners, Types of Penetration Tests: External Testing, Web Application Testing, Internal Penetration Testing, SSID or Wireless Testing, Mobile Application Testing.

UNIT V **7 Hours**
HACKING TECHNIQUES AND TOOLS
Social Engineering, Injection, Cross-Site Scripting(XSS), Broken Authentication and Session Management, Cross-Site Request Forgery, Security Misconfiguration, Insecure Cryptographic Storage, Failure to Restrict URL Access, Tools: Comodo, OpenVAS, Nexpose, Nikto, Burp Suite, etc.

EXPERIMENT 1 **6 Hours**

Install wireshark and explore the various protocols
a. Analyze the difference between HTTP vs HTTPS
b. Analyze the various security mechanisms embedded with different protocols

EXPERIMENT 2 **6 Hours**

Identify the vulnerabilities using OWASP ZAP tool

EXPERIMENT 3 **6 Hours**
Create simple REST API using python for following operation

a) GET,
b) PUSH,
c) POST
d) DELETE

EXPERIMENT 4 **6 Hours**

Install Burp Suite to do following vulnerabilities:

a) SQL injection
b) cross-site scripting (XSS)

EXPERIMENT 5 **6 Hours**

Attack the website using Social Engineering method.

Total:30+30= 60 Hours

Reference(s)

1. Andrew Hoffman, Web Application Security: Exploitation and Countermeasures for Modern Web Applications, First Edition, 2020, O'Reilly Media, Inc.
2. Bryan Sullivan, Vincent Liu, Web Application Security: A Beginners Guide, 2012, The McGraw-Hill Companies.
3. Neil Madden, API Security in Action, 2020, Manning Publications Co., NY, USA.
4. Michael Cross, Developer's Guide to Web Application Security, 2007, Syngress Publishing, Inc.
5. Ravi Das and Greg Johnson, Testing and Securing Web Applications, 2021, Taylor & Francis Group, LLC.
6. Prabath Siriwardena, Advanced API Security, 2020, Apress Media LLC, USA.
   Malcom McDonald, Web Security for Developers, 2020, No Starch Press, Inc.
7. Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, Gideon Lenkey, and Terron
8. Williams Grey Hat Hacking: The Ethical Hacker's Handbook, Third Edition, 2011, The McGraw-Hill Companies.

22CT011 SOFTWARE TESTING AND AUTOMATION 3 0 0 3

Course Objectives

- Understand the importance of software testing in the software development process
- Analyze different testing methodologies and techniques to create test plans, test cases, and test scripts
- Apply automation testing tools and frameworks to design and implement automated test suites

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PSO1: Demonstrate the knowledge and technical skills in software development.
PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Understand the importance of testing in the software development process
2. Compare the different test case design strategies
3. Analyze the different levels of testing and their importance
4. Apply test management techniques and the role of a test specialist
5. Analyze the software test automation and its requirements

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1	-	1	-	-	-	-	-	-	-	-	2
2	2	3	2	-	2	-	-	-	-	-	-	-	1	2
3	2	2	2	-	2	-	-	-	-	-	-	-	1	2
4	2	3	2	-	3	-	-	-	-	-	-	-	-	2
5	3	2	1	-	3	-	-	-	-	-	-	-	2	2

UNIT I 9 Hours

INTRODUCTION

Basic definitions – Software Testing Principles – The Tester's Role in a Software Development Organization – Origins of Defects – Cost of Defects – Defect Classes – The Defect Repository andTest Design – Defect Examples- Developer/Tester Support of Developing a Defect Repository.

UNIT II 9 Hours

TEST CASE DESIGN STRATEGIES

Test Scenarios - Test Cases - Test case Design Strategies - Black Box Approach to Test Case Design - Using White Box Approach to Test design – Test Adequacy Criteria – Static testing vs. Structural testing – Code functional testing – Coverage and Control Flow Graphs – Covering CodeLogic – Paths – Code complexity testing – Additional White box testing approaches - Test Coverage

UNIT III **9 Hours**

LEVELS OF TESTING

Types of testing - manual and automation - Introduction to testing methods - White-box, Black- box and Grey-box - Functional testing - Non-functional testing - Introduction to levels of testing– Unit Testing, Integration Testing, System Testing, User Acceptance Testing - Introduction to types of testing – Regression Testing, Smoke Testing, Database Testing, Usability Testing, Load Testing, Stress Testing, Performance Testing, Compatibility Testing, Security Testing, Internationalization Testing, Localization Testing

UNIT IV **9 Hours**

TEST MANAGEMENT

People and organizational issues in testing – Organization structures for testing teams – testing services – Test Planning – Test Plan Components – Test Plan Attachments – Locating Test Items – test management – test process – Reporting Test Results – Introducing the test specialist – Skillsneeded by a test specialist – Building a Testing Group- The Structure of Testing Group - The Technical Training Program.

UNIT V **9 Hours**

TEST AUTOMATION

Software test automation – Design and Architecture for Automation - Automation testing - Automation Tools - Selenium Web Driver - Create Selenese Commands - TestNG - TestNG Annotations - Jmeter - Assertions in JMeter - Junit

Total: 45 Hours

Reference(s)

1. Srinivasan Desikan and Gopalaswamy Ramesh, "Software Testing – Principles and Practices", Pearson Education, 2006.
2. Ron Patton, "Software Testing", Second Edition, Sams Publishing, Pearson Education, 2007.
3. Ilene Burnstein, "Practical Software Testing", Springer International Edition, 2003.
4. Edward Kit," Software Testing in the Real World – Improving the Process", Pearson Education, 1995.
5. Boris Beizer," Software Testing Techniques" – 2nd Edition, Van Nostrand Reinhold, New York, 1990.
6. Aditya P. Mathur, "Foundations of Software Testing _ Fundamental Algorithms and Techniques", Dorling Kindersley (India) Pvt. Ltd., Pearson Education, 2008.

22CT012 **DevOps** **3 0 0 3**

Course Objectives

- To introduce DevOps terminology, definition & concepts
- To understand the different Version control tools like Git, Mercurial
- To understand the concepts of Continuous Integration/ Continuous Testing/ Continuous Deployment)
- To understand Configuration management using Ansible
- Illustrate the benefits and drive the adoption of cloud-based DevOps tools to solve real-world problems

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Analyze the different actions performed through Version control tools like Git
2. Perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven & Gradle
3. Build Jenkins workspace for Automated Continuous Deployment
4. Perform configuration management using Ansible
5. Apply Azure DevOps to leverage Cloud-based DevOps tools.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1	2	2	-	-	-	-	-	-	-	3	-
2	3	3	3	3	2	-	-	-	-	-	-	-	2	-
3	2	2	2	3	2	-	-	-	-	-	-	-	2	-
4	2	2	2	2	2	-	-	-	-	-	-	-	2	-
5	2	2	2	2	2	-	-	-	-	-	-	-	3	-

UNIT I **7 Hours**

INTRODUCTION TO DevOps

DevOps Essentials - Introduction to AWS, GCP, Azure - Version control systems: Git and GitHub

UNIT II **10 Hours**

COMPILE AND BUILD USING MAVEN AND GRADLE

Introduction, Installation of Maven, POM files, Maven Build lifecycle, build phases (compile build, test, package) Maven Profiles-Maven repositories (local, central, global)- Maven plugins- Maven create and build Artifacts- Dependency Management-Installation of Gradle- understanding build using Gradle.

UNIT III **12 Hours**

CONTINUOUS INTEGRATION USING JENKINS

Install & Configure Jenkins- Jenkins Architecture Overview- creating a Jenkins Job- Configuring a Jenkins job- Introduction to Plugins- Adding Plugins to Jenkins-commonly used plugins (Git Plugin, Parameter Plugin- HTML Publisher- Copy Artifact, and Extended choice parameters). Configuring Jenkins to work with Java- Git- and Maven- Creating a Jenkins Build and Jenkins workspace

UNIT IV **9 Hours**

CONFIGURATION MANAGEMENT USING ANSIBLE

Ansible Introduction- Installation-Ansible master/slave configuration- YAML basics-Ansible Modules-Ansible Inventory files- Ansible playbooks- Ansible Roles- and ad-hoc commands in Ansible

UNIT V **7 Hours**

BUILDING DevOps PIPELINES USING AZURE

Create GitHub Account, Create Repository- Create Azure Organization- Create a new pipeline- Build a sample code- Modify azure-pipelines- yaml file

Total: 45 Hours

Reference(s)

1. Roberto Vormittag, “A Practical Guide to Git and GitHub for Windows Users: From Beginner to Expert in Easy Step-By-Step Exercises”, Second Edition, Kindle Edition, 2016.
2. Jason Cannon, “Linux for Beginners: An Introduction to the Linux Operating System and Command Line”, Kindle Edition, 2014
3. Hands-On Azure DevOps: Cicd Implementation for Mobile, Hybrid, And Web Applications Using Azure DevOps and Microsoft Azure: CICD Implementation for ... DevOps and Microsoft Azure (English Edition) Paperback – 1 January 2020 by Mitesh Soni.
4. Jeff Geerling, “Ansible for DevOps: Server and configuration management for humans”, First Edition, 2015.
5. David Johnson, “Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOps”, Second Edition, 2016.
6. Mariot Tsitoara, “Ansible 6. Beginning Git and GitHub: A Comprehensive Guide to Version Control, Project Management, and Teamwork for the New Developer”, Second Edition, 2019.
7. https://www.jenkins.io/user-handbook.pdf
8. https://maven.apache.org/guides/getting-started/

22CT013 VIRTUALIZATION IN CLOUD COMPUTING 3 0 0 3

Course Objectives

- Analyze the basic concepts of virtualization technology to derive the best practice model for deploying cloud-based applications.
- Create an application by utilizing cloud platforms such as Amazon Web Services and Windows Azure.
- Identify major security and privacy problems in cloud computing environment.
- Apply the ability to use the architecture of cloud, service and delivery models.
- Implement the key enabling technologies that help in the development of cloud.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PSO1: Demonstrate the knowledge and technical skills in software development. PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Apply the concept of virtualization and its properties.
2. Apply the different forms of virtualization.
3. Analyze various architectures for implementing virtualization methods.
4. Evaluate virtual machines and installing various operating systems.
5. Evaluate the performance of the virtual machines and deployed applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	3	-	-	-	-	-	-	-	-	-	1	2
2	-	-	3	2	-	-	-	-	-	-	-	-	1	2
3	-	2	1	3	-	-	-	-	-	-	-	-	1	2
4	1	2	1	3	-	-	-	-	-	-	-	-	1	2
5	1	3	-	2	-	-	-	-	-	-	-	-	1	2

UNIT I **9 Hours**

UNDERSTANDING VIRTUALIZATION

Describing Virtualization-Microsoft Windows Drives Server Growth -Explaining Moore's Law-Understanding the Importance of Virtualization -Examining Today's Trends -Virtualization and Cloud Computing -Understanding Virtualization Software Operation -Virtualizing Servers -Virtualizing Desktops-Virtualizing Applications

UNIT II **9 Hours**

HYPERVISORS

Describing a Hypervisor -Exploring the History of Hypervisors -Understanding Type 1 Hypervisors -Type 2 Hypervisors - Role of a Hypervisor -Holodecks and Traffic Cops -Resource Allocation -Comparing Today's Hypervisors -VMware ESX -Citrix Xen -Microsoft Hyper-V -Other Solutions.

UNIT III **9 Hours**

VIRTUAL MACHINES

Introduction to Virtual Machine - CPUs in a Virtual Machine -Memory in a Virtual Machine -Network Resources in a Virtual Machine - Storage in a Virtual Machine -Understanding How a Virtual Machine Works -Working with Virtual Machines -Virtual Machine Clones -Templates -Snapshots -OVF -Containers

UNIT IV **9 Hours**

CREATION OF VIRTUAL MACHINES AND CONFIGURATIONS

Understanding Configuration Options-Installing Windows on a Virtual Machine- Installing Linux on a Virtual Machine-Installing VirtualBox Guest Additions- Managing CPUs for a Virtual Machine-Configuring VM CPU Options-Managing Storage for a Virtual Machine- Managing Networking for a Virtual Machine- Copying a Virtual Machine- Managing Additional Devices in Virtual Machines

UNIT V **9 Hours**

AVAILABILITY AND APPLICATIONS IN A VIRTUAL MACHINE

Increasing Availability-Protecting a Virtual Machine-Protecting Multiple Virtual Machines-Protecting Data Centers - Examining Virtual Infrastructure Performance Capabilities -Deploying Applications in a Virtual Environment-Understanding Virtual Appliances and vApps -Open Stack and Containers.

Total: 45 Hours

Reference(s)

1. Matthew Portney, Virtualization Essentials, John Wiley & Sons, Second Edition, 2016
2. Kailash Jayaswal, Jagannath Kallakurchi,Donald J.Houde,Dr.devan Shah, Cloud Computing Black Book, Dreamtech press, 2015
3. Rajkumar Buyya, Christian Vecchiola and Thamarai Selvi S,Mastering in Cloud Computing, McGraw Hill Education, (India) Private Limited, 2013
4. Bernard Golden, Amazon Web Services for Dummies, John Wiley & Sons, First Edition, 2013
5. http//www.microsoft.com/learning/default.mspx
6. https://www.oreilly.com/library/view/cloud- security-and/9780596806453/ch04.html

22CT014 CLOUD SERVICES AND DATA MANAGEMENT 3 0 0 3

Course Objectives

- Analyze the basic concepts of Cloud and capabilities across the various Cloud service models.
- Analyze virtualization technology to derive the best practice model for deploying cloud-based applications.
- Create an application by utilizing cloud platforms such as Google App Engine, Microsoft Azure and Open Stack.
- Identify strategies to reduce risk and eliminate issues associated with adoption of cloud services.
- Select appropriate structures for designing, deploying and running cloud-based services in a business environment.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PSO1: Demonstrate the knowledge and technical skills in software development. PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Apply the performance of the virtual machines and deployed applications. Apply Cloud Computing reference architecture for developing clouds
2. Apply the different forms of cloud service models
3. Analyze the characteristics and architecture of IaaS using various real-world applications.
4. Evaluate PaaS concepts and architectures with real-world examples.
5. Create and synthesize concepts related to the SaaS delivery model.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	3	-	-	-	-	-	-	-	-	-	-	2
2	-	1	3	2	-	-	-	-	-	-	-	-	-	2
3	-	2	1	3	-	-	-	-	-	-	-	-	1	2
4	1	2	1	3	-	-	-	-	-	-	-	-	1	2
5	1	3	-	2	-	-	-	-	-	-	-	-	1	2

UNIT I **9 Hours**

CLOUD COMPUTING REFERENCE ARCHITECTURE (CCRA)

Introduction to Cloud Computing Reference Architecture (CCRA), Benefits of CCRA, Architecture Overview, Versions and Application of CCRA for Developing Clouds

UNIT II **9 Hours**

INTRODUCTION OF DELIVERY MODELS IN CLOUD COMPUTING

Introduction to Cloud Delivery Models, List Various Cloud Delivery Models, Advantages of Delivery Models in Cloud, Trade-off in Cost to Install Versus Flexibility, Cloud Service Model Architecture.

UNIT III **9 Hours**

INFRASTRUCTURE AS A SERVICE (IaaS)

Introduction to Infrastructure as a Service Delivery Model, Characteristics of IaaS, Architecture, Examples of IaaS, Applicability of IaaS in the Industry.

UNIT IV **9 Hours**

PLATFORM AS A SERVICE (PaaS)

Introduction to Platform as a Service Delivery Model, Characteristics of PaaS, Patterns, Architecture and Examples of PaaS, Applicability of PaaS in the Industry.

UNIT V **9 Hours**

SOFTWARE AS A SERVICE (SaaS)

Introduction to Software as a Service Delivery Model, Characteristics of SaaS, Architecture, Examples of SaaS, Applicability of SaaS in the Industry.

Total: 45 Hours

Reference(s)

1. (IBM ICE), Cloud Computing Architecture, IBM Global Technology Services Thought Leadership White Paper, April 2011
2. Bernard Golden, Amazon Web Services for Dummies, John Wiley & Sons, First Edition, 2013
3. Cloud Computing: A Practical Approach, Anthony T.Velte, Toby J.Velte, Robert Elsenpeter, Tata McGraw Hill, 2011
4. Enterprise Cloud Computing, Gautam Shroff, Cambridge University Press, 2010
5. Cloud Application Architectures: Building Applications and Infrastructure in the Cloud, George Reese, O'reilly, SPD, 2011

22CT015 CLOUD STORAGE TECHNOLOGIES 3 0 0 3

Course Objectives

- Characterize the functionalities of logical and physical components of storage
- Describe various storage networking technologies
- Identify different storage virtualization technologies
- Discuss the different backup and recovery strategies
- Understand common storage management activities and solutions

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Apply the fundamentals of information storage management and various models of Cloud infrastructure services and deployment.
2. Apply the usage of advanced intelligent storage systems and RAID.
3. Analyze various storage networking architectures - SAN, including storage subsystems and virtualization.
4. Evaluate the different roles in providing disaster recovery and remote replication technologies.
5. Create the security needs and security measures to be employed in information storage management.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1	3	3	-	-	-	-	-	-	-	-	2
2	3	1	2	3	3	-	-	-	-	-	-	-	-	1
3	1	1	3	2	2	-	-	-	-	-	-	-	-	2
4	3	2	1	2	2	-	-	-	-	-	-	-	-	1
5	1	3	2	1	2	-	-	-	-	-	-	-	-	2

UNIT I **8 Hours**

STORAGE SYSTEMS

Cloud Storage Fundamentals and Architecture - Cloud Storage Providers and Services - Access methods (RESTful APIs, SDKs) for cloud object storage - Block storage technologies in cloud environments - File Storage in the Cloud: Network File System (NFS) and Server Message Block (SMB) protocols -Hybrid Cloud Storage - Data Migration - Data Lifecycle Management in the Cloud

UNIT II **9 Hours**

INTELLIGENT STORAGE SYSTEMS AND RAID

Storage Tiering and Caching - Automated Data Placement and Load Balancing: Intelligent Algorithms for Data Placement, Load Balancing Strategies for Distributed Storage Systems, Dynamic Resource Allocation

- RAID Technologies in Cloud Storage: RAID Levels - Data Striping, Mirroring, and Parity for Fault Tolerance - RAID Configuration and Performance Optimization

UNIT III **10 Hours**

STORAGE NETWORKING TECHNOLOGIES AND VIRTUALIZATION

Storage Networking in Cloud Environments - Understanding storage protocols - Network-attached storage (NAS) vs. storage area network (SAN) - Storage virtualization techniques and technologies - Network- Attached Storage (NAS) - Storage Area Network (SAN) - iSCSI and Fiber Channel over IP (FCIP) in Cloud Storage - Network Virtualization and Overlay Networks - Storage Virtualization and Abstraction - Network Performance Optimization - Network Security in Cloud Storage

UNIT IV **9 Hours**

BACKUP, ARCHIVE AND REPLICATION

Understanding Configuration Options-Installing Windows on a Virtual Machine- Installing Linux on a Virtual Machine-Installing VirtualBox Guest Additions- Managing CPUs for a Virtual Machine-Configuring VM CPU Options-Managing Storage for a Virtual Machine- Managing Networking for a Virtual Machine- Copying a Virtual Machine- Managing Additional Devices in Virtual Machines

UNIT V **9 Hours**

SECURING STORAGE INFRASTRUCTURE

Storage Security Fundamentals: Key Security Principles, Threats and Vulnerabilities in Storage Infrastructure, Access Control and Authentication: Role-based Access Control (RBAC) and Permissions Management, Multi-factor authentication (MFA) for Storage Systems - Storage-level Encryption and Application-level Encryption - Storage infrastructure Management Functions and Processes.

Total: 45 Hours

Reference(s)

1. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice) ‖, O'Reilly, 2009.
2. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
3. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, ―Mastering Cloud Computing‖, Tata Mcgraw Hill, 2013.
4. Rittinghouse, John W., and James F. Ransome, ―Cloud Computing: Implementation, Management and Security‖, CRC Press, 2017.
5. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing - A Practical Approach‖, Tata Mcgraw Hill, 2009.

22CT016 CLOUD AUTOMATION TOOLS AND APPLICATIONS 3 0 0 3

Course Objectives

- To learn the options for running automation tools, and load balancers in the cloud-native applications.
- To learn the configuration management in the cloud.
- To know why cloud automation is important.
- To learn what types of cloud automation tools can be used.
- To learn load balancing and auto scaling in the cloud

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PSO1: Demonstrate the knowledge and technical skills in software development. PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Apply the cloud native applications on AWS, Terraform etc.
2. Apply the VM provisioning and migration in the cloud.
3. Analyze the cloud automation and configuration.
4. Evaluate the balance load and auto scaling in the cloud.
5. Evaluate the AWS cloud formation use-case.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	-	2	1	3	-	-	-	-	-	-	-	-	2
2	-	2	-	-	3	-	-	-	-	-	-	-	-	1
3	-	-	3	2	3	-	-	-	-	-	-	-	-	2
4	-	-	2	-	3	-	-	-	-	-	-	-	2	-
5	-	-	2	-	3	-	-	-	-	-	-	-	-	2

UNIT I **7 Hours**

UNDERSTANDING THE CLOUD AUTOMATION

Introduction to Automation & Configuration Tools. Introduction to Terraform. Understanding Terraform Vs CloudFormation. Deploying & Destroying AWS environment with Terraform. Introduction to Packer.

UNIT II **9 Hours**

ABSTRACTION AND VIRTUALIZATION

Introduction to Virtualization Technologies, Load Balancing and Virtualization, Understanding hypervisors Porting Applications, Virtual Machines Provisioning and Manageability, Virtual Machine Migration Services, Virtual Machine Provisioning and Migration in Action, Provisioning in the Cloud Context, Virtualization of CPU, Memory, I/O Devices, Virtual Clusters and Resource management, Virtualization for Data Centre Automation.

UNIT III **9 Hours**

AUTOMATION AND CONFIGURATION MANAGEMENT IN THE CLOUD

Cloud automation at scale, Cloud Configuration Management –unmanaged and managed configuration management, Modification of the capacity of the service, horizontal and vertical scaling, and automatic versus manual scaling. Migrating the business to Cloud. Automating cloud deployments –Balancers.

UNIT IV **9 Hours**

LOAD BALANCING AND AUTO SCALING IN CLOUD

Managed instance groups, Auto scaling and health check, Overview of HTTP(S) load balancing. Example: HTTP load balancer, HTTP(S) load balancing, Configuring an HTTP Load Balancer with Auto scaling, SSL proxy load balancing, TCP proxy load balancing, Network load balancing, Internal load balancing, Configuring an Internal Load Balancer, Choosing a load balancer.

UNIT V **11 Hours**

AWS CLOUDFORMATION USE CASE

Introduction to AWS CloudFormation, AWS CloudFormation Features and Components, Working of AWS CloudFormation, setting up AWS CloudFormation, building a Pipeline for Test and Production Stacks, AWS CloudFormation Artifacts, Parameter Override Functions with Code Pipeline, Using AWS CLI. AWS CloudFormation, Terraform, VMware vs Center Configuration Manager (VCM), and Puppet.

Total: 45 Hours

Reference(s)

1. Bernd Ruecker, Practical Process Automation: Orchestration and Integration in Micro services and Cloud Native Architectures, O'Reilly Media, First Edition, 2021.
2. Douglas Comer, The Cloud Computing Book: The Future of Computing Explained, Chapman and Hall/CRC, First Edition, 2021.
3. Karen Tovmasyan, Mastering AWS CloudFormation: Plan, develop, and deploy your cloud infrastructure effectively using AWS CloudFormation, Packt Publishing Limited, First Edition, 2020.
4. Mikael Krief, Mitchell Hashimoto, Terraform Cookbook: Efficiently define, launch, and manage Infrastructure as Code across various cloud platforms, Packet Publishing Limited, 2020.
5. Yogesh Raheja, Dennis McCarthy, Automation with Puppet 5.0, Wiley, First Edition, 2018.

22CT017 SOFTWARE DEFINED NETWORKS 2 0 2 3

Course Objectives

- To understand the need for SDN and its data plane operations.
- To understand the functions of control plane.
- To comprehend the migration of networking functions to SDN environment.
- To explore various techniques of network function virtualization.
- To comprehend the concepts behind network virtualization.

Course Outcomes (COs)

1. Apply the motivation behind SDN
2. Apply the functions of the data plane and control plane
3. Analyze and develop network applications using SDN
4. Evaluate the network services using NFV
5. Create various use cases of SDN and NFV

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PSO2: Develop practical competencies in Software and Hardware Design

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	3	-	-	-	-	-	-	-	-	-	-	2
2	-	1	3	2	-	-	-	-	-	-	-	-	-	2
3	-	2	1	3	-	-	-	-	-	-	-	-	-	2
4	1	2	1	3	-	-	-	-	-	-	-	-	-	2
5	1	3	-	2	-	-	-	-	-	-	-	-	-	2

UNIT I **6 Hours**

INTRODUCTION

History of Software Defined Networking (SDN) – Modern Data Center – Traditional Switch Architecture – Why SDN – Evolution of SDN – How SDN Works – Centralized and Distributed Control and Date Planes.

UNIT II **6 Hours**

SDN DATA PLANE AND CONTROL PLANE

Data Plane functions and protocols - OpenFlow Protocol - Packet Processing and Performance Optimization – Flow Table - Control Plane Functions - Southbound Interface, Northbound Interface – SDN Controllers
- Ryu, Open Daylight, ONOS - Distributed Controllers.

UNIT III **6 Hours**

VIRTUALMACHINES SDN APPLICATIONS

SDN Application Plane Architecture – Network Services Abstraction Layer – Traffic Engineering – Measurement and Monitoring – Security – Data Center Networking – Wide Area Networks (WAN) – Service Provider Networks – Internet Service Providers (ISPs).

UNIT IV **6 Hours**

NETWORK FUNCTION VIRTUALIZATION

Network Virtualization - NFV Architecture – Virtual LANs – OpenFlow VLAN Support – NFV Standards and Frameworks – NFV Concepts – Benefits and Requirements – Reference Architecture.

UNIT V **6 Hours**

NFV FUNCTIONALITY

NFV Infrastructure – Virtualized Network Functions – NFV Management and Orchestration – NFV Use Cases: Virtual Customer Premises Equipment, Virtual Evolved Packet Core, Virtualized Network Monitoring and Traffic Analysis, Network Slicing, Edge Computing and NFV.

EXPERIMENT 1 **12 Hours**

Design, and Test the LAN connection for an organization to create a risk-free virtual environment using GNS3 network simulation tool.

EXPERIMENT 2 **6 Hours**

Design a Mininet topology with a single SDN controller and two hosts connected to a switch, and use Wireshark to capture for an institution.

EXPERIMENT 3 **6 Hours**

Design and implement an SDN-based network infrastructure for a smart campus that uses the Northbound API to program flow table rules on the switch for various use cases.

EXPERIMENT 4 **6 Hours**

Install a network topology using the OSM GUI or CLI, connecting the necessary VNFs to form service chains or network service graphs for an organization.

Total:30+30= 60 Hours

Reference(s)

1. Fei Hu, Network Innovation through OpenFlow and SDN: Principles and Design, 1^{st} Edition, CRC Press, 2014.
2. Ken Gray, Thomas D. Nadeau, Network Function Virtualization, Morgan Kauffman, 2016.
3. Oswald Coker, Siamak Azodolmolky, Software-Defined Networking with OpenFlow, 2^{nd} Edition, O'Reilly Media, 2017.
4. Paul Goransson, Chuck Black Timothy Culver, Software Defined Networks: A Comprehensive Approach, 2^{nd} Edition, Morgan Kaufmann Press, 2016.
5. Thomas D Nadeau, Ken Gray, SDN: Software Defined Networks, O'Reilly Media, 2013.
6. William Stallings, Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud, Pearson Education, 1^{st} Edition, 2015.

22CT018 SECURITY AND PRIVACY IN CLOUD 3 0 0 3

Course Objectives

- To Introduce Cloud Computing terminology, definition & concepts
- To understand the security design and architectural considerations for Cloud
- To understand the Identity, Access control in Cloud
- To follow best practices for Cloud security using various design patterns
- To be able to monitor and audit cloud applications for security

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PSO1: Demonstrate the knowledge and technical skills in software development. PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Apply the cloud security concepts and fundamentals.
2. Apply the security challenges in the cloud.
3. Analyze the cloud policy, identity and Access Management.
4. Analyze various risks, audit and monitoring mechanisms in the cloud.
5. Create the various architectural and design considerations for security in the cloud.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	3	1	2	-	-	-	-	-	-	-	2	-
2	1	3	2	3	1	-	-	-	-	-	-	-	-	2
3	3	2	2	3	2	-	-	-	-	-	-	-	2	-
4	2	1	2	3	3	-	-	-	-	-	-	-	-	2
5	1	3	3	1	1	-	-	-	-	-	-	-	-	2

UNIT I **8 Hours**

FUNDAMENTALS OF CLOUD SECURITY CONCEPTS

Overview of Cloud Security- Security Services - Confidentiality, Integrity, Authentication, Non-repudiation, Access Control - Basic of Cryptography - Conventional and Public-key cryptography, Hash Functions, Authentication and Digital Signatures.

UNIT II **11 Hours**

SECURITY DESIGN AND ARCHITECTURE FOR CLOUD

Security Design Principles for Cloud Computing - Comprehensive Data Protection - End-to-end access control - Common Attack Vectors and threats - Network and Storage - Secure Isolation Strategies - Virtualization strategies - Inter-tenant network segmentation strategies - Data Protection strategies: Data Redaction, Tokenization, Obfuscation, PKI and Key

UNIT III **9 Hours**

ACCESS CONTROL AND IDENTITY MANAGEMENT

Access Control Requirements for Cloud infrastructure - User Identification - Authentication and Authorization - Roles-based Access Control - Multi-factor authentication - Single Sign-on, Identity Federation - Identity providers and service consumers - Storage and network access control options - OS Hardening and minimization – Verified and measured boot - Intruder Detection

UNIT IV **8 Hours**

CLOUD SECURITY DESIGN PATTERNS

Introduction to Design Patterns, Cloud Bursting, Geo-tagging, Secure Cloud Interfaces, Cloud Resource Access Control, Secure On-Premise Internet Access, Secure External Cloud

UNIT V **9 Hours**

MONITORING, AUDITING AND MANAGEMENT

Proactive Activity Monitoring – Incident Response, Monitoring for Unauthorized Access, Malicious Traffic, Abuse of System Privileges – Events and Alerts – Auditing – Record generation, Reporting and Management, Tamper-Proofing Audit logs, Quality of Services, Secure Management, User Management, Identity Management, Security Information and Event Management

Total: 45 Hours

Reference(s)

1. Dave Shackleford, Virtualization Security, SYBEX a Wiley Brand, 2013
2. Mark C. Chu-Carroll, Code in the Cloud, CRC Press, 2011.
3. Mather, Kumaraswamy and Latif, Cloud Security and Privacy, Oreilly, 2011.
4. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, Mastering Cloud Computing Foundations and Applications Programming, 2013.
5. Raj Kumar Buyya, James Broberg, Andrzej Goscinski, Cloud Computing, Wiley 2013.

22CT019 CYBER SECURITY 3 0 0 3

Course Objectives

- To learn cybercrime and cyber law.
- To understand the cyber-attacks and tools for mitigating them.
- To understand information gathering.
- To learn how to detect a cyber-attack.
- To learn how to prevent a cyber-attack.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Apply the principles of cybersecurity, cybercrime, and cyber law and their impact on digital systems.
2. Analyze various types of cyber-attacks and assess the effectiveness of tools used to launch them.
3. Apply advanced tools and techniques for secure information gathering to ensure data security and integrity.
4. Analyze intrusion techniques to detect unauthorized access and examine network traffic for malicious activities.
5. Apply and evaluate intrusion prevention mechanisms to mitigate cyber threats and enhance system security.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	1	1	2	-	-	-	-	-	-	-	2	-
2	1	3	1	3	3	-	-	-	-	-	-	-	2	-
3	2	1	1	1	2	-	-	-	-	-	-	-	2	-
4	3	3	2	2	1	-	-	-	-	-	-	-	3	-
5	3	2	2	2	3	-	-	-	-	-	-	-	3	-

UNIT I **9 Hours**

INTRODUCTION

Cyber Security – History of Internet – Impact of Internet – CIA Triad; Reason for Cyber Crime – Need for Cyber Security – History of Cyber Crime; Cybercriminals – A Global Perspective on Cyber Crimes - Classification of Cybercrimes.

UNIT II **9 Hours**

ATTACKS AND COUNTER MEASURES

OSWAP; Malicious Attack Threats and Vulnerabilities: Scope of Cyber-Attacks – Security Breach – Types of Malicious Attacks – Malicious Software – Common Attack Vectors – Social engineeringAttack – Wireless Network Attack – Web Application Attack – Attack Tools – Countermeasures.

UNIT III **9 Hours**

RECONNAISSANCE

Harvester – Who is – Netcraft – Host – Extracting Information from DNS – Extracting Information from E- mail Servers – Social Engineering Reconnaissance; Scanning – Port Scanning – Network Scanning and Vulnerability Scanning – Scanning Methodology – Ping Sweer Techniques – Nmap Command Switches – SYN – Stealth – XMAS – NULL – IDLE – FIN Scans – Banner Grabbing and OS Fingerprinting Techniques.

UNIT IV **9 Hours**

INTRUSION DETECTION

Host -Based Intrusion Detection – Network -Based Intrusion Detection – Distributed or Hybrid Intrusion Detection – Intrusion Detection Exchange Format – Honeypots – Example System Snort -Cyber Laws – The Indian IT Act – Cyber Crime and Punishment.

UNIT V **9 Hours**

INTRUSION PREVENTION

Firewalls and Intrusion Prevention Systems: Need for Firewalls – Firewall Characteristics and Access Policy – Types of Firewalls – Firewall Basing – Firewall Location and Configurations – Intrusion Prevention Systems – Example Unified Threat Management Products.

Total: 45 Hours

Reference(s)

1. Anand Shinde, "Introduction to Cyber Security Guide to the World of Cyber Security",Notion Press, 2021
2. Nina Godbole, Sunit Belapure, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley Publishers, 2011
3. https://owasp.org/www-project-top-ten/
4. David Kim, Michael G. Solomon, "Fundamentals of Information Systems Security", Jones& Bartlett Learning Publishers, 2013.
5. Patrick Engebretson, "The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made easy", Elsevier, 2011.
6. Kimberly Graves, "CEH Official Certified Ethical Hacker Review Guide", Wiley Publishers,2007.
7. William Stallings, Lawrie Brown, "Computer Security Principles and Practice", ThirdEdition, Pearson Education, 2015.
8. Georgia Weidman, "Penetration Testing: A Hands-On Introduction to Hacking", No StarchPress, 2014.

22CT020 **MODERN CRYPTOGRAPHY** **3 0 0 3**

Course Objectives

- To learn about the basics of modern cryptography.
- To focus on how cryptographic algorithms and protocols work and how to use them.
- To build a Pseudo random permutation.
- To construct the basics of cryptanalytic techniques for ensuring data integrity.
- To provide instruction on how to use the concepts of block ciphers and message authentication codes.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Apply the fundamental principles of cryptography and cryptanalysis and their role in secure communication.
2. Analyze symmetric encryption techniques and authentication mechanisms for their effectiveness in securing data.
3. Analyze the applications of public key encryption, digital signatures, and key establishment in real-world scenarios.
4. Apply cryptographic algorithms to design, implement, and analyze secure cryptographic solutions.
5. Evaluate the effectiveness of Message Authentication Codes (MACs) in ensuring data integrity and authenticity

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	3	3	1	-	-	-	-	-	-	2	2	-
2	1	3	2	1	2	-	-	-	-	-	-	2	2	-
3	1	1	2	3	2	-	-	-	-	-	-	3	1	-
4	3	1	2	1	3	-	-	-	-	-	-	2	2	-
5	2	3	3	3	3	-	-	-	-	-	-	1	2	-

UNIT I **9 Hours**

INTRODUCTION

Basics of Symmetric Key Cryptography - Basics of Asymmetric Key Cryptography - Hardness of Functions -Notions of Semantic Security (SS) and Message Indistinguishability (MI): Proof of Equivalence of SS and MI – Hard Core Predicate - Trap-door permutation - Goldwasser-Micali Encryption - Goldreich-Levin Theorem: Relation between Hardcore Predicates and Trap-door permutations.

UNIT II **9 Hours**

FORMAL NOTIONS OF ATTACKS

Attacks under Message Indistinguishability: Chosen Plaintext Attack (IND-CPA), Chosen Ciphertext Attacks (IND-CCA1 and IND-CCA2) - Attacks under Message Non-malleability:NM-CPA and NMCCA2
- Inter-relations among the attack model

UNIT III **9 Hours**

RANDOM ORACLES

Provable Security and asymmetric cryptography - hash functions -One-way functions: Weak and Strong one-way functions - Pseudo-random Generators (PRG): Blum-Micali-Yao Construction - Construction of more powerful PRG - Relation between One-way functions and PRG - Pseudorandom Functions (PRF).

UNIT IV **9 Hours**

BUILDING A PSEUDORANDOM PERMUTATION

The Luby Rackoff Construction: Formal Definition, Application of the Luby Rackoff Construction to the construction of Block Ciphers -The DES in the light of Luby Rackoff Construction.

UNIT V **9 Hours**

MESSAGE AUTHENTICATION CODES

Introduction to Left or Right Security (LOR) - Formal Definition of Weak and Strong MACs - Using a PRF as a MAC - Variable length MAC - Public Key Signature Schemes: Formal Definitions, Signing and Verification - Formal Proofs of Security of Full Domain Hashing - Assumptions for Public Key Signature Schemes: One-way functions - Imply Secure One-time Signatures -Shamir's Secret Sharing Scheme - Analyzing Cryptographic Protocols - Zero Knowledge Proofs and Protocols.

Total: 45 Hours

Reference(s)

1. William Stallings, "Cryptography and Network Security: Principles and Practice", PHI 7th Edition, 2017.
2. Oded Goldreich, Foundations of Cryptography, CRC Press (Low Priced Edition Available), 2009.
3. Hans Delfs and Helmut Knebl, Introduction to Cryptography: Principles and Applications, Springer Verlag, 2007.
4. Wenbo Mao, Modern Cryptography, Theory and Practice, Pearson Education (Low Priced Edition), 2004.

22CT021 **CYBER FORENSICS** **3 0 0 3**

Course Objectives

- To understand the principles and concepts of computer forensics.
- To learn to utilize forensic tools for network-based attacks.
- To identify and apply appropriate methodologies for forensics data.
- To identify and analyze the vulnerabilities in the network.
- To analyze the various hacking techniques and their impacts.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Analyze computer forensics principles, legal and ethical considerations, and the importance of preserving digital evidence integrity.
2. Apply forensic tools to ensure data integrity and security in network environments.
3. Analyze and validate forensic data from communication devices to detect and analyze intrusion attempts.
4. Analyze firewall techniques to identify and mitigate network vulnerabilities.
5. Apply and analyze real-world hacking techniques to test system security and enhance protection against cyber threats.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	3	1	2	-	-	2	-	-	-	-	2	-
2	2	2	3	2	3	-	-	2	-	-	-	-	2	-
3	2	1	3	2	2	-	-	3	-	-	-	-	2	-
4	2	1	2	3	3	-	-	3	-	-	-	-	3	-
5	2	2	2	2	3	-	-	3	-	-	-	-	3	-

UNIT I **9 Hours**

INTRODUCTION TO COMPUTER FORENSICS

Introduction to Traditional Computer Crime, Traditional problems associated with Computer Crime. Introduction to Identity Theft & Identity Fraud. Types of CF techniques - Incident and incident response methodology - Forensic duplication and investigation. Preparation for IR: Creating response tool kit and IR team. - Forensics Technology and Systems - Understanding Computer Investigation – Data Acquisition.

UNIT II **9 Hours**

EVIDENCE COLLECTION AND FORENSICS TOOLS

Processing Crime and Incident Scenes – Working with Windows and DOS Systems. Current Computer Forensics Tools: Software/ Hardware Tools.

UNIT III **9 Hours**

ANALYSIS AND VALIDATION

Validating Forensics Data – Data Hiding Techniques – Performing Remote Acquisition – Network Forensics – Email Investigations – Cell Phone and Mobile Devices Forensics.

UNIT IV **9 Hours**

E-MAIL SECURITY AND FIREWALLS

PGP - S/MIME - Internet Firewalls for Trusted System: Roles of Firewalls – Firewall related terminology- Types of Firewalls - Firewall designs - SET for E-Commerce Transactions.

UNIT V **9 Hours**

ETHICAL HACKING IN WEB

Social Engineering - Denial of Service - Session Hijacking - Hacking Web servers - Hacking Web Applications – SQL Injection - Hacking Wireless Networks - Hacking Mobile Platforms.

Total: 45 Hours

Reference(s)

1. Bill Nelson, Amelia Phillips, Frank Enfinger, Christopher Steuart, Computer Forensicsand Investigations, Cengage Learning, India Edition, 2016.
2. CEH official Certified Ethical Hacking Review Guide, Wiley India Edition, 2015.
3. MarjieT.Britz, Computer Forensics and Cyber Crime: An Introduction, 3rd Edition,Prentice Hall, 2013.
4. John R. Vacca, “Computer Forensics: Computer Crime Scene Investigation”, CengageLearning, 2nd Edition, 2005.
5. Man Young Rhee, “Internet Security: Cryptographic Principles”, “Algorithms and Protocols”, Wiley Publications, 2003.

22CT022 ETHICAL HACKING 3 0 0 3

Course Objectives

- To learn about the importance of information security.
- To learn different scanning and enumeration methodologies and tools.
- To understand various hacking techniques and attacks.
- To be exposed to programming languages for security professionals.
- To understand the different phases in penetration testing

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Apply the various attack methodologies used in ethical hacking and penetration testing in digital systems.
2. Apply hacking techniques and evaluate the effectiveness of tools used for ethical hacking.
3. Analyze the vulnerabilities in Windows and Linux operating systems to assess potential security risks.
4. Apply advanced hacking techniques to exploit web server vulnerabilities.
5. Evaluate firewall characteristics, intrusion detection mechanisms, and malicious software to enhance system security.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1	2	2	-	-	-	-	-	-	-	2	-
2	1	2	2	1	2	-	-	-	-	-	-	-	2	-
3	1	2		2	2	-	-	-	-	-	-	-	2	-
4	1	2	2	3	3	-	-	-	-	-	-	-	2	-
5	1	2	1	2	2	-	-	-	-	-	-	-	2	-

UNIT I **9 Hours**

INTRODUCTION

Ethical Hacking Overview - Role of Security and Penetration Testers - Penetration-TestingMethodologies- Laws of the Land - Overview of TCP/IP- The Application Layer - The TransportLayer - The Internet Layer

- IP Addressing - Network and Computer Attacks - Malware - Protecting Against Malware Attacks-Intruder Attacks - Addressing Physical Security

UNIT II **9 Hours**

SCANNING AND ENUMERATION

Introduction to Scanning – Objectives – Scanning Methodology – Tools – Introduction to Enumeration – Enumeration Techniques – Enumeration Procedure – Tools

UNIT III **9 Hours**

SYSTEM HACKING

Introduction – Cracking Passwords – Password Cracking Websites – Password Guessing –Password Cracking Tools – Password Cracking Countermeasures – Escalating Privileges –Executing Applications – Keyloggers and Spyware

UNIT IV **9 Hours**

PROGRAMMING FOR SECURITY PROFESSIONALS

Programming Fundamentals – C language – HTML – Perl – Windows OS Vulnerabilities –Tools for Identifying Vulnerabilities – Countermeasures – Linux OS Vulnerabilities – Tools for Identifying Vulnerabilities – Countermeasures

UNIT V **9 Hours**

NETWORK PROTECTION SYSTEMS

Access Control Lists. - Cisco Adaptive Security Appliance Firewall - Configuration and Risk Analysis Tools for Firewalls and Routers - Intrusion Detection and Prevention Systems - Network-Based and Host- Based IDSs and IPSs - Web Filtering - Security Incident Response Teams – Honeypots.

Total: 45 Hours

Reference(s)

1. EC-Council, “Ethical Hacking and Countermeasures: Attack Phases”, Cengage Learning,2010.
2. Jon Erickson, “Hacking, 2nd Edition: The Art of Exploitation”, No Starch Press Inc.,2008.
3. Michael T. Simpson, Kent Backman, James E. Corley, “Hands-On Ethical Hacking andNetwork Defense”, Cengage Learning, 2013.
4. Patrick Engebretson, “The Basics of Hacking and Penetration Testing – Ethical Hackingand Penetration Testing Made Easy”, Second Edition, Elsevier, 2013.
5. Rafay Boloch, “Ethical Hacking and Penetration Testing Guide”, CRC Press, 2014.

22CT023 SECURE SOFTWARE SYSTEMS 2 0 2 3

Course Objectives

- To Know the importance and need for software security.
- To Know about various attacks.
- To Learn about secure software design.
- To Understand risk management in secure software development.
- To Know the working of tools related to software security.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PSO1: Demonstrate the knowledge and technical skills in software development. PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Analyze various malware analysis concepts and technologies used for threat detection.
2. Apply static and dynamic analysis techniques to independently examine modern malware samples.
3. Analyze professional malware analysis methods and techniques for identifying cyber threats.
4. Apply skills to safely analyze, debug, and disassemble malicious software using malware analysis tools.
5. Analyze Android malware architecture and assess its impact on app security and development.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	2	2	2	-	-	-	-	-	-	-	2	-
2	3	3	2	2	2	-	-	-	-	-	-	-	2	-
3	3	3	3	3	3	-	-	-	-	-	-	-	3	-
4	3	3	3	3	3	-	-	-	-	-	-	-	3	-
5	3	3	3	3	3	-	-	-	-	-	-	-	3	-

UNIT I **6 Hours**

NEED OF SOFTWARE SECURITY AND LOW LEVEL ATTACKS

Software Assurance and Software Security - Threats to software security - Sources of software insecurity - Benefits of Detecting Software Security - Properties of Secure Software – MemoryBased Attacks: Low- Level Attacks Against Heap and Stack - Defense Against Memory-Based Attacks

UNIT II **7 Hours**

SECURE SOFTWARE DESIGN

Requirements Engineering for secure software - SQUARE process Model – Requirements elicitation and prioritization- Isolating The Effects of Untrusted Executable Content - Stack Inspection – Policy Specification Languages – Vulnerability Trends – Buffer Overflow – Code Injection - Session Hijacking. Secure Design - Threat Modeling and Security Design Principles

UNIT III **5 Hours**

SECURITY RISK MANAGEMENT

Risk Management Life Cycle – Risk Profiling – Risk Exposure Factors – Risk Evaluation and Mitigation – Risk Assessment Techniques – Threat and Vulnerability Management

UNIT IV **8 Hours**

SECURITY TESTING

Traditional Software Testing – Comparison - Secure Software Development Life Cycle – Risk Based Security Testing – Prioritizing Security Testing With Threat Modeling – Penetration Testing – Planning and Scoping - Enumeration – Remote Exploitation – Web Application Exploitation - Exploits and Client Side Attacks – Post Exploitation – Bypassing Firewalls and Avoiding Detection - Tools for Penetration Testing

UNIT V **4 Hours**

SECURE PROJECT MANAGEMENT

Governance and security - Adopting an enterprise software security framework - Security and project management - Maturity of Practice

EXPERIMENT 1 **5 Hours**

Implement the SQL injection attack.

EXPERIMENT 2 **5 Hours**

Implement the Buffer Overflow attack.

EXPERIMENT 3 **5 Hours**

Implement Cross Site Scripting and Prevent XSS.

EXPERIMENT 4 **5 Hours**

Perform Penetration testing on a web application to gather information about the system, then initiate XSS and SQL injection attacks using tools like Kali Linux.

EXPERIMENT 5 **5 Hours**

Develop and test the secure test cases.

EXPERIMENT 6 **5 Hours**

Penetration test using kali Linux

Total:30+30= 60 Hours

Reference(s)

1. Julia H. Allen, “Software Security Engineering”, Pearson Education, 2008
2. Evan Wheeler, “Security Risk Management: Building an Information Security Risk Management Program from the Ground Up”, First edition, Syngress Publishing, 2011.
3. Chris Wysopal, Lucas Nelson, Dino Dai Zovi, and Elfriede Dustin, “The Art of Software Security Testing: Identifying Software Security Flaws (Symantec Press)”, Addison-Wesley Professional, 2006
4. Robert C. Seacord, “Secure Coding in C and C++ (SEI Series in Software Engineering)”, Addison-Wesley Professional, 2005.
5. Jon Erickson, “Hacking: The Art of Exploitation”, 2nd Edition, No Starch Press, 2008.
6. Mike Shema, “Hacking Web Apps: Detecting and Preventing Web Application Security Problems”, First edition, Syngress Publishing, 2012
7. Bryan Sullivan and Vincent Liu, “Web Application Security, A Beginner's Guide”, Kindle Edition, McGraw Hill, 2012
8. Lee Allen, “Advanced Penetration Testing for Highly-Secured Environments: The Ultimate Security Guide (Open Source: Community Experience Distilled)”, Kindle Edition, Packt Publishing,2012,Jason Grembi, “Developing Secure Software”.

22CT024 **MALWARE ANALYSIS** **3 0 0 3**

Course Objectives

- Understand the fundamentals of malware, types and its effects.
- Identify and analyze various malware types by static and dynamic analysis.
- To deal with detection, analysis, understanding, controlling, and eradication of malware.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Analyze various malware analysis concepts and technologies used for threat detection.
2. Apply static and dynamic analysis techniques to independently examine modern malware samples.
3. Analyze professional malware analysis methods and techniques for identifying cyber threats.
4. Apply skills to safely analyze, debug, and disassemble malicious software using malware analysis tools.
5. Analyze Android malware architecture and assess its impact on app security and development.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	2	2	2	-	-	-	-	-	-	-	2	-
2	3	3	2	2	2	-	-	-	-	-	-	-	2	-
3	3	3	3	3	3	-	-	-	-	-	-	-	3	-
4	3	3	3	3	3	-	-	-	-	-	-	-	3	-
5	3	3	3	3	3	-	-	-	-	-	-	-	3	-

UNIT I **9 Hours**

INTRODUCTION AND BASIC ANALYSIS

Introduction to Malware - Malware threats - Malware types: Viruses, Worms, Rootkits, Trojans, Bots, Spyware, Adware, Logic Bombs - Goals of Malware Analysis - AV Scanning – Hashing - Finding Strings - Packing and Obfuscation - PE file format – Static - Linked Libraries and Functions - Static Analysis tools - Virtual Machines and their usage in Malware analysis – Sandboxing - Basic dynamic analysis - Malware execution - Process Monitoring -Viewing processes - Registry snapshots

UNIT II **10 Hours**

ADVANCED STATIC ANALYSIS

The Stack – Conditionals – Branching - Rep Instructions – Disassembly - Global and local variables - Arithmetic operations – Loops - Function Call Conventions - C Main Method and Offsets. Portable Executable File Format - The PE File Headers and Sections - IDA Pro - Function analysis – Graphing - The Structure of a Virtual Machine - Analyzing Windows programs - Anti-static analysis techniques – obfuscation – packing – metamorphism - polymorphism.

UNIT III **10 Hours**

ADVANCED DYNAMIC ANALYSIS

Live malware analysis - dead malware analysis - analyzing traces of malware - system calls - api calls – registries - network activities. Anti-dynamic analysis techniques - VM detection techniques- Evasion techniques - Malware Sandbox - Monitoring with Process Monitor - Packet Sniffing with Wireshark - Kernel vs. User-Mode Debugging – OllyDbg – Breakpoints – Tracing - Exception Handling – Patching

UNIT IV **8 Hours**

MALWARE FUNCTIONALITY

Downloaders and Launchers – Backdoors - Credential Stealers - Persistence Mechanisms- Handles – Mutexes - Privilege Escalation - Covert malware launching- Launchers - Process Injection- Process Replacement - Hook Injection – Detours - APC injection

UNIT V **8 Hours**

ANDROID MALWARE ANALYSIS

Android Malware Analysis: Android architecture - App development cycle – APKTool- APKInspector - Dex2Jar - JD-GUI - Static and Dynamic Analysis - Case Study: Smartphone (Apps) Security

Total: 45 Hours

Reference(S)

1. Michael Sikorski and Andrew Honig, “Practical Malware Analysis” by No Starch Press, 2012, ISBN: 9781593272906
2. Bill Blunden, “The Rootkit Arsenal: Escape and Evasion in the Dark Corners of the System”, Second Edition, Jones & Bartlett Publishers, 2009.
3. Jamie Butler and Greg Hoglund, “Rootkits: Subverting the Windows Kernel” by 2005, Addison-Wesley Professional.
4. Bruce Dang, Alexandre Gazet, Elias Bachaalany, Sébastien Josse, "Practical Reverse Engineering: x86, x64, ARM, Windows Kernel, Reversing Tools, and Obfuscation", 2014.
5. Victor Marak, "Windows Malware Analysis Essentials" Packt Publishing, O’Reilly, 2015.
6. Ken Dunham, Shane Hartman, Manu Quintans, Jose Andre Morales, Tim Strazzere, "Android Malware and Analysis", CRC Press, Taylor & Francis Group, 2015.

22CT025 MULTIMEDIA AND ANIMATION 2 0 2 3

Course Objectives

- Understand the basic knowledge of multimedia Systems and related technologies.
- To learn about multimedia elements in a comprehensive way.
- Understand the basics of digital 2D animation to create story and multimedia production
- Design the technical and artistic skills to produce 3D animations.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Apply multimedia elements, image processing, and animation techniques to design and produce interactive digital content for diverse applications.
2. Analyze and evaluate encoding and decoding processes for multimedia elements to optimize their quality and efficiency.
3. Design and author 2D and 3D creative presentations by integrating interactive elements tailored to specific target audiences and applications.
4. Create and animate 3D models using advanced software tools, demonstrating proficiency in modeling, shading, and rigging techniques.
5. Evaluate and compare different multimedia authoring tools and techniques to select the most appropriate solutions for specific projects.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	3	2	3	1	1	1	-	2	-	2	3	3
2	3	3	2	3	3	1	1	1	-	2	-	2	3	2
3	2	2	3	2	3	2	2	1	-	3	2	2	3	3
4	3	2	3	2	3	1	1	1	-	3	2	2	3	3
5	3	3	2	3	3	1	1	1	2	2	2	3	3	2

UNIT I 6 Hours

INTRODUCTION TO MULTIMEDIA ELEMENTS

Multimedia - Medium - Properties of a Multimedia System - Traditional Data Stream Characteristics -Text - Basic Sound Concepts – Speech. Image – Computer Image Processing

UNIT II **6 Hours**

MULTIMEDIA COMPRESSION

Storage Space - Coding Requirements - Hybrid Coding - JPEG: Image Preparation, Lossy Mode, Lossless Mode, Hierarchical Mode - H.261 - MPEG: Video Encoding, Data Stream, MPEG 3, MPEG 7, MPEG 21

UNIT III **6 Hours**

MULTIMEDIA AUTHORING

Authoring metaphors, Tools Features and Types: Card and Page Based Tools - Icon and Object Based Tools, Time Based Tools - 3D Modeling and Animation Tools - Image Editing Tools - audio Editing Tools - Digital Movie Tools - Creating interactive presentations - virtual learning, simulations.

UNIT IV **6 Hours**

2D ANIMATION

Introduction to 2D Animation, Colour theory & basics - Layout & Designing Basic of sketching - Composition of basic elements - Graphics and advertising - Creating Digital Layout, Professional image editing - Story Boarding, stop motion animation - Production / Post-Production-Background composition - 2D animation and techniques.

UNIT V **6 Hours**

3D ANIMATION

3D Modeling - Modeling Techniques - Types of Modeling - 3D Shading-Use of Material, Shader and Texture editing - Introduction to 3D Animation -3D Animation and Rigging - Setting up controllers for joints - Simple Skeleton structure with proper joint orientation - 3D Lighting and Rendering.

EXPERIMENT 1 **3 Hours**

Image Editing and Manipulation - Basic Operations on images using anyimage editing software.

EXPERIMENT 2 **3 Hours**

Implementation of audio and Video Editing techniques.

EXPERIMENT 3 **3 Hours**

Sketching of cartoon characters.

EXPERIMENT 4 **3 Hours**

Design 2D Logo using the image editing tool.

EXPERIMENT 5 **3 Hours**

Creating gif animated images in 2D Animation**.**

EXPERIMENT 6 **3 Hours**

Exploring the Interface of 3D application & Primitive Modelling.

EXPERIMENT 7 **3 Hours**

Create different types of Materials and Shading.

EXPERIMENT 8 **3 Hours**

Create a simple walk cycle using the character Rigs.

EXPERIMENT 9 **3 Hours**

Create a 3-point Light Setup.

EXPERIMENT 10 **3 Hours**

Create particle Simulation & Rendering.

Total: 30+30 = 60 Hours

Reference(s)

1. Ze-Nian Li, Mark S. Drew, Jiangchuan Liu, Fundamentals of Multimedia", Third Edition,Springer Texts in Computer Science, 2021.
2. Andleigh, P. K and Kiran Thakrar, "Multimedia Systems and Design", PHI, 2003.
3. Multimedia: Making It Work, Tay Vaughan, 9th Edition,
4. The Illusion of Life: Disney Animation - Frank Thomas and Ollie Johnston
5. Maraffi, Chris, Maya Character Creation: Modeling and Animation Controls. New Riders, 2008.
6. John M Blain, The Complete Guide to Blender Graphics: Computer Modeling & Animation,CRC press, 3rd Edition, 2016.

22CT008 **UI AND UX DESIGN** **3 0 0 3**

Course Objectives

- Study about designing web pages and understand the difference between UI and UX Design.
- To understand the concept of UX design and how it has evolved Able o to understand UX designprocess and methodology.
- Learning the Importance and scope of Interaction design, User centered design

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PSO1: Demonstrate the knowledge and technical skills in software development. PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Understand to do user research, persona mapping, customer journey mapping
2. Design of interactive products Methods of interaction design Tools for interaction design
3. Design wireframes on paper and translate paper concepts into digital wireframes.
4. Apply and practice the techniques involved in designing digital wireframes using various UI elements.
5. Implement the process of conducting usability tests learning steps for digital products.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1												1	1
2	1	2	2		1								2	1
3		3	3		1								2	1
4		2	2										1	2
5		2	2										1	2

UNIT I **9 Hours**

USER CENTERED DESIGN PROCESS

Scripting Languages – HTML, CSS - Fundamentals of graphics design, principles of visual design - Overview of UI & UX Design - Overview of the UX Design Process - Difference between User Interface (UI) vs User Experience (UX) - Defining problem and vision statement - Persona creation – Primary and Secondary persona - Requirement definition - Creative ideation – brainstorming and ideation techniques
- Scenarios and functionality extraction - Information Architecture - Task flows - Wireframe design

UNIT II **9 Hours**

FUNDAMENTALS OF UI, HEURISTICS, AND INTERACTION DESIGN

Design Principles for UX and UI Design - UI Elements-Patterns - Material Design (Google) and Human Interface Design (Apple) guidelines - Interaction Principles & Interaction Behaviour - Masterthe Brand Platforms & Style Guides - comments and current UI patterns - Understand problems and design solutions for e-commerce, social media, message, data, and dashboard design

UNIT III **9 Hours**

ELEMENTARY SKETCHING

Principles of Sketching - Core Responsive Design - Wireframing vs Wireflows - Click through Wireframing Prototyping - Wireflow Creation - Work with different tools – Figma - Low-High Fidelity Design: Inclusive Design and Designing for Accessibility - Building High-Fidelity Mockups - Designing Efficiently with Tools - Interaction Patterns - Designing animations and interactions.

UNIT IV **9 Hours**

UNDERSTAND STYLE GUIDES, ELEMENTS, PROTOTYPING

Building a Design System – Style guides, color palette, fonts, grid, iconography, UI elements, photography or imagery, and illustration - Use of grids in UI design - Design animations and interaction patterns for key UI elements.

UNIT V **9 Hours**

USABILITY EVALUATION AND PRODUCT DESIGN

Type of usability evaluation – Qualitative & Quantitative evaluation - Guerilla testing , A/B Testing, Unmoderated remote usability testing, Card sorting, Session recording, think aloud - Think aloud – Introduction and advantages - Designing evaluation protocol - Conducting usability evaluation study – Conduct Usability Test explicit - Synthesize Test Findings - practices in corporate World - Product Design Types of products & solutions - Design Psychology for e-commerce sites , CMS - Design Thinking Life Cycle

Total: 45 Hours

Reference(s)

1. Norman, Donald A. The Design of Everyday Things. Basic Books, 2002. ISBN: 9780465067107.
2. Nielsen, Jakob. Usability Engineering. Morgan Kaufmann, 1993. ISBN: 9780125184069.
3. Mullet, Kevin, and Darrell Sano. Designing Visual Interfaces: Communication Oriented Techniques. Prentice Hall, 1994. ISBN: 9780133033892.
4. Wilbent. O. Galitz ,“The Essential Guide To User Interface Design”, John Wiley&Sons, 2001.
5. Ben Sheiderman, “Design The User Interface”, Pearson Education, 1998.
6. Alan Cooper, “The Essential Of User Interface Design”, Wiley – Dream Tech Ltd.,2002.

22CT026 AUGMENTED REALITY AND VIRTUAL REALITY 2 0 2 3

Course Objectives

- To impart the fundamental aspects and principles of AR/VR technologies.
- To know the internals of the hardware and software components involved in the development of AR/VR enabled applications.
- To learn about the graphical processing units and their architectures.
- To gain knowledge about AR/VR application development.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1: Demonstrate the knowledge and technical skills in software development. PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Analyze and compare tools and technologies related to AR/VR to determine their suitability for specific applications.
2. Design and develop 3D models using advanced modeling techniques, ensuring accuracy and realism.
3. Apply programming concepts and techniques to create immersive VR environments, integrating 3D graphics and interactivity.
4. Develop and evaluate AR/VR applications for diverse domains, such as education, healthcare, and entertainment.
5. Analyze the human factors and societal impacts of AR/VR technologies to propose solutions for ethical and safe usage.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	2	3	3	-	-	-	-	2	-	2	3	2
2	3	2	3	2	3	-	-	-	-	2	-	2	3	3
3	3	2	3	2	3	-	-	-	2	3	2	2	3	3
4	3	2	3	3	3	2	2	1	2	3	2	3	3	3
5	2	2	2	2	2	3	3	3	-	3	-	3	2	2

UNIT I **6 Hours**

INTRODUCTION

Introduction to Virtual Reality and Augmented Reality – Definition – Introduction to Trajectories and Hybrid Space-Three I's of Virtual Reality – Virtual Reality Vs 3D Computer Graphics – Benefits of Virtual Reality – Components of VR System – Introduction to AR-AR Technologies-Input Devices – Types of Trackers –Human Visual System – Personal Graphics Displays – Human Auditory System

UNIT II **6 Hours**

VR MODELING

Modelling – Geometric Modelling – Virtual Object Shape – Object Visual Appearance – Kinematics Modelling – Transformation Matrices – Object Position – Transformation Invariants –Object Hierarchies – Physical Modelling – Behavior Modelling – Model Management

UNIT III **6 Hours**

VR PROGRAMMING

VR Programming – Toolkits and Scene Graphs – World ToolKit – Java 3D – Comparison of World ToolKit and Java 3D.

UNIT IV **6 Hours**

APPLICATIONS

Human Factors in VR – Methodology and Terminology – VR Health and Safety Issues – VR and Society- Medical Applications of VR – Education, Arts and Entertainment – Military VR Applications – Emerging Applications of VR.

UNIT V **6 Hours**

AUGMENTED REALITY

Introduction to Augmented Reality – Computer vision for AR – Interaction – Modelling and Annotation Navigation – Wearable devices.

EXPERIMENT 1 3 Hours

Study of tools like Unity, Maya, 3DS MAX, AR toolkit, Vuforia and Blender.

EXPERIMENT 2 3 Hours

Use the primitive objects and apply various projection types by handling camera.

EXPERIMENT 3 **3 Hours**

Download objects from asset store and apply various lighting and shading effects

EXPERIMENT 4 **3 Hours**

Model three dimensional objects using various modelling techniques and apply textures over them.

EXPERIMENT 5 **3 Hours**

Create three dimensional realistic scenes and develop simple virtual reality enabled mobile applicationswhich have limited interactivity.

EXPERIMENT 6 **3 Hours**

Add audio and text special effects to the developed application.

EXPERIMENT 7 **3 Hours**

Develop VR enabled applications using motion trackers and sensors incorporating full haptic interactivity.

EXPERIMENT 8 **3 Hours**

Develop AR enabled applications with interactivity like E learning environment, Virtual walk throughs and visualization of historic places.

EXPERIMENT 9 **3 Hours**

Develop AR enabled simple applications like human anatomy, DNA/RNA structure visualization.

EXPERIMENT 10 **3 Hours**

Develop simple MR enabled gaming applications.

Total:30+30= 60 Hours

Reference(s)

1. Charles Palmer, John Williamson, “Virtual Reality Blueprints: Create compelling VR experiences for mobile”, Packt Publisher, 2018.
2. Dieter Schmalstieg, Tobias Hollerer, “Augmented Reality: Principles & Practice”, Addison Wesley, 2016.
3. John Vince, “Introduction to Virtual Reality”, Springer-Verlag, 2004.
4. William R. Sherman, Alan B. Craig: Understanding Virtual Reality – Interface, Application, Design”, Morgan Kaufmann, 2003.

22CT027 GAME DEVELOPMENT 2 0 2 3

Course Objectives

- To know the basics of 2D and 3D graphics for game development.
- To know the stages of game development.
- To understand the basics of a game engine.
- To survey the gaming development environment and tool kits.
- To learn and develop simple games using Pygame environment

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PSO1: Demonstrate the knowledge and technical skills in software development. PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Analyze the foundations of 2D and 3D graphics to design and implement game components such as avatars, transformations, and animations.
2. Design and develop game design documents, including storyboards, scripts, and level designs, to guide the game development process.
3. Implement game engines by applying rendering techniques, spatial sorting algorithms, and collision detection mechanisms.
4. Evaluate gaming environments and frameworks (e.g., Pygame, Unity, Unreal Engine) to select the most appropriate tools for specific game projects.
5. Create and construct interactive 2D and 3D games using Pygame, integrating game physics, sound, and user interaction with ethical and social implications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	3	2	3	-	-	-	-	2	-	2	3	3
2	2	2	3	2	3	-	-	-	2	3	2	2	3	2
3	3	2	3	3	3	-	-	-	2	3	2	2	3	3
4	3	3	2	3	3	-	-	-	-	2	-	2	3	2
5	3	2	3	2	3	1	1	1	2	3	2	2	3	3

UNIT I **6 Hours**

3D GRAPHICS FOR GAME DESIGN

Genres of Games, Basics of 2D and 3D Graphics for Game Avatar, Game Components – 2D and 3D Transformations – Projections – Color Models – Illumination and Shader Models – Animation – Controller Based Animation.

UNIT II **6 Hours**

GAME DESIGN PRINCIPLES

Character Development, Storyboard Development for Gaming – Script Design – Script Narration, Game Balancing, Core Mechanics, Principles of Level Design – Proposals – Writing for Preproduction, Productionand Post – Production.

UNIT III **6 Hours**

GAME ENGINE DESIGN

Rendering Concept – Software Rendering – Hardware Rendering – Spatial Sorting Algorithms – Algorithms for Game Engine– Collision Detection – Game Logic – Game AI – Pathfinding.

UNIT IV **6 Hours**

OVERVIEW OF GAMING PLATFORMS AND FRAMEWORKS

Pygame Game development – Unity – Unity Scripts –Mobile Gaming, Game Studio, Unity Single player and Multi-Player games.

UNIT V **6 Hours**

GAME DEVELOPMENT USING PYGAME

Developing 2D and 3D interactive games using Pygame – Avatar Creation – 2D and 3D Graphics Programming – Incorporating music and sound – Asset Creations – Game Physics Algorithms Development – Device Handling in Pygame – Overview of Isometric and Tile Based Arcade Games – Puzzle Games.

EXPERIMENT 1 3 Hours

Installation of a game engine, e.g., Unity, Unreal Engine, familiarization of the GUI. Conceptualize the theme for a 2D game

EXPERIMENT 2 3 Hours

Character design, sprites, movement and character control

EXPERIMENT 3 3 Hours

Level design: design of the world in the form of tiles along with interactive and collectible objects

EXPERIMENT 4 4 Hours

Design of interaction between the player and the world, optionally using the physics engine.

EXPERIMENT 5 **4 Hours**

Developing a 2D interactive using Pygamme

EXPERIMENT 6 **4 Hours**

Developing a Puzzle game

EXPERIMENT 7 **3 Hours**

Design of menus and user interaction in mobile platforms.

EXPERIMENT 8 **3 Hours**

Developing a 3D Game using Unreal

EXPERIMENT 9 **3 Hours**

Developing a Multiplayer game using unity

Total:30+30= 60 Hours

Reference(s)

1. Sanjay Madhav, "Game Programming Algorithms and Techniques: A Platform Agnostic Approach",Addison Wesley,2013.
2. Will McGugan, "Beginning Game Development with Python and Pygame: From Novice to Professional", Apress,2007.
3. Paul Craven, "Python Arcade games", Apress Publishers,2016.
4. David H. Eberly, "3D Game Engine Design: A Practical Approach to Real-Time Computer Graphics", Second Edition, CRC Press,2006.
5. Jung Hyun Han, "3D Graphics for Game Programming", Chapman and Hall/CRC, 2011.

22CT028 VIDEO CREATION AND EDITING 2 0 2 3

Course Objectives

- To introduce the broad perspective of linear and nonlinear editing concepts.
- To understand the concept of Storytelling styles.
- To be familiar with audio and video recording. To apply different media tools.
- To learn and understand the concepts of AVID XPRESS DV 4.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1: Demonstrate the knowledge and technical skills in software development. PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Analyze the risks and ethical considerations associated with altering reality through editing in filmmaking.
2. Design and develop storytelling narratives using digital editing techniques such as jump cuts, L-cuts, and match cuts.
3. Create and edit audio and video content using professional tools like Final Cut Pro and Avid Xpress DV 4.
4. Apply advanced editing techniques in Final Cut Pro to create, edit, and refine video sequences, integrating effects, audio adjustments, and timeline management for professional-quality video projects.
5. Evaluate and optimize post-production workflows, including editing, sound design, and finishing.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	2	-	2	-	3	2	3	-	2	-	2	2	-
2	2	2	3	-	3	-	-	-	2	3	2	2	3	2
3	2	-	3	2	3	-	-	-	-	2	-	2	3	3
4	3	-	3	3	3	-	-	-	2	2	2	2	3	3
5	3	2	3	3	3	-	-	-	-	2	2	3	3	2

UNIT I **6 Hours**
FUNDAMENTALS
Evolution of filmmaking - linear editing - non-linear digital video - Economy of Expression - risks associated with altering reality through editing.

UNIT II **6 Hours**
STORYTELLING
Storytelling styles in a digital world through jump cuts, L-cuts, match cuts, cutaways, dissolves, splitedits - Consumer and pro NLE systems - digitizing images - managing resolutions - Understanding video color - Color Correcting Basics - Color Enhancement Effects mechanics of digital editing - pointer files - media management.

UNIT III **6 Hours**
USING AUDIO AND VIDEO
Audio: Timeline Audio Tracks - Editing Audio- Gaining, Fading and Balancing Audio- Video: Capturing digital and analog video - importing audio on putting video - exporting digital video to tape - recording to CDs and VCDs

UNIT IV **6 Hours**
WORKING WITH FINAL CUT PRO
Working with clips and the Viewer - working with sequences, the Timeline, and the canvas - Basic Editing - Adding and Editing Testing Effects - Advanced Editing and Training Techniques - Workingwith Audio - Using Media Tools - Viewing and Setting Preferences.

UNIT V **6 Hours**
WORKING WITH AVID XPRESS DV 4
Starting Projects and Working with Project Window - Using Basic Tools and Logging - Preparing toRecord and Recording - Importing Files - Organizing with Bins - Viewing and Making Footage - Using Timeline and Working in Trim Mode - Working with Audio - Output Options.

EXPERIMENT 1 **3 Hours**

Write a Movie Synopsis (Individual/Team Writing)

EXPERIMENT 2 **3 Hours**
Present team stories in class

EXPERIMENT 3 **4 Hours**
Script/Storyboard Writing(Individual Assignment)

EXPERIMENT 4 **4 Hours**
Pre-Production: Personnel, budgeting, scheduling, location scouting, casting, contracts & agreements

EXPERIMENT 5 **4 Hours**
Production: Single camera production personnel & equipment, Documentary Production

EXPERIMENT 6 **3 Hours**
Writing The Final Proposal: Overview, Media Treatments, Summary, Pitching

EXPERIMENT 7 **4 Hours**
Write Documentary & Animation Treatment

EXPERIMENT 8 **5 Hours**
Post-production: Editing, Sound design, Finishing

Total:30+30= 60 Hours

Reference(s)

1. Avid Xpress DV 4 User Guide, 2007.
2. Final Cut Pro 6 User Manual, 2004.
3. Keith Underdahl, Digital Video for Dummies, Third Edition, Dummy Series, 2001.
4. Robert M. Goodman and Partick McGarth, Editing Digital Video: The Complete Creative and Technical Guide, Digital Video and Audio, McGraw - Hill 2003.

22CT029 **DIGITAL MARKETING** **3 0 0 3**

Course Objectives

- Understand the overview of Digital Marketing.
- Examine the role and importance of digital marketing in the business environment.
- Determine the focuses on digital marketing and its measure

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PSO1: Demonstrate the knowledge and technical skills in software development. PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Analyze the latest digital marketing trends and the essential skill sets required for modern marketers.
2. Evaluate the strengths and limitations of search engine optimization in improving website visibility and traffic.
3. Apply appropriate email marketing techniques, including automation and lead generation, to optimize customer outreach.
4. Create data-driven digital marketing campaigns by leveraging advanced strategies in search, social, and mobile marketing.
5. Analyze and evaluate digital marketing assets to prioritize key business components and maximize return on investment (ROI).

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	-	-	3	-	2	2	3	2	-	3	3	-
2	3	3	2	-	3	-	2	-	3	2	3	-	3	-
3	-	3	3	2	3	3	-	-	3	3	3	3	3	3
4	3	-	3	3	3	3	3	-	3	3	-	3	3	3
5	3	3	-	3	3	3	-	-	3	3	3	3	3	3

UNIT I **9 Hours**

INTRODUCTION TO ONLINE MARKET

Online Market space- Digital Marketing Strategy- Components - Opportunities for building Brand Website - Planning and Creation - Content Marketing.

UNIT II **9 Hours**

SEARCH ENGINE OPTIMISATION

Search Engine optimisation - Keyword Strategy- SEO Strategy - SEO success factors -On-Page Techniques - Off-Page Techniques. Search Engine Marketing- How Search Engine works- SEM components- PPC advertising -Display Advertisement.

UNIT III **9 Hours**

EMAIL MARKETING

EMail Marketing - Types of EMail Marketing - Email Automation - Lead Generation – Integrating Email with Social Media and Mobile- Measuring and maximizing email campaign effectiveness. Mobile Marketing- Mobile Inventory/channels- Location based; Context based; Coupons and offers, Mobile Apps, Mobile Commerce, SMS Campaigns-Profiling and targeting

UNIT IV **9 Hours**

SOCIAL MEDIA MARKETING

Social Media Marketing - Social Media Channels- Leveraging Social media for brand conversations and buzz. Successful /benchmark Social media campaigns. Engagement Marketing- Building Customer relationships - Creating Loyalty drivers - Influencer Marketing.

UNIT V **9 Hours**

DIGITAL TRANSFORMATION

Digital Transformation & Channel Attribution- Analytics- Ad-words, Email, Mobile, social media,Web Analytics - Changing your strategy based on analysis- Recent trends in Digital marketing.

Total: 45 Hours

Reference(s)

1. Fundamentals of Digital Marketing by Puneet Singh Bhatia;Publisher: Pearson Education; Firstedition (July 2017);ISBN-10: 933258737X;ISBN-13: 978-9332587373
2. Digital Marketing by Vandana Ahuja; Publisher: Oxford University Press (April 2015). ISBN-10: 0199455449
3. Marketing 4.0: Moving from Traditional to Digital by Philip Kotler;Publisher: Wiley; 1st edition(April 2017); ISBN10: 9788126566938;ISBN 13: 9788126566938;ASIN: 8126566930.
4. Michael Millerth, B2B Digital Marketing: Using the Web to Market Directly to Businesses,firstedition, Que Biz-Tech series2012.
5. Dave Chaffey, Fiona Ellis Chadwick, Digital Marketing: Strategy, Implementation & Practice,Paperback - Import, 2012.

22CT030 REAL TIME OPERATING SYSTEM 3 0 0 3

Course Objectives

- Analyze the students to the fundamentals of interaction of OS with a computer and User computation.
- Apply the fundamental concepts of how processes are created and controlled with the OS.
- Analyze on programming logic of modelling Process based on range of OS features.
- Evaluate types and Functionalities in commercial OS, application development using RTOS
- Analyze the involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PSO1: Demonstrate the knowledge and technical skills in software development. PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Analyze Operating System structures and types.
2. Apply into scheduling, disciplining of various processes execution.
3. Implement knowledge on various RTOS support modelling
4. Evaluate commercial RTOS Suite features to work on real time processes design.
5. Analyze Employability and entrepreneurship capacity due to knowledge upgradation on recent trends in RTOS and embedded automation design.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	-	1	-	2	-	-	-	-	-	-	-	2	-
2	-	-	2	-	3	1	-	-	-	-	-	-	2	-
3	2	-	2	1	2	2	-	-	-	-	-	-	-	1
4	2	2	3	2	1	3	-	-	-	-	-	-	-	2
5	-	-	1	-	3	1	-	-	-	-	-	-	-	2

UNIT I **9 Hours**

REVIEW OF OPERATING SYSTEMS

Basic Principles – Operating System Structures – System Calls – Files – Processes – Design and Implementation of Processes – Communication between Processes – Introduction to Distributed Operating System – Embedded Operating Systems.

UNIT II **9 Hours**

OVERVIEW OF RTOS

RTOS Task and Task State – Multithreaded Preemptive Scheduler- Process Synchronization – Message Queues – Mailboxes – Pipes – Critical Section – Semaphores – Classical Synchronization Problem – Deadlocks.

UNIT III **9 Hours**

REALTIME MODELS AND LANGUAGES

Event Based – Process based and Graph based Models – Real Time Languages – RTOS Tasks – RT Scheduling – Interrupt Processing – Synchronization – Control Blocks – Memory Requirements.

UNIT IV **9 Hours**

REALTIME KERNEL

Principles – Design Issues – Polled Loop Systems – RTOS Porting to a Target – Comparison and basic Study of Various RTOS like – VX works – Linux Supportive RTOS – C Executive.

UNIT V **9 Hours**

APPLICATION DEVELOPMENT

Discussions on basics of Linux Supportive RTOS – µC/OS-System Level Functions- Task Service and Time Functions and their Exemplary Uses –Time Delay Functions – Memory Allocation Related Functions- C Executive for Development of RTOS

Total: 45 Hours

Reference(s)

1. Charles Crowley, Operating Systems-A Design Oriented approach, McGraw Hill, 2006.
2. Karim Yaghmour, Building Embedded Linux System,O’reilly Pub,2008.
3. Mukesh Sighal and N G Shi , Advanced Concepts in Operating System, McGraw Hill, 2017
4. Raj Kamal,Embedded Systems- Architecture, Programming and Design,Tata McGraw Hill,2006.
5. Silberschatz,Galvin,Gagne, Operating System Concepts, 9th ed, John Wiley, 2012.

22CT031 WIRELESS AND MOBILE COMMUNICATION 3 0 0 3

Course Objectives

- Analyze the Channel planning for Wireless Systems
- Apply the Mobile Radio Propagation and Equalization and Diversity
- Implement study the Equalization and Diversity
- Analyze the provide insight about wideband code division based access.
- Execute the study of Wireless multiple access and IP

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Apply Cellular communication concepts
2. Analyze the Mobile radio propagation
3. Execute the Wireless network different type of MAC protocols
4. Analyze the Equalization and Diversity
5. Implement the Wireless multiple access and IP

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	2	1	-	-	-	-	-	-	-	-	-	2
2	3	3	2	2	-	-	-	-	-	-	-	-	-	2
3	3	3	2	3	2	2	-	-	-	-	-	-	-	2
4	-	2	2	-	3	-	-	-	-	-	-	-	-	2
5	-	2	3	-	2	-	-	-	-	-	-	-	-	2

UNIT I **9 Hours**

WIRELESS COMMUNICATION SYSTEM

Introduction to Wireless Communication System – The Cellular Concept: Introduction – Frequency Reuse – Channel Assignment Strategies – Handoff Strategies – Interference and System Capacity – Trunking – Improving Coverage & Capacity in Cellular Systems.

UNIT II **9 Hours**

MOBILE RADIO PROPAGATION: LARGE SCALE PATH LOSS

Introduction to Radio Wave Propagation – Free Space Propagation Model – Relating Power to Electric Field – The Three Basic Propagation Mechanisms – Reflections – Diffraction – Scattering – Practical Link Budget Detection using Path Loss models – Outdoor Propagation Models – Indoor Propagation Models – Signal penetration into buildings – Ray Tracing and Site Specific Modelling.

UNIT III **9 Hours**

MOBILE RADIO PROPAGATION: SMALL SCALE FADING AND MULTIPATH

Small Scale Multipath propagation – Impulse Response Model of a multipath channel – Small-Scale Multipath Measurements – Parameters of Mobile Multipath Channels: Time Dispersion Parameters, Coherence Bandwidth, Doppler Spread and Coherence Time – Types of Small-Scale Fading – Rayleigh and Ricean Distributions – Fundamentals of Equalization, Training A Generic Adaptive Equalizer, Equalizers in a Communication Receiver, Linear Equalizers, Nonlinear Equalization.

UNIT IV **9 Hours**

WIDEBAND CODE DIVISION MULTIPLE ACCESS

CDMA System Overview – Air Interface – Physical and Logical Channel – Speech Coding, Multiplexing and Channel Coding – Spreading and Modulation: Frame Structure, Spreading Codes-Uplink-Downlink – Physical Layer Procedures: Cell Search and Synchronization – Establishing a Connection – Power Control – Handover-Overload Control.

UNIT V **9 Hours**

IP MOBILITY FRAMEWORK

Challenges of IP Mobility – Address Management – Dynamic Host Configuration Protocol and Domain Name Server Interfaces – Security – Mobility-based AAA Protocol – IP Mobility Architecture Framework – x Access Network – IPv6 Challenges for IP Mobility.

Total: 45 Hours

Reference(s)

1. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2005.
2. Gottapu Sasibhushana Rao, Mobile Cellular Communication, Pearson Education, 2012.
3. Kaveh PahLavan and P. Krishna Murthy, Principles of Wireless Networks , 2002.
4. Theodore, S. Rappaport, Wireless Communications, Principles, Practice, 2nd Ed., 2002.
5. William Stallings, Wireless Communication and Networking, 2003.

22CT032 DESIGN OF EMBEDDED SYSTEMS 2 0 2 3

Course Objectives

- Apply knowledge on the basics, building blocks of Embedded systems.
- Apply Input/output Interfacing & Bus Communication with processors.
- Execute automation using scheduling algorithms and Real time operating systems.
- Evaluate modeling of embedded systems with hardware and software design approaches
- Implement different Phases & Modeling of a new embedded product.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Apply the functionalities of processor internal blocks, with their requirement.
2. Analyze that Bus standards are chosen based on interface overheads without sacrificing processor performance
3. Execute the role and features of the RT operating system, that makes multi task execution possible by processors.
4. Evaluate that using multiple CPUs based on either hardcore or softcore helps data overhead management with processing- speed reduction for uC execution.
5. Apply Embedded consumer product design based on phases of product development.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	3	2	1	-	-	-	-	-	-	-	-	3
2	2	-	1	2	-	-	-	-	-	-	-	-	-	3
3	-	2	2	3	-	-	-	-	-	-	-	-	-	3
4	2	-	3	3	-	-	-	-	-	-	-	-	-	3
5	2	-	1	2	-	-	-	-	-	-	-	-	-	3

UNIT I **6 Hours**

INTRODUCTION TO EMBEDDED SYSTEMS

Introduction to Embedded Systems – Built in Features for Embedded Target Architecture - Selection of Embedded Processor – DMA – Memory Devices – Memory Management Methods – Memory Mapping, Cache Replacement Policies – Timer and Counting Devices, Watchdog Timer, Real Time Clock Software Development Tools – IDE, Assembler, Compiler, Linker, Simulator, Debugger, In-circuit Emulator, Target Hardware Debugging – Overview of Functional Safety Standards for Embedded Systems.

UNIT II **6 Hours**

EMBEDDED NETWORKING BY PROCESSORS

Embedded Networking: Introduction, I/O Device Ports & Buses – Multiple Interrupts and Interrupt Service Mechanism – Serial Bus Communication Protocols – RS232 Standard – RS485 – USB – Inter Integrated Circuits (I2C) – CAN Bus – Wireless Protocol based on Wifi , Bluetooth, Zigbee – Introduction to Device Drivers.

UNIT III **6 Hours**

RTOS BASED EMBEDDED SYSTEM DESIGN

Introduction to Basic Concepts of RTOS – Need, Task, Process & Threads, Interrupt Routines in RTOS, Multiprocessing and Multitasking, Preemptive and Non-Preemptive Scheduling, Task Communication Context Switching, Interrupt Latency and Deadline Shared Memory, Message Passing, Interprocess Communication – Synchronization between Processes – Semaphores, Mailbox, Pipes, Priority Inversion, Priority Inheritance, Comparison of Real Time Operating Systems: VxWorks, uC/OS-II, RT Linux.

UNIT IV **6 Hours**

MODELING WITH HARDWARE AND SOFTWARE DESIGN APPROACHES

Modeling Embedded Systems – Embedded Software Development Approach – Overview of UML Modeling with UML, UML Diagrams – Hardware/Software Partitioning, Co-Design Approaches for System Specification and Modeling – CoSynthesis – Features Comparing Single – Processor Architectures & Multi-Processor Architectures – Design Approach on Parallelism in Uniprocessors & Multiprocessors.

UNIT V **6 Hours**

EMBEDDED SYSTEM APPLICATION DEVELOPMENT

Phases & Modelling of the EDLC - Target Architectures for Control Dominated Embedded Application Development – Data Dominated Systems – Case Studies: Digital Camera, Car Adaptive Cruise Control, Mobile Software for Key Inputs.

EXPERIMENT 1 6 Hours

Programming with 8 bit Microcontrollers # Assembly programming.

EXPERIMENT 2 6 Hours

Programming with 8 bit Microcontrollers # C programming.

EXPERIMENT 3 6 Hours

I/O Programming with 8 bit Microcontrollers I/O Interfacing : Serial port programming/ LCD/Sensor Interfacing /PWM Generation/ Motor Control.

EXPERIMENT 4 **6 Hours**

Programming with PIC Microcontrollers: a) Assembly b) C programming

EXPERIMENT 5 **6 Hours**

I/O Programming with PIC Microcontrollers I/O Interfacing : PWM Generation/ Motor Control/ADC/DAC/ LCD/Sensor Interfacing

Total:30+30= 60 Hours

Reference(s)

1. Bruce Powel Douglass, Real-Time UML Workshop for Embedded Systems, Elsevier, 2011.
2. EliciaWhite, Making Embedded Systems,O'Reilly Series, SPD, 2011.
3. JohnWiley & Sons, Embedded system Design, Peckol, 2010.
4. Lyla B Das, Embedded Systems - An Integrated Approach, Pearson, 2013.
5. Rajkamal, Embedded system - Architecture, Programming, Design, TMH, 2011.

22CT033 EMBEDDED SYSTEM NETWORKING 3 0 0 3

Course Objectives

- Apply the foundations and building blocks of an Embedded system.
- Analyze introduce the concepts of Embedded Ethernet.
- Evaluate expose the students to the fundamentals of Embedded Networking Protocols & Standards.
- Execute develop the control strategies and algorithms to optimize the operation of building systems.
- Implement optimize the operation and management of Electrical Systems in Industrial Environment.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PSO1: Demonstrate the knowledge and technical skills in software development. PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Analyze the different bus communication protocols used for embedded networking.
2. Evaluate the concepts of embedded networking.
3. Apply the embedded networking concepts in wireless networks.
4. Implement the appropriate security measures to protect the building automation system.
5. Analyze system automation for different industrial applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	-	-	3	1	-	-	-	-	-	-	2	1
2	-	2	-	-	2	1	-	-	-	-	-	-	-	2
3	3	2	2	3	2	3	-	-	-	-	-	-	-	3
4	2	-	3	3	-	2	-	-	-	-	-	-	-	2
5	3	-	3	3	-	2	-	-	-	-	-	-	-	3

UNIT I **9 Hours**

EMBEDDED PROCESS COMMUNICATION WITH INSTRUMENT BUS

Embedded Networking: Introduction – Serial and Parallel Communication, Address Resolution Protocol (ARP) – Cluster of Instruments in System: Introduction to Embedded Communication Protocol – UART, SPI, I2C, USB, CAN Bus, LIN Bus, RS 232, RS 422, RS 485 and Embedded Ethernet.

UNIT II **9 Hours**

EMBEDDED ETHERNET

Elements of a Network – Inside Ethernet – Building a Network: Hardware options – Cables, Connections and Network Speed – Design Choices: Selecting Components – Ethernet controllers – Inside the Internet Protocol – Exchanging Messages using UDP and TCP – Serving Web Pages with Dynamic Data – Email for Embedded Systems using FTP – Keeping Devices and Network Secure.

UNIT III **9 Hours**

WIRELESS EMBEDDED NETWORKING

Wireless Sensor Networks: Introduction – Applications – Network Topology – Localization – Time Synchronization – Energy Efficient MAC Protocols – SMAC – Energy Efficient and Robust Routing – Data Centric Routing.

UNIT IV **9 Hours**

BUILDING SYSTEM AUTOMATION

Sensor Types & Characteristics: Sensing Voltage, Current, Flux, Torque, Position, Proximity, Accelerometer – Data Acquisition System – Signal Conditioning Circuit Design – UC Based & PC based Data Acquisition – UC for Automation and Protection of Electrical Appliances – Processor based Digital Controllers for Switching Actuators: Stepper Motors, Relays – System Automation with Multi-channel Instrumentation and Interface.

UNIT V **9 Hours**

INDUSTRIAL ELECTRICAL SYSTEM AUTOMATION

Data Acquisition: Monitoring, Communication, Event Processing, and Polling Principles, SCADA System for Electrical Distribution: Components – Communication System – Operator Workstation – Electrical Automation System: Substation Automation, Extended Control Feeder Automation, End User Load Control Automation – SCADA Data Models and Interface.

Total: 45 Hours

Reference(s)

1. Dogan Ibrahim, Advanced PIC microcontroller projects in C: from USB to RTOS with the PIC18F series, Elsevier, 2008.
2. James Northcote-Green, Robert Wilson, CRC, Taylor and Francis, Control and automation of electrical power distribution systems, 2006.
3. Jan Axelson, Embedded Ethernet and Internet Complete, Penram publications, 2013.
4. Krzysztof Iniewski, Smart Grid, Infrastructure and Networking, TMcGH, 2012.
5. William Stallings, Cryptography and Network Security Principles and Practice, 7th Edition – Global Edition, Pearson Education Limited, 2017.

22CT034 **EMBEDDED SECURITY** **3 0 0 3**

Course Objectives

- Analyze introduce the fundamentals related to Cryptography and Data Security
- Apply the mathematical foundations for Cryptography.
- Execute impart knowledge about Embedded Cryptography and Data Protection Protocols
- Apply them understand the practical aspects of Embedded System Security.
- Execute the students in Discussions/Tutorials/Programming to familiarize the concepts for improved employability skills.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PSO1: Demonstrate the knowledge and technical skills in software development. PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Analyze the significance of Security.
2. Analyze the major concepts and techniques related to Cryptography.
3. Show thorough knowledge about the aspects of Embedded System Security.
4. Implement insight into the role of Security Aspects during Data Transfer and Communication.
5. Apply the Security Algorithms for Real-time Applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	-	1	1	-	-	-	-	-	-	-	2	2
2	3	2	2	-	-	2	-	-	-	-	-	-	2	2
3	1	3	-	1	-	-	-	-	-	-	-	-	2	2
4	3	1	2	-	3	1	-	-	-	2	-	-	2	3
5	3	2	3	2	3	3	-	-	-	-	-	-	2	2

UNIT I **9 Hours**
INTRODUCTION ON SECURITY
Computer and Network Security Concepts – The OSI Security Architecture – Security Attacks – Security Services – Security Mechanisms – Fundamentals of Security Design Principles – Attack Surfaces and Attack Trees – A Model for Network Security. Introduction to Number Theory: Divisibility and the Division Algorithm – The Euclidean Algorithm – Modular Arithmetic – Prime Numbers – Fermet's and Euler's Theorems – Testing for Primality – The Chinese Remainder Theorem – Discrete Logarithms.

UNIT II **9 Hours**
SYMMETRIC CIPHERS
Classical Encryption Techniques: Symmetric Cipher Model – Substitution Techniques – Transposition Techniques. Block Ciphers and the Data Encryption Standard (DES): Traditional Block Cipher Structure – Advanced Encryption Standard (AES): Finite Field Arithmetic, Structure, Transformation Functions, Key Expansion and Implementation.

UNIT III **9 Hours**
EMBEDDED SYSTEMS SECURITY
Embedded Security Trends – Security Policies – Security Threats. System Software Considerations: The Role of Operating System – Microkernel versus Monolithic – Core Embedded OS Security Requirements – Access Control and Capabilities – Hypervisors and System Virtualization – I/O Virtualization – Remote Management – Assuring Integrity of the TCB.

UNIT IV **9 Hours**
EMBEDDED CRYPTOGRAPHY AND DATA PROTECTION PROTOCOLS
The One-time Pad – Cryptographic Modes – Block Ciphers – Authenticated Encryption – Public Key Cryptography – Public Key Authentication – Elliptic Curve Cryptography – Cryptographic Hashes – Message Authentication Codes – Random Number Generation – Key Management for Embedded Systems – Cryptographic Certifications – Data Protection Protocols for Embedded Systems.

UNIT V **9 Hours**
PRACTICAL EMBEDDED SYSTEM SECURITY
Network Communications Protocols and Built-in Security – Security Protocols and Algorithms – The Secured Socket Layer – Embedded Security – Wireless – Application Layer and Client/Server Protocols – Choosing and Optimizing Cryptographic Algorithms for Resource-Constrained Systems – Hardware Based Security.

Total: 45 Hours

Reference(s)

1. William Stallings, Cryptography and Network Security Principles and Practice, 7th Edition – Global Edition, Pearson Education Limited, 2017.
2. David Kleidermacher and Mike Kleidermacher, Newnes, Embedded Systems Security - Practical Methods for Safe and Secure Software and Systems Development, 2012.
3. Timothy Stapko, Newnes, Practical Embedded Security - Building Secure Resource-Constrained Systems, 2008.

22CT035 EMBEDDED PROCESSOR DEVELOPMENT 3 0 0 3

Course Objectives

- Analyze introduce the architecture of the ARM processor.
- Apply train students in ARM programming.
- Analyze the On-chip peripherals
- Implement design innovative applications by interfacing the processors with real world
- Analyze various ARM cortex processors

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Analyze the architectures of different Embedded Processors
2. Apply the specialty of RISC processor Architecture.
3. Analyze an appropriate on chip peripherals for serial and parallel communication
4. Execute real time applications using ARM processors
5. Implement innovative products using Embedded processors

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	1	1	-	3	-	-	-	-	-	-	-	2
2	3	-	3	3	2	-	-	-	-	-	-	-	-	2
3	-	-	2	2	3	-	-	-	-	-	-	-	-	2
4	-	-	3	-	2	-	-	-	-	-	-	-	-	3
5	2	-	3	2	3	-	-	-	-	-	-	-	-	3

UNIT I **9 Hours**

ARM7, ARM9, ARM11 PROCESSORS

Introduction to ARM Processors and its Versions, ARM7, ARM9 & ARM11 Features, Advantages and Suitability in Embedded Application, ARM7 Data Flow Model, Programmer's Model, Modes of Operations, Instruction Set, Programming in Assembly Language.

UNIT II **9 Hours**

ARM ASSEMBLY LANGUAGE

Assembler Rules and Directives, Loads, Stores, and Addressing, ARM general Instruction Set – Thumb Instruction Set, Mixing C and Assembly, Introduction to DSP on ARM – Basic Programming.

UNIT III **9 Hours**

EMBEDDED PROCESSORS ON CHIP PERIPHERALS

Memory –- Interrupts – I/O Ports-Timers & Real Time Clock (RTC), Watchdog timer – CCP Modules – Capture Mode – Compare Mode – PWM Mode – Serial Communication Module – USART – SPI Interface – I2C Interface, Analog Comparator, Analog Interfacing and Data Acquisition.

UNIT IV **9 Hours**

REAL WORLD INTERFACING USING ARM PROCESSOR

Interfacing the Peripherals to LPC2148: GSM and GPS using UART, On-chip ADC using Interrupt (VIC), EEPROM using I2C, SD Card Interface using SPI, On-chip DAC for Waveform Generation.

UNIT V **9 Hours**

ARM CORTEX PROCESSORS

Introduction to ARM CORTEX Series, Improvement over Classical Series and Advantages for Embedded System Design. CORTEX A, CORTEX M, CORTEX R Processors Series, Versions, Features and Applications, Need of Operating System in Developing Complex Applications in Embedded System, Firmware Development for ARM Cortex, Survey of CORTEX M3 based Controllers, its Features and Comparison.

Total: 45 Hours

Reference(s)

1. Mark Fisher, ARM Cortex M4 Cookbook, Packt Publishing, 2016.
2. Rajkamal, Microcontrollers Architecture, Programming, Interfacing, & System Design, Pearson, 2nd Edition, 2012.
3. S. Pascricha and N. Dutt, Morgan Kaufmann, On-Chip Communication Architectures, System on Chip Interconnect, Elsevier Publishers, 2008.
4. Steve Furber, ARM System on Chip Architecture, Addison Wesley Professional, 2nd Edition, 2000.
5. William Hohl, ARM Assembly Language Fundamentals and Techniques, CRC Press, 2nd Edition 2014.

22CT036 XML AND WEB SERVICES 3 0 0 3

Course Objectives

- Understand the proficiency in creating, manipulating, and validating XML documents, including understanding XML syntax, structure, and key concepts and use XML technologies such as XML Schema, XPath, and XSLT.
- Understanding of web services and their role in distributed systems. Explore SOAP and REST architectures, understand their differences.
- Acquire practical skills in implementing XML-based web services using industry-standard technologies like SOAP and WSDL.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1: Demonstrate the knowledge and technical skills in software development. PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Analyze XML technologies in XML-based systems.
2. Design scalable and secure web service architectures using industry-standard protocols.
3. Implement the web services by creating services between heterogeneous systems.
4. Design and implement XML-based solutions for electronic data interchange (EDI).
5. Design and implement XML-based content management solutions.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	3	-	-	-	-	2	2	1	-	1	2	-
2	2	2	3	-	-	-	-	2	2	1	-	2	2	-
3	2	3	3	-	-	-	-	2	2	2	-	2	2	-
4	2	3	3	-	-	-	-	2	2	2	-	3	2	1
5	2	3	3	-	-	-	-	2	2	2	-	3	2	-

UNIT I **9 Hours**
XML TECHNOLOGY FAMILY
XML – benefits – Advantages of XML over HTML – EDL –Databases – XML based standards – DTD –XML Schemas – X- Files – XML processing – DOM –SAX presentation technologies – XSL – XFORMS – XHTML – voice XML – Transformation – XSLT – XLINK – XPATH –XQ

UNIT II **9 Hours**
ARCHITECTING WEB SERVICES
Business motivations for web services – B2B – B2C- Technical motivations – limitations of CORBA and DCOM – Service – oriented Architecture (SOA) – Architecting web services – Implementation view – web services technology stack – logical view – composition of web services – deployment view – from application server to peer to peer – process view – life in the runtime.

UNIT III **9 Hours**
WEB SERVICES BUILDING BLOCK
Transport protocols for web services – messaging with web services – protocols – SOAP – describing web services – WSDL – Anatomy of WSDL – manipulating WSDL – web service policy – Discovering web services – UDDI – Anatomy of UDDI- Web service inspection –Ad-Hoc Discovery – Securing web services **UNIT IV** **9 Hours**
IMPLEMENTING XML IN E-BUSINESS
B2B - B2C Applications – Different types of B2B interaction – Components of e-business XML systems – ebXML – Rosetta Net Applied XML in vertical industry – Web services for mobile devices.

UNIT V **9 Hours**
XML AND CONTENT MANAGEMENT
Semantic Web – Role of Meta data in web content – Resource Description Framework – RDF schema – Architecture of semantic web – content management workflow – XLANG –WSFL.

Total: 45 Hours

Reference(s)

1. Ron schmelzer et al, “XML and Web Services”, Pearson Education, 2002.
2. Sandeep Chatterjee and James Webber, “Developing Enterprise Web Services: An Architect’s Guide”, Prentice Hall, 2004. Reference(s):
3. Frank P. Coyle, “XML, Web Services and the Data Revolution”, Pearson Education, 2002.
4. Keith Ballinger, “.NET Web Services Architecture and Implementation”, Pearson Education, 2003.
5. Henry Bequet and Meeraj Kunnumpurath, “Beginning Java Web Services”, Apress, 2004.
6. Russ Basiura and Mike Batongbacal, “Professional ASP.NET Web Services”, Apress,2. ASP .NET Web Services”, Apress, 2003.

22CT037 SOFTWARE PROJECT MANAGEMENT 3 0 0 3

Course Objectives

- To understand the Software Project Planning and Evaluation techniques.
- To plan and manage projects at each stage of the software development life cycle.
- To learn about the activity planning and risk management principles.
- To manage software projects and control software deliverables.
- To develop skills to manage the various phases involved in project management and people management.
- To deliver successful software projects that support organization's strategic goals.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PSO1: Demonstrate the knowledge and technical skills in software development. PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Analyze Project Management principles while developing software.
2. Assess extensive knowledge about the basic project management concepts, framework and the process models.
3. Apply adequate knowledge about software process models and software effort estimation techniques.
4. Evaluate the risks involved in various project activities.
5. Show the checkpoints, project reporting structure, project progress and tracking mechanisms using project management principles

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	-	1	-	2	-	-	-	-	-	-	-	3	-
2	-	-	2	-	3	1	-	-	-	-	-	-	3	-
3	2	-	2	1	2	2	-	-	-	-	-	-	3	1
4	2	2	3	2	1	3	-	-	-	-	-	-	3	2
5	-	-	1	-	3	1	-	-	-	-	-	-	3	2

UNIT I **9 Hours**

PROJECT EVALUATION AND PROJECT PLANNING

Importance of Software Project Management – Activities - Methodologies – Categorization of Software Projects – Setting objectives – Management Principles – Management Control – Project portfolio Management – Cost-benefit evaluation technology – Risk evaluation – Strategic program Management – Stepwise Project Planning.

UNIT II **9 Hours**

PROJECT LIFE CYCLE AND EFFORT ESTIMATION

Software process and Process Models – Choice of Process models - Rapid Application development – Agile methods – Dynamic System Development Method – Extreme Programming– Managing interactive processes – Basics of Software estimation – Effort and Cost estimation techniques – COSMIC Full function points - COCOMO II - a Parametric Productivity Model.

UNIT III **9 Hours**

ACTIVITY PLANNING AND RISK MANAGEMENT

Objectives of Activity planning – Project schedules – Activities – Sequencing and scheduling – Network Planning models – Formulating Network Model – Forward Pass & Backward Pass techniques – Critical path (CRM) method – Risk identification – Assessment – Risk Planning –Risk Management – – PERT technique – Monte Carlo simulation – Resource Allocation – Creation of critical paths – Cost schedules.

UNIT IV **9 Hours**

PROJECT MANAGEMENT AND CONTROL

Framework for Management and control – Collection of data – Visualizing progress – Cost monitoring – Earned Value Analysis – Prioritizing Monitoring – Project tracking – Change control – Software Configuration Management – Managing contracts – Contract Management.

UNIT V **9 Hours**

STAFFING IN SOFTWARE PROJECTS

Importance of Software Project Management – Activities - Methodologies – Categorization of Software Projects – Setting objectives – Management Principles – Management Control – Project portfolio Management – Cost-benefit evaluation technology – Risk evaluation – Strategic program Management – Stepwise Project Planning.

Total: 45 Hours

Reference(s)

1. Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – Fifth Edition, Tata McGraw Hill, New Delhi, 2012.
2. Robert K. Wysocki "Effective Software Project Management" – Wiley Publication, 2011.
3. Walker Royce: "Software Project Management"- Addison-Wesley, 1998.
4. Gopalaswamy Ramesh, "Managing Global Software Projects" – McGraw Hill Education (India), Fourteenth Reprint 2013

22CT038 HUMAN COMPUTER INTERACTION 3 0 0 3

Course Objectives

- To learn the foundations of Human Computer Interaction.
- To become familiar with the design technologies for individuals and persons with disabilities.
- To learn the model and theories of human computer interaction
- To be aware of mobile computer systems and its applications.
- To learn the guidelines for designing web user interfaces.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Apply HCI principles to enhance user interaction in a digital system.
2. Design effective HCI for individuals and groups using the design rules.
3. Apply models and theories of HCI to design an intuitive user interface.
4. Design an optimized multimedia, e-commerce, or e-learning website by applying
HCI principles and evaluating their impact.
5. Develop and design meaningful user interfaces.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	-	-	-	-	-	-	-	-	-	-	2	-
2	1	2	3	-	-	-	-	-	-	-	-	-	2	-
3	2	2	-	-	-	-	-	-	-	-	-	-	3	-
4	2	-	3	-	-	-	-	-	-	-	-	-	3	-
5	2	-	3	-	-	-	-	-	-	-	-	-	3	-

UNIT I **9 Hours**
FOUNDATIONS OF HCI

The Human: I/O channels – Memory – Reasoning and problem solving; The Computer: Devices – Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity- Paradigms. - Case Studies

UNIT II **9 Hours**
DESIGN

Interactive Design: Basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process: Software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules: principles, standards, guidelines, rules. Evaluation Techniques – Universal Design

UNIT III **9 Hours**
MODELS AND THEORIES

HCI Models: Cognitive models: Socio-Organizational issues and stakeholder requirements – Communication and collaboration models-Hypertext, Multimedia and WWW.

UNIT IV **9 Hours**
MOBILE HCI

Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets,Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools. - Case Studies

UNIT V **9 Hours**
WEB INTERFACE DESIGN

Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow - Case Studies

Total: 45 Hours

Reference(s)

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, ―Human Computer Interaction‖, 3rd Edition, Pearson Education, 2004.
2. Brian Fling, ―Mobile Design and Development‖, First Edition, O‘Reilly Media Inc., 2009.
3. Bill Scott and Theresa Neil, ―Designing Web Interfaces‖, First Edition, O‘Reilly, 2009.

22CT039 VISUAL EFFECTS 3 0 0 3

Course Objectives

- To Gain a comprehensive understanding of the principles, techniques, and workflows involved in creating visual effects.
- To Acquire knowledge and skills in compositing techniques.
- To Learn the process of creating 3D models, rigging characters, and animating them realistically.
- To Enhance problem-solving skills by tackling various challenges

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Analyze 2D / 3D animation principles and techniques
2. Analyze CGI, color and light elements in VFX applications
3. Create special effects using any of the state of the art tools
4. Apply popular visual effects techniques using advanced tools
5. Evaluate compositing tools for creating VFX for a variety of applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	-	-	-	-	-	-	-	-	-	-	-	1
2	1	2	-	-	-	-	-	-	-	-	-	-	-	1
3	-	-	2	-	2	-	-	-	-	-	-	-	-	2
4	2	-	-	-	2	-	-	-	-	-	-	-	-	2
5	-	-	-	-	3	-	-	-	-	-	-	-	-	3

UNIT I **9 Hours**
FOUNDATIONAL ASPECTS OF ANIMATION
Principles of Animation - Frame Rate and Timings - Foundational Aspects: Key frame and In-betweening, Character Design, Storyboarding, Squash and Stretch, Timing and Spacing, Walk Cycles, Lip Sync and Dialogue Animation, Expressions and Emotions.

UNIT II **9 Hours**
CGI, COLOR, LIGHT
CGI – virtual worlds, Photorealism, physical realism, function realism, 3D Modeling and Rendering: color - Color spaces, color depth, Color grading, color effects, HDRI, Light – Area and mesh lights, image based lights, PBR lights, photometric light, BRDF shading model

UNIT III **9 Hours**
SPECIAL EFFECTS
Special Effects – props, scaled models, animatronics, pyrotechniques, Schufftan process, Particle effects – wind, rain, fog, fire

UNIT IV **9 Hours**
VISUAL EFFECTS TECHNIQUES
Green Screen and Blue Screen Techniques - Tracking and Match moving: Tracking, Camera Reconstruction, Planar Tracking, Calibration, Point Cloud Projection, Ground Plane Determination, 3D Match Moving - CGI Integration - Matte Painting and Rigging - Rotoscoping and Masking.

UNIT V **9 Hours**
ADVANCED COMPOSITING TECHNIQUES
Deep Compositing – 3D Projection Mapping - Advanced Keying Techniques - Advanced Rotoscoping - Multi-Pass Compositing - Virtual Reality (VR) Compositing - Advanced Color Grading and Finishing - VFX tools: Blender, Natron, GIMP.

Total: 45 Hours

Reference(s)

1. Chris Roda, Real Time Visual Effects for the Technical Artist, CRC Press, 1st Edition, 2022.
2. Steve Wright, Digital Compositing for film and video, Routledge, 4th Edition, 2017.
3. John Gress, Digital Visual Effects and Compositing, New Riders Press, 1st Edition, 2014.

22CT040 BUSINESS ANALYTICS 3 0 0 3

Course Objectives

- Comprehend the process of acquiring Business Intelligence.
- Understand various types of analytics for Business Forecasting.
- Apply analytics for different functions of a business.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PSO1: Demonstrate the knowledge and technical skills in software development. PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Apply the real-world business problems and model with analytical solutions.
2. Apply the business processes for extracting Business Intelligence
3. Apply predictive analytics for business fore-casting
4. Apply analytics for supply chain and logistics management
5. Apply analytics for marketing and sales

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	-	-	-	-	-	-	-	-	-	-	2	-
2	2	2	-	2	-	-	-	-	-	-	-	-	2	-
3	3	3	-	3	3	-	-	-	-	-	-	-	2	2
4	3	3	-	3	3	-	-	-	-	-	-	-	2	-
5	3	3	-	3	3	-	-	-	-	-	-	-	2	2

UNIT I **9 Hours**

INTRODUCTION TO BUSINESS ANALYTICS

Analytics and Data Science – Analytics Life Cycle – Types of Analytics – Business Problem Definition – Data Collection – Data Preparation – Hypothesis Generation – Modeling – Validation and Evaluation – Interpretation – Deployment and Iteration

UNIT II **9 Hours**

BUSINESS INTELLIGENCE

Data Warehouses and Data Mart - Knowledge Management –Types of Decisions - Decision Making Process - Decision Support Systems – Business Intelligence –OLAP – Analytic functions

UNIT III **9 Hours**

BUSINESS FORECASTING

Introduction to Business Forecasting and Predictive analytics - Logic and Data Driven Models – Data Mining and Predictive Analysis Modeling –Machine Learning for Predictive analytics.

UNIT IV **9 Hours**

HR AND SUPPLY CHAIN ANALYTICS

Human Resources – Planning and Recruitment – Training and Development - Supply chain network - Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR & Supply Chain. Apply HR Analytics to make a prediction of the demand for hourly employees for a year.

UNIT V **9 Hours**

MARKETING AND SALES ANALYTICS

Marketing Strategy, Marketing Mix, Customer Behaviour –selling Process – Sales Planning – Analytics applications in Marketing and Sales. Do predictive analytics for customers' behaviour in marketing and sales.

Total: 45 Hours

Reference(s)

1. R. Evans James, Business Analytics, 2017
2. R N Prasad, Seema Acharya, Fundamentals of Business Analytics, 2016
3. Philip Kotler and Kevin Keller, Marketing Management, 15th edition, PHI, 2016
4. VSP RAO, Human Resource Management, 3rd Edition, Excel Books, 2010.
5. Mahadevan B, “Operations Management -Theory and Practice”,3rd Edition, Pearson Education,2018

22CT041 IoT AND USE CASES 3 0 0 3

Course Objectives

- To understand Smart Objects and IoT Architectures
- To learn about various IOT-related protocols
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT
- To develop IoT infrastructure for popular applications

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PSO1: Demonstrate the knowledge and technical skills in software development. PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Analyze the concept of IoT.
2. Analyze various protocols for IoT.
3. Design a PoC of an IoT system using Rasperry Pi/Arduino
4. Apply data analytics and use cloud offerings related to IoT.
5. Analyze applications of IoT in real time scenario

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	-	-	-	-	-	-	-	-	-	-	-	-	2
2	1	3	-	-	-	-	-	-	-	-	-	-	1	-
3	-	1	3	-	-	-	-	-	-	-	-	-	2	3
4	-	-	2	3	-	-	-	-	-	-	-	-	3	-
5	-	-	1	-	3	-	-	-	-	-	-	-	2	-

UNIT I **9 Hours**

FUNDAMENTALS OF IoT

Evolution of Internet of Things - Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT Architecture and Core IoT Functional Stack -– Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects

UNIT II **9 Hours**

IoT PROTOCOLS

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition – Application Layer Protocols: CoAP and MQTT

UNIT III **9 Hours**

DESIGN AND DEVELOPMENT

Design Methodology - Embedded computing logic - Microcontroller, System on Chips - IoT system building blocks - Arduino - Board details, IDE programming - Raspberry Pi - Interfaces and Raspberry Pi with Python Programming.

UNIT IV **9 Hours**

DATA ANALYTICS FOR IoT

Structured Vs Unstructured Data and Data in Motion Vs Data in Rest – Role of Machine Learning– No SQL Databases – Hadoop Ecosystem – Apache Kafka, Apache Spark – Edge Streaming Analytics and Network Analytics – Flexible NetFlow Architecture- FNF Components - Flexible NetFlow in Multiservice IoT Networks

UNIT V **9 Hours**

CASE STUDIES AND INDUSTRIAL APPLICATIONS

Cisco IoT system - IBM Watson IoT platform – Manufacturing - Converged Plantwide Ethernet Model (CPwE) – Power Utility Industry – GridBlocks Reference Model - Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control

Total: 45 Hours

Reference(s)

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015.
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, “IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017.
3. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internet of Things”, Springer, 2011.
4. Jan Ho¨ ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
5. Michael Margolis, Arduino Cookbook, Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, O'Reilly Media, 2011.
6. Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things – Key applications and Protocols”, Wiley, 2012.

22CT042/ 22CTM42 PROBLEM SOLVING USING PYTHON 2 0 2 3

Course Objectives

- To understand the basics of python programming.
- To learn to solve problems using Python conditionals and loops.
- To define Python functions and use function calls to solve problems.
- To use Python data structures - lists, tuples, dictionaries to represent complex data.
- To do input/output with files in Python.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes(COs)

1. Develop and execute simple Python programs.
2. Create a simple Python programs using conditionals and loops for solving problems.
3. Design a Python program into functions.
4. Apply compound data using Python lists, tuples, dictionaries etc.
5. Implement read and write data from/to files in Python programs.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	3	2	2	-	-	-	-	-	-	2	3	-
2	3	3	3	3	2	-	-	-	-	-	-	2	3	-
3	2	2	2	2	2	-	-	-	-	-	-	2	2	-
4	2	2	2	2	2	-	-	-	-	-	-	2	2	-
5	2	2	2	2	2	-	-	-	-	-	-	2	2	-

UNIT I

INTRODUCTION TO PYTHON PROGRAMMING **5 Hours**

Identification of Computational Problems – Pseudo Code and Flowcharts – Instructions – Algorithms – Building Blocks of Algorithms Overview of Python and its history, Installation and setup of Python development environment. Python interpreter and interactive mode, debugging; Basic syntax and structure of Python programs

UNIT II **6 Hours**

DATA TYPES, EXPRESSIONS, STATEMENTS

values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III **7 Hours**

CONTROL FLOW, FUNCTIONS, STRINGS

Conditionals: Boolean values and operators, conditional statements, Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV **6 Hours**

LISTS, TUPLES, DICTIONARIES

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.

UNIT V **6 Hours**

FILES, MODULES, PACKAGES

Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter's age validation, Marks range validation (0-100).

EXPERIMENT 1 **6 Hours**

Design a program to calculate your EB bill based on the tiered system and user input for units consumed.

EXPERIMENT 2 **3 Hours**

Create a python program to print a right-angled triangle pattern of numbers.

EXPERIMENT 3 **6 Hours**

Develop a library management system to add, remove and search for books, including title, author, and publication year.

EXPERIMENT 4 **6 Hours**

Develop a simple budgeting program using functions to manage income, expenses, and track spending.

EXPERIMENT 5 **3 Hours**

Analyze a company's sales data to identify trends, patterns, and key insights.

EXPERIMENT 6 **3 Hours**

Create a program for file handling to manage an address book.

EXPERIMENT 7 **3 Hours**

Design a program to validate Course Registration details using Exception Handling.

Total: 30+30=60 Hours

Reference(s)

1. Paul Deitel and Harvey Deitel, “Python for Programmers”, Pearson Education, 1st Edition, 2021.
2. G Venkatesh and Madhavan Mukund, “Computational Thinking: A Primer for Programmers and Data Scientists”, 1st Edition, Notion Press, 2021.
3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data”, Third Edition, MIT Press, 2021
4. Eric Matthes, “Python Crash Course, A Hands - on Project Based Introduction to Programming”, 2nd Edition, No Starch Press, 2019.
5. https://www.python.org/ 6. Martin C. Brown, “Python: The Complete Reference”, 4th Edition, Mc- Graw Hill, 2018.

22CT043 / 22CTM43 DATA STRUCTURES AND ALGORITHMS USING PYTHON 3 0 0 3

Course Objectives

- Understand the basic principles of data structures and algorithms.
- Implement common data structures in Python, including lists, stacks, queues, linked lists, trees, and graphs.
- Apply various searching and sorting algorithms to real-world problems.
- Analyze the efficiency of algorithms using time and space complexity.
- Design and implement algorithms for solving problems in various domains.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Implement various data structures efficiently in Python (including user-defined lists)
2. Apply searching and sorting algorithms to solve real-world problems
3. Design and implement algorithms for solving problems in different domains using appropriate data structures
4. Analyze the performance of algorithms and choose the most efficient approach for a given problem
5. Develop effective problem-solving and critical thinking skills through algorithm design and implementation

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2	2	2	-	-	-	-	-	2	2	3	-
2	2	2	2	2	2	-	-	-	-	-	2	3	3	-
3	2	3	3	2	2	-	-	-	-	-	2	2	2	-
4	3	3	3	3	2	-	-	-	-	-	3	2	2	-
5	3	3	3	3	3	-	-	-	-	-	2	2	2	-

UNIT I **9 Hours**

ABSTRACT DATA TYPES

Abstract Data Types (ADTs) – ADTs and classes – introduction to OOP – classes in Python – inheritance – namespaces – shallow and deep copying Introduction to analysis of algorithms – asymptotic notations – divide & conquer – recursion – analyzing recursive algorithms

UNIT II **9 Hours**

LINEAR STRUCTURES

List ADT – array-based implementations – linked list implementations – singly linked lists – circularly linked lists – doubly linked lists – Stack ADT – Queue ADT – double ended queues – applications

UNIT III **9 Hours**

SORTING AND SEARCHING

Bubble sort – selection sort – insertion sort – merge sort – quick sort – analysis of sorting algorithms – linear search – binary search – hashing – hash functions – collision handling – load factors, rehashing, and efficiency

UNIT IV **9 Hours**

TREE STRUCTURES

Tree ADT – Binary Tree ADT – tree traversals – binary search trees – AVL trees – heaps – multiway search trees

UNIT V **9 Hours**

GRAPH STRUCTURES

Graph ADT – representations of graph – graph traversals – DAG – topological ordering – greedy algorithms – dynamic programming – shortest paths – minimum spanning trees – introduction to complexity classes and intractability

Total: 45 Hours

Reference(s)

1. Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser, "Data Structures & Algorithms in Python", An Indian Adaptation, John Wiley & Sons Inc., 2021
2. Lee, Kent D., Hubbard, Steve, "Data Structures and Algorithms with Python" Springer Edition 2015
3. Rance D. Necaise, "Data Structures and Algorithms Using Python", John Wiley & Sons, 2011
4. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", Fourth Edition, Pearson Education, 2014
5.Udi Manber, Introduction to algorithms : A Creative approach, Addison-Wesley Publishing Company Inc.

22CT044 / 22CTM44 RELATIONAL DATABASE SYSTEMS 3 0 0 3

Course Objectives

- Understand the basic concepts of relational database systems.
- Design and implement relational databases.
- Use SQL to query and manipulate data.
- Analyze recovery techniques.
- Analyze Database Recovery Systems.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Analyze the fundamental concepts of Database Management Systems
2. Design and implement relational databases using the Entity-Relationship (ER) model and normalization techniques.
3. Create SQL to query and manipulate data in relational databases.
4. Develop ACID properties, Concurrency control mechanisms and recovery techniques.
5. Analyze the Recovery System to retrieve the data.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2	2	2	-	-	-	-	-	2	2	3	-
2	2	2	2	2	2	-	-	-	-	-	2	3	3	-
3	2	3	3	2	2	-	-	-	-	-	2	2	2	-
4	3	3	3	3	2	-	-	-	-	-	3	2	2	-
5	3	3	3	3	3	-	-	-	-	-	2	2	2	-

UNIT I **9 Hours**

INTRODUCTION TO DATABASE MANAGEMENT SYSTEM

Database Systems, Advantages of using a DBMS, Overview of Data Model, Applications, Purpose of Database Systems, View of Data, Database Language, Database Design, Database Engine,Database and Application Architecture, Three-schema architecture

UNIT II **9 Hours**

INTRODUCTION TO RELATIONAL MODEL

Relational Database Concepts, Structure of Relational Databases, Database schema design, keys,Schema diagram, Relational Query Language, Entity-Relationship (ER) modeling, Normalization techniques, Data integrity constraints.

UNIT III **9 Hours**

STRUCTURED QUERY LANGUAGE (SQL)

Introduction to SQL, SQL Query Language- Data Definition Language(DDL)- Data Manipulation Language(DML) – Data Query Language (DQL), Basic Structure of Query Language – Three clauses – Select – From – Where, Single Relation Query – Multiple Relation Query, Advanced SQL Features- Subqueries – Joins – Views.

UNIT IV **9 Hours**

TRANSACTION MANAGEMENT AND CONCURRENCY CONTROL

Transaction Management – Transaction Concepts, ACID Properties, Simple Transaction Model,Volatile and Non-Volatile Storage, Transaction Atomicity and Durability, State Diagram, Transaction Isolation. Concurrency Control – Lock Based Protocol, Two-Phase Locking Protocol, Deadlock Handling.

UNIT V **9 Hours**

DATABASE RECOVERY TECHNIQUES

Recovery Concepts, Caching of Disk Blocks, Fuzzy checkpointing, Transaction Rollback, Cascading Rollback, Recovery Techniques Based on Immediate Update, Shadow paging, ARIES Recovery Algorithm.

Total: 45 Hours

Reference(s)

1. Elmasri, R., & Navathe, S. B. (2016). Fundamentals of Database Systems (7th Pearson Education)
2. Korth, H. F., & Silberschatz, A. (2019). Database System Concepts (7th ed.).
McGraw Hill Education.
3. https://docs.oracle.com/cd/E11882_01/appdev.112/e25519/toc.htm
4. MySQL Documentation: https://dev.mysql.com/doc/refman/8.0/en/introduction.html
5. PostgreSQL Documentation: https://www.postgresql.org/docs/current/index.html

22CT045 / 22CTM45 OBJECT ORIENTED PROGRAMMING USING JAVA 2 0 2 3

Course Objectives

- To understand Object Oriented Programming concepts and basics of Java programming language.
- To know the principles of packages, inheritance and interfaces.
- To develop a java application with threads and generics classes.
- To define exceptions and use I/O streams.
- To design and build Graphical User Interface Application using JAVAFX.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Apply the concepts of classes and objects to solve simple problems Analyze network architectures, protocols, and security mechanisms.
2. Develop programs using inheritance, packages and interfaces.
3. Analyze the use of exception handling mechanisms and multithreaded model to solve real world problems.
4. Create Java applications with I/O packages, string classes, Collections and generics concepts.
5. Anlayze the concepts of event handling and JavaFX components and controls for developing GUI based applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
2	-	3	-	-	-	-	-	-	-	-	-	-	3	-
3	-	-	2	-	-	-	-	-	-	-	-	-	2	-
4	-	-	-	2	-	-	-	-	-	-	-	-	2	-
5	-	-	-	-	2	-	-	2	2	2	2	2	2	-

UNIT I **6 Hours**

INTRODUCTION TO OOP AND JAVA

Overview of OOP – Object oriented programming paradigms – Features of Object-Oriented Programming – Overview of Java – Data Types, Variables and Arrays – Operators – Control Statements – Programming Structures in Java – Defining classes in Java – Constructors- Methods -Access specifiers - Static members- Java Doc comments

UNIT II **6 Hours**

INHERITANCE, PACKAGES AND INTERFACES

Overloading Methods – Objects as Parameters – Returning Objects –Static, Nested and Inner Classes. Inheritance: Basics– Types of Inheritance -Super keyword -Method Overriding – Dynamic Method Dispatch –Abstract Classes – final with Inheritance. Packages and Interfaces: Packages – Packages and Member Access –Importing Packages – Interfaces

UNIT III **6 Hours**

EXCEPTION HANDLING AND MULTITHREADING

Exception Handling basics – Multiple catch Clauses – Nested try Statements – Java's Built-in Exceptions – User defined Exception. Multithreaded Programming: Java Thread Model–Creating a Thread and Multiple Threads – Priorities – Synchronization – Inter Thread Communication- Suspending –Resuming, and Stopping Threads –Multithreading. Wrappers – Auto boxing

UNIT IV **6 Hours**

I/O, GENERICS, STRING HANDLING

I/O Basics – Reading and Writing Console I/O – Reading and Writing Files. Generics: Generic Programming – Generic classes – Generic Methods – Bounded Types – Restrictions and Limitations. Strings: Basic String class, methods and String Buffer Class

UNIT V **6 Hours**

JAVAFX EVENT HANDLING, CONTROLS AND COMPONENTS

JAVAFX Events and Controls: Event Basics – Handling Key and Mouse Events. Controls: Checkbox, ToggleButton – RadioButtons – ListView – ComboBox – ChoiceBox – Text Controls – ScrollPane. Layouts – FlowPane – HBox and VBox – BorderPane – StackPane – GridPane. Menus – Basics – Menu – Menu bars – MenuItem.

EXPERIMENT 1 **2 Hours**

Program to define a structure of a basic JAVA program.

EXPERIMENT 2 **2 Hours**

Program to define the data types, variable, operators, arrays and control structures.

EXPERIMENT 3 **3 Hours**

Program to define class and constructors. Demonstrate constructors.

EXPERIMENT 4 **3 Hours**

Program to define class, methods and objects. Demonstrate method overloading.

EXPERIMENT 5 **3 Hours**

Program to define inheritance and show method overriding.

EXPERIMENT 6 **3 Hours**

Program to demonstrate Packages.

EXPERIMENT 7 **2 Hours**

Program to demonstrate Exception Handling.

EXPERIMENT 8 **3 Hours**

Program to demonstrate Multithreading.

EXPERIMENT 9 **3 Hours**

Program to demonstrate I/O operations.

EXPERIMENT 10 **3 Hours**

Program to demonstrate AWT controls.

EXPERIMENT 11 **3 Hours**

Program to demonstrate event handling.

Total:30+30=60 Hours

Reference(s)

1. Herbert Schildt, "Java: The Complete Reference", 11 th Edition, McGraw Hill Education, New Delhi, 2019.
2. Herbert Schildt, "Introducing JavaFX 8 Programming", 1 st Edition, McGraw Hill Education, New Delhi, 2015.
3. Cay S. Horstmann, "Core Java Fundamentals", Volume 1, 11 th Edition, Prentice Hall, 2018.
4. Deitel & Deitel, Java How to Program, Prentice Hall of India, 2010.
5. Jeff Linwood and Dave Minter, Beginning Hibernate Second Edition, Apress 2010.

22CT046 / 22CTM46 FUNDAMENTALS OF COMPUTER NETWORKS AND OPERATING SYSTEMS 3 0 0 3

Course Objectives

- Understanding of the fundamental concepts and principles of computer networks.
- Analyze, design, and implement network and operating system solutions.
- Apply skills in troubleshooting and performance optimization of networking.
- Understanding of the fundamental concepts and principles of operating systems.
- Apply skills in troubleshooting of operating systems.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Apply the fundamental concepts and principles of computer networks and operating systems.
2. Analyze network architectures, protocols, and security mechanisms.
3. Design and implement network solutions for specific applications.
4. Analyze the process, memory, file, and device management functions of operating systems.
5. Apply their knowledge of computer networks and operating systems to solve real-world problems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
2	-	3	-	-	-	-	-	-	-	-	-	-	3	-
3	-	-	3	-	-	-	-	-	-	-	-	-	3	-
4	-	-	-	2	-	-	-	-	-	-	-	-	2	-
5	-	-	-	-	2	-	-	2	2	2	2	2	2	-

UNIT I **9 Hours**

INTRODUCTION TO COMPUTER NETWORKS

Definition, types of networks, applications of networks. Network architecture: OSI model, TCP/IP model, layered architecture. Network devices: Routers, switches, hubs, bridges, gateways. Transmission media: Wired and wireless media, transmission modes. Error detection and correction techniques.

UNIT II **9 Hours**

DATA LINK LAYER AND NETWORK LAYER

Data link layer: Framing, error detection and correction, MAC protocols (Ethernet, Token Ring). Network layer: Routing algorithms (Distance Vector, Link State), IP addressing, subnetting, NAT. Network protocol: IPv4, ICMP. Security threats and solutions: Firewalls, encryption, VPNs.

UNIT III **9 Hours**

TRANSPORT LAYER AND UPPER LAYERS

Transport layer: Connection-oriented and connectionless services, flow control, congestion control. Application layer: HTTP, FTP, SMTP, DNS, P2P applications. Network management: SNMP, network monitoring tools. Emerging trends: SDN, NFV, Cloud computing

UNIT IV **9 Hours**

INTRODUCTION TO OPERATING SYSTEMS

Operating system concepts: Functions, structure, types of operating systems. Process management: Process creation, scheduling, synchronization, deadlock. Memory management: Contiguous allocation, paging, segmentation, virtual memory.

UNIT V **9 Hours**

CASE STUDIES

Linux operating system: Architecture, kernel modules, process management, memory management, file systems, networking. Windows operating system: Architecture, system components, process management, memory management, registry, networking. Comparative analysis of different operating systems.

Total: 45 Hours

Reference(s)

1. Kurose, James F., and Keith W. Ross. Computer Networking: A Top-Down Approach. Pearson Education India, 2017.
2. Silberschatz, Abraham, Peter Baer Galvin, and Greg Gagne. Operating System Concepts Essentials. John Wiley & Sons, 2018.
3. Stallings, William. Data and Computer Communications. 10th ed., Pearson Education, 2013.
4. Tanenbaum, Andrew S., and Herbert Bos. Modern Operating Systems. Pearson Education India, 2015.

22CT047 / 22CTM47 SOFTWARE ANALYSIS AND DESIGN 3 0 0 3

Course Objectives

- To Equip students with a comprehensive understanding of the software development life cycle (SDLC) with a specific focus on the software analysis and design (SAD) phases.
- To Develop the ability to gather, analyze, and document software requirements effectively.
- To Impart knowledge on designing system architecture using various models for optimal system functionality.
- To Foster the ability to develop object-oriented designs using industry-standard Unified Modeling Language (UML) diagrams.
- To Instill best practices for designing software for reusability, maintainability, and testability.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1: Demonstrate the knowledge and technical skills in software development. PSO2: Develop practical competencies in Software and Hardware Design.

Course Outcomes (COs)

1. Apply various techniques for gathering software requirements from stakeholders, including interviews, surveys, and use case analysis.
2. Analyze and document software requirements effectively using Software Requirements Specification (SRS) documents.
3. Design system architecture considering different approaches like layered, client-server, and distributed architectures based on project needs
4. Develop object-oriented designs leveraging concepts like objects, classes, inheritance, polymorphism, and encapsulation.
5. Create behavior modelling diagrams, including data flow and control flow diagrams, and state transition diagrams, to represent system design.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	-	-	-	-	-	-	-	-	-	-	-	3	3
2	-	3	-	-	-	-	-	-	-	-	-	-	3	3
3	-	-	3	-	-	-	-	-	-	-	-	-	3	3
4	-	-	-	3	-	-	-	-	-	-	-	-	3	3
5	-	-	-	-	3	-	-	3	3	2	2	2	3	3

UNIT I **9 Hours**

INTRODUCTION

Software -Characteristics, Applications-Software Engineering: A Layered Technology - The Software Process - Software Process Models - The Linear Sequential Model- The Prototyping Model-The RAD Model - Evolutionary Software Process Models -Component-Based Development-The Formal Methods Model- Fourth Generation

UNIT II **9 Hours**

ANALYSIS CONCEPTS AND PRINCIPLES

Requirements Analysis-Requirements Elicitation for Software-Analysis Principles-Software Prototyping- Specification-Principles-Representation-The Software Requirements Specification-Specification Review

UNIT III **9 Hours**

ANALYSIS MODELING

The Elements of the Analysis Model- Data Modeling-Functional Modeling and Information Flow-Behavioral Modeling- UML Diagrams The Mechanics of Structured Analysis-Creating an Entity/Relationship Diagram-The Data Dictionary- Other Classical Analysis Methods

UNIT IV **9 Hours**

DESIGN CONCEPTS AND PRINCIPLES

Software Design and Software Engineering-Design Principles-Design Concepts-Effective Modular Design- Design Heuristics for Effective Modularity-The Design Model-Design Documentation

UNIT V **9 Hours**

ARCHITECTURAL DESIGN

Software Architecture- Data Design-Architectural Styles-Analyzing Alternative Architectural Designs-Mapping Requirements into a Software Architecture-Transform Mapping-Transaction Mapping.

Total: 45 Hours

Reference(s)

1. Software Engineering, A practitioner's Approach- Roger S. Pressman, 9th edition, Mc Graw Hill International Edition,2020.
2. Software Engineering- Sommerville, 10th edition, Pearson Education,2016.
3. The unified modeling language user guide Grady Booch, James Rambaugh, Ivar Jacobson, Pearson Education, 2010.
4. Software Engineering, an Engineering approach- James F. Peters, Witold Pedrycz, John Wiley,2007.
5. Software Engineering principles and practice- Waman S Jawadekar, The Mc Graw-Hill Companies,2010.
6. Fundamentals of object-oriented design using UML Meiler page-Jones: Pearson Education,2000.

22CT048 / 22CTM48 DATA VISUALIZATION WITH PYTHON 2 0 2 3

Course Objectives

- Introduce students to the fundamental concepts and principles of data visualization.
- Equip students with the skills to use Python libraries for data manipulation and visualization.
- Develop the ability to create informative and aesthetically pleasing visualizations to communicate insights from data.
- Foster critical thinking skills to choose appropriate visualizations for different data types and analysis goals.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Apply perceptual principles to design effective and compelling visualizations.
2. Identify appropriate chart types based on data characteristics and analysis goals.
3. Develop interactive visualizations to enhance user engagement with data
4. Communicate effectively using data visualizations for diverse audiences
5. Apply data analysis, visualization design principles, and Python libraries to effectively communicate insights from data for diverse audiences, considering real-world applications in engineering disciplines.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
2	-	3	-	-	-	-	-	-	-	-	-	-	3	-
3	-	-	2	-	-	-	-	-	-	-	-	-	2	-
4	-	-	-	-	-	-	-	-	-	2	-	-	2	-
5	-	-	-	-	2	-	-	2	2	2	2	2	2	-

UNIT I **6 Hours**

INTRODUCTION

Importance of Data Visualization; Jupyter or colab notebook; Basics of python data types, Flow control; Slicing; functions; Data cleaning; Data Wrangling; Types of data; Exploratory data analysis(EDA).

UNIT II **6 Hours**

NUMPY AND PANDAS

NumPy, ndarray object, slicing ndarrays, Boolean indexing; transpose of ndarray; dot products; pandas; series and dataframes; loading and saving data with pandas; creating dataframes; inspecting data; head and tail methods; descriptive statistics from a dataframe; filtering; sorting and grouping

UNIT III **6 Hours**

VISUALIZATION WITH MATPLOTLIB

Matplotlib; axes labels titles legends and grids; the pyplot API; plot() method; Line chart; Area chart; Stacked area chart; Scatter plot; Bubble chart; Heat map; Contour plot; Histogram; Box plots; Violin plots; Bar plot; Tree maps

UNIT IV **6 Hours**

SIMPLIFYING VISUALIZATION WITH SEABORN

Introduction to seaborn, installing and importing seaborn, basic seaborn plots, customizing colors and styles, handling missing data, grouping and aggregating data, faceting for subplots, visualization relationships with regression plots, categorical data visualization, adding context to plots

UNIT V **6 Hours**

ADVANCED DATA VISUALIZATION

Introduction to interactive visualization, tools for interactive visualization, creating basic interactive plots, interactive dashboards, interactive maps, brushing and linking, dynamic data filtering, customizing interactivity, real-time data visualization, storytelling through interactivity.

EXPERIMENT 1 **2 Hours**

Create a NumPy array, perform basic operations such as addition, multiplication, and element-wise operations, and visualize the results.

EXPERIMENT 2 **2 Hours**

Create a simple Pandas Data Frame, visualize the structure of the data, and display summary statistics.

EXPERIMENT 3 **2 Hours**

Load a dataset with missing values, perform basic data cleaning using Pandas, and visualize the cleaned data.

EXPERIMENT 4 **2 Hours**

Implement Matplotlib to visualize the results of functions solving technical problems, such as finding the factorial or determining the largest number in a list.

EXPERIMENT 5 **3 Hours**

Use Matplotlib to illustrate real-time/technical scenarios such as library inventory or car components, demonstrating the visual representation of data stored in lists and tuples.

EXPERIMENT 6 **3 Hours**

Utilize Matplotlib to visually represent string manipulation operations, such as string reversal, palindrome identification, character count, and character replacement.

EXPERIMENT 7 **3 Hours**

Use Seaborn to create a pair plot of the famous Iris dataset, visualizing relationships between different features (sepal length, sepal width, petal length, petal width) for different species.

EXPERIMENT 8 **3 Hours**

Utilize Seaborn to generate a heatmap visualizing the correlation matrix of a dataset, providing insights into the relationships between different variables.

EXPERIMENT 9 **4 Hours**

Create a basic dashboard using Dash to explore and visualize a dataset interactively. Allow users to select variables, apply filters, and observe dynamic visualizations.

EXPERIMENT 10 **6 Hours**

Develop a advanced dashboard using Dash to display interactive visualizations of financial data. Incorporate dropdowns, sliders, and charts to allow users to explore and analyze financial trends dynamically.

Total:30+30= 60 Hours

Reference(s)

1. John D. Hunter, “Matplotlib: A 2D Graphics Environment”, Journal of Open-Source Software (JOSS), 2007.
2. Hadley Wickham, Dianne Cook, “Interactive and Dynamic Graphics for Data Analysis: With Examples Using R and GGob”, Journal of Computational and Graphical Statistics, 2015.
3. Michael Waskom et al, " Seaborn: A Statistical Data Visualization Library”, IEEE Transactions on Visualization and Computer Graphics, 2016
4. Alex Y. Han, “Plotly: A Web-Based Platform for Collaborative Data Science and D3.js-based Visualizations”, ACM Transactions on Interactive Intelligent Systems (TiiS), 2019.
5. Mine Çetinkaya-Rundel et al, “Integrating Python and Jupyter Notebooks into the Statistics Classroom Journal of Data Science Education, 2018.

22CT049 / 22CTM49 DATA ANALYTICS FOR DECISION SUPPORT SYSTEMS 3 0 0 3

Course Objectives

To introduce students to the fundamentals of decision-making processes and analytics techniques.

• To equip students with the ability to analyze and interpret data using descriptive analytics for industry applications.

• To familiarize students with predictive analytics methods such as text mining, sentiment analysis, and natural language processing.

• To provide an understanding of web analytics, web mining, and social media analytics for insights into user behavior and trends.

• To explore prescriptive analytics techniques for developing decision models and expert systems.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Understand the phases of decision-making and the capabilities of decision support systems.
2. Apply statistical measures to identify trends, patterns, and customer behavior in various industries.
3. Analyze text data using text mining and sentiment analysis tools and techniques for meaningful insights.
4. Conduct web analytics and social network analysis to evaluate online user behavior and engagement.
5. Develop decision models and expert systems for solving real-world problems under certainty, uncertainty, and risk conditions..

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1	1	-	-	-	2	1	1	-	2	3	-
2	3	2	1	2	-	-	-	1	1	1	-	2	3	-
3	3	2	1	3	-	-	-	1	2	2	-	3	3	-
4	3	2	1	3	-	-	-	1	2	1	-	2	3	-
5	3	2	1	3	-	-	-	2	1	2	2	3	3	-

UNIT I **9 Hours**

DECISION MAKING AND ANALYTICS

Importance of Data Visualization; Jupyter or colab notebook; Basics of python data types, Flow control; Slicing; functions; Data cleaning; Data Wrangling; Types of data; Exploratory data analysis(EDA).

UNIT II **9 Hours**

DESCRIPTIVE ANALYTICS

Overview of Descriptive Analytics: Statistics- Mean, Median, Mode and Standard Deviation, Identifying Trends and Patterns in Data. Applications of Descriptive Analytics in Industry. Customer behavior using descriptive analytics.

UNIT III **9 Hours**

PREDICTIVE ANALYTICS

Text Analytics, Text Mining and Sentiment Analysis – Concepts – Natural Language Processing – Text mining approaches – Text mining process with application case study – Text mining tools – Sentiment Analysis overview – Sentiment analysis applications – Sentiment analysis process.

UNIT IV **9 Hours**

WEB AND SOCIAL ANALYTICS

Web Analytics, Web Mining and Social Analytics – Web mining overview – Web content and web structure mining – Web usage mining – Web analytics maturity model and web analytics tools – Social analytics and social network analysis with application case study – Social media concepts – Social media analytics.

UNIT V **9 Hours**

PRESCRIPTIVE ANALYTICS

Model based decision making – DSS modeling – Structure – Certainty, Uncertainty and Risk – Decision modeling with spreadsheets – Decision analysis with decision tables and trees – Automated Decision Systems and Expert Systems – Artificial intelligence – Basic concepts of expert systems – Structure of expert systems with application case study – Knowledge engineering – Development of Expert system.

Total= 45 Hours

Reference(s)

1. Ramesh Sharda, Dursun Delen, Efraim Turban, “Business Intelligence and Analytics Systems for Decision Support”, 10th Edition, Pearson Education, 2018.
2. Ken Black: Business Statistics: For Contemporary Decision Making, 9th Edition, Wiley, 2020.
3. Galit Shmueli, Peter C. Bruce, and Inbal Yahav: Data Mining for Business Analytics: Concepts, Techniques, and Applications in R, Wiley, 2017.
4. Mining the Social Web: Data Mining Facebook, Twitter, LinkedIn, Instagram, GitHub, and More, 3rd Edition, O'Reilly, 2019.
5. Diego Galar Pascual “Artificial Intelligence Tools: Decision Support Systems in Condition Monitoring and Diagnosis,” 1st Edition, CRC Press, 2015.
6. Stuart Russell and Peter Norvig: Artificial Intelligence: A Modern Approach, 4th Edition, Pearson, 2020.

22OCE01 ENERGY CONSERVATION AND MANAGEMENT 3 0 0 3

Course Objectives

- To develop an understanding and analyze the energy data of industries
- To carryout energy accounting and balancing
- To conduct energy audit and suggest methodologies for energy savings and
- To utilize the available resources in optimal ways

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Classify and characterize the energy resources.
2. Illustrate the concept of green building.
3. Outline the sustainable construction practices.
4. Understand the hydropower production and conservation of water.
5. Emphasis the significance of energy and resource recovery from waste materials.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	-	-	-	-	-	-	-	-	-	-	1	-	-
2	1	2	-	-	-	-	2	-	-	-	-	1	-	1
3	1	2	-	-	-	-	2	-	-	-	-	1	-	1
4	1	2	-	-	-	-	2	-	-	-	-	1	-	1
5	1	2	-	-	-	-	2	-	-	-	-	1	-	1

UNIT I **9 Hours**

INTRODUCTION TO ENERGY SCIENCE

Introduction to energy systems and resources; Introduction to Energy, sustainability & the environment. Energy - Past & Present scenario of World; Renewable and Nonrenewable energy resources.

UNIT II **9 Hours**

ENERGY CONSERVATION IN BUILDINGS

Principles of Planning of buildings: orientation, energy efficiency, utility. Components of building-classification of buildings. Green building - LEED building assessment standard – LEED certification process

- Building rating system - Building energy issues – Building energy design strategies – Energy Auditing.

UNIT III **9 Hours**

SUSTAINABLE CONSTRUCTION

Equipment use in excavations, foundation, concreting. Advanced Techniques in tunneling, under water construction, piling techniques, Innovations & efficiency in Highways, Railways & Harbours - linkages between economic and environmental outcomes

UNIT IV **9 Hours**

WATER CONSERVATION AND SUSTAINABILITY

Types of reservoirs and its functions – Hydropower production – Types of Turbines & selections of turbines & Energy calculations. Water losses from reservoirs and channels – Canal lining & its economic aspects. Water supply systems & Irrigation methods - Rain Water Harvesting methods & benefits.

UNIT V **9 Hours**

ENERGY RECOVERY FROM WASTE

Classification and sources of wastes- Factors affecting MSW generation – Waste management hierarchy - Energy recovery from wastes: Thermochemical methods for energy production - Details of incineration, gasification and pyrolysis & biochemical conversions - Landfill gas recovery system - Principles of fermentation - Concept of MFC - Trans-esterification process - Biofuel processing - Biomass gasification - Organic waste for hydrogen production.

Total: 45 Hours

Reference(s)

1. Boyle, Godfrey, Bob Everett, and Janet Ramage (Eds.) (2004), Energy Systems and Sustainability: Power for a Sustainable Future. Oxford University Press
2. Charles. J. Kibert, Sustainable Construction: Green Building Design and Delivery, John Wiley & Sons, Inc., New Jersey, 2008.
3. H. M. Raghunath, Irrigation Engieering, Wiley India (P) Ltd, 2011
4. E H Thorndike (1976), Energy & Environment: A Primer for Scientists and Engineers, Addison-Wesley Publishing Company
5. M. Datta, Waste Disposal in Engineered Landfills, Narosa Publishing House, ISBN-10: 8173191409,1997.
6. Lal, P.M. Sarma, Priyangshu M, Wealth from Waste: Trends and Technologies, 3rd Edition, The Energy and Resources Institute, New Delhi, ISBN: 9788179934241, 2011.
7. W. McDonough, M. Braungart, Cradle to Cradle: Remaking the Way We Make Things, United States: North Point Press, ISBN-10: 0865475873, 2002.

22OEC02 MICROCONTROLLER PROGRAMMING 3 0 0 3

Course Objectives

- Understand Series of Microcontrollers in terms of architecture, Programming and Interfacing.
- Learn Programming of PIC series of microcontrollers and learn building of hardware circuits using PIC 16F series of Microcontrollers
- Learn the emerging trends in the design of advanced Microcontrollers.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Interpret the components and functionalities of 8051 Microcontrollers.
2. Develop microprocessor applications using the Assembly Language Program
3. Illustrate the working nature of PIC microcontroller on various versions
4. Illustrate the interfacing of different peripherals using PIC Microcontroller
5. Analyze the architecture and instruction set of ARM Microcontroller

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1	-	-	-	-	-	-	-	-	-	-	2
2	1	3	1	-	-	-	-	-	-	-	-	-	-	2
3	1	1	2	-	1	-	-	-	-	-	-	-	-	2
4	1	1	2	-	3	-	-	-	-	-	-	-	-	2
5	1	1	3	-	2	-	-	-	-	-	-	-	-	2

UNIT I 9 Hours
8-BIT MICROCONTROLLER
Introduction-Intel 8051 architecture-Counters and Timers-Serial Interface- Interrupts- Interfacing to external memory and 8255- Instruction set- Address modes.

UNIT II 9 Hours
8051 ALP AND APPLICATIONS
Assembly language program- Timers and Counters programming- DAC- ADC- Sensor- Keyboard and LCD.

UNIT III **9 Hours**

PIC MICROCONTROLLER

PIC Microcontroller features- PIC Architecture, Program Memory, Addressing Modes, Instruction Set, Instruction Format- Byte-oriented Instructions- Bit-oriented Instructions- Literal Instructions- Control Instructions (CALL & GOTO)- Destination Designator. MPLAB overview: Using MPLAB, Toolbars, Select Development Mode and Device type, Project, Text Editor, Assembler, MPLAB operations.

UNIT IV **9 Hours**

PIC HARDWARE

Reset, Clock, Control registers, Register banks, Program Memory Paging, Ports, Interrupts, Timer and Counter, Watchdog Timer, Power up timer, Sleep mode, I2C bus- A/D converter.

UNIT V **9 Hours**

HIGH PERFORMANCE RISC ARCHITECTURE

ARM: The ARM architecture- ARM organization and implementation- The ARM instruction set- The THUMB instruction set- Basic ARM Assembly Language Program- ARM CPU Cores.

Total: 45 Hours

Reference(s)

1. Ayala, Kenneth, "The 8051 Microcontroller", Thomson, 3rd Edition, 2004.
2. Muhammad Ali Mazidi, Janice Gillispie Mazidi, " The 8051 Microcontroller and Embedded Systems", Person Education, 2nd Edition, 2004.
3. John B.Peatman, "Design with Microcontrollers", Person Education", 1st Edition, 2004.
4. Steave Furber, "ARM system-on-chip architecture" Addison Wesley, 2nd Edition, 2000.
5. A.V.Deshmukh, "Microcontrollers: Theory and Applications", Tata Mc Graw Hill, 12th reprint, 2005.

22OEC03 PRINCIPLES OF COMMUNICATION SYSTEMS 3 0 0 3

Course Objectives

- To study the various analog and digital modulation techniques
- To study the various digital communication techniques
- To enumerate the idea of spread spectrum modulation
- To study the design concepts of satellite and optical communication

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Illustrate the process involved in Amplitude, Frequency and phase modulation systems.
2. Analyze the performance of different digital modulation /demodulation techniques.
3. Analyze Pulse Code Modulation scheme for the transmission of analog data in digital format.
4. Apply the concepts of spread spectrum modulation techniques to eradicate interference in wireless communication.
5. Analyze the system design of satellite and optical communication.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2	-	-	-	-	-	-	-	-	-	-	1
2	3	2	-	-	-	-	-	-	-	-	-	-	-	1
3	3	2	-	-	-	-	-	-	-	-	-	-	-	1
4	2	2	2	-	-	-	-	-	-	-	-	-	-	1
5	3	2	-	-	-	-	-	-	-	-	-	-	-	1

UNIT I 9 Hours

FUNDAMENTALS OF ANALOG COMMUNICATION

Principles of amplitude modulation, AM envelope, frequency spectrum and bandwidth, modulation index and percent modulation, AM Voltage distribution, AM power distribution, Angle modulation. FM andPM waveforms, phase deviation and modulation index, frequency deviation and percent modulation,Frequency analysis of angle modulated waves. Bandwidth requirements for Angle modulated waves

UNIT II **9 Hours**

DIGITAL COMMUNICATION

Introduction, Shannon limit for information capacity, Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK) Minimum Shift Keying (MSK),Phase Shift Keying (PSK), BPSK, QPSK, 8 PSK Quadrature Amplitude Modulation (QAM), Bandwidth Efficiency,Comparison of various Digital Communication System (ASK - FSK - PSK - QAM).

UNIT III **9 Hours**

DIGITAL TRANSMISSION

Introduction, Pulse modulation, PCM , PCM sampling, sampling rate, signal to quantization noise rate,companding, delta modulation, adaptive delta modulation, differential pulse code modulation, pulse transmission, Intersymbol interference, eye patterns.

UNIT IV **9 Hours**

SPREAD SPECTRUM AND MULTIPLE ACCESS TECHNIQUES

Introduction, Pseudo-noise sequence, DS spread spectrum with coherent binary PSK, processing gain, FH spread spectrum, multiple access techniques, wireless communication, TDMA and CDMA in wireless communication systems, source coding of speech for wireless communications.

UNIT V **9 Hours**

SATELLITE AND OPTICAL COMMUNICATION

Satellite Communication Systems-Keplers Law,LEO and GEO Orbits, footprint, Link model-OpticalCommunication Systems-Elements of Optical Fiber Transmission link, Types, Losses, Sources and Detectors.

Total: 45 Hours

Reference(s)

1. Wayne Tomasi, Advanced Electronic Communication Systems, 6/e, Pearson Education, 2007.
2. Simon Haykin, Communication Systems, 4th Edition, John Wiley & Sons., 2001.
3. H.Taub,D L Schilling,G Saha ,Principles of Communication,3/e,2007.
4. B.P.Lathi,Modern Analog And Digital Communication systems, 3/e, Oxford University Press, 2007
5. Dennis Roddy, "Satellite Communications", Third Edition, Mc Graw Hill International Editions, 2001.
6. Gerd Keiser, Optical Fiber Communication, McGraw-Hill International, Singapore, 4th edition., 2011.

22OEI01 PROGRAMMABLE LOGIC CONTROLLER 3 0 0 3

Course Objectives

- To impart knowledge about automation and architecture of PLC
- To understand the PLC programming using timers, counters and advanced PLC functions
- To familiarize the student with PLC based applications

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PSO1: Demonstrate the knowledge and technical skills in software development. PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Outline the fundamental Concepts of Automation
2. Conclude the architecture, interfacing and communication techniques of PLC
3. Execute the suitable PLC Programming languages
4. Attribute the various functions and instruction sets of PLC
5. Generate a suitable logical programming for given applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	-	2	2	-	3	-	-	-	-	-	1	1
2	2	1	-	2	2	-	3	-	-	-	-	-	-	1
3	2	1	-	2	2	-	3	-	-	-	-	-	2	1
4	2	1	-	2	2	-	3	-	-	-	-	-	2	1
5	2	1	-	2	2	-	3	-	-	-	-	-	2	1

UNIT I 10 Hours

INTRODUCTION TO AUTOMATION

Evolution of automation -Types of automation - Fixed, flexible and programmable automation - Batch process and continuous process - open loop system and closed loop system - Function of sensors - Proximity sensors: Capacitive and Inductive - Infrared and Laser Push-buttons and toggle switches - Actuators: Solenoid valve - servo motor - electromagnetic relays.

UNIT II **9 Hours**

ARCHITECTURE OF PLC

Components of PLC - sink and source I/O cards - Processor - Memory: Types of memory, Input and Output modules: Discrete, Analog -Scan time of PLC -Interfacing computer and PLC: RS232, RS485, Ethernet - Selection criteria for PLC.

UNIT III **8 Hours**

PLC PROGRAMMING

Programming languages - Ladder logic components: User and bit Instructions, branch instructions, internal relay instruction Boolean logic using ladder logic programming, Latching -Timers: On Delay timer, OFF Delay timer and Retentive timer - Counters: Up Counter and Down Counter.

UNIT IV **10 Hours**

ADVANCED PLC FUNCTIONS

Instructions in PLC: Program Control Instructions, Math Instructions, Data Manipulation Instructions: Data compare operations, Data transfer operations - Sequencer and Shift register instructions- Analog Instructions: PID Controller - Scaling Instructions.

UNIT V **8 Hours**

APPLICATIONS OF PLC

Case Studies: Bottle filling system - Pick and place robot - Car Parking - Traffic light control (4 ways with pedestrian signal) -Elevators - Pneumatic stamping system - alarm annunciator system.

Total: 45 Hours

Reference(s)

1. F.D. Petruzella, Programmable Logic Controllers, Tata Mc-Graw Hill, Third edition, 2015.
2. Benjamin C Kuo, Automatic Control Systems, Prentice Hall of India, New Delhi, 2014.
3. John Park, Steve Mackay, Edwin Wright, Practical data communications for instrumentation and control, Newnes, Elsevier, 2015.
4. K. L.S. Sharma, Overview of Industrial Process Automation, Elsevier, 2014.
5. John W Webb and Ronald A Resis, Programmable Logic Controller, Prentice Hall of India Pvt. Ltd., New Delhi, 2013.

22OEI02 SENSOR TECHNOLOGY 3 0 0 3

Course Objectives

- To impart knowledge about various sensors in multidisciplinary engineering domain
- To familiarize students with different applications and its material handling technology
- To understand the concept of sensing circuits and its static and dynamic characteristics

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Conclude the static and dynamic characteristics of measuring instruments
2. Compare the characteristics and working principles of Resistance, Inductance and Capacitance type sensors
3. Construct the interfacing and signal conditioning circuit for measurement system using different types of sensor
4. Analyze and select the suitable sensor for different industrial applications
5. Combine the modern technologies and smart materials to design various sensors

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1	-	-	-	-	-	-	-	-	-	-	1
2	2	3	2	1	1	-	-	-	-	-	-	-	-	1
3	1	2	3	3	1	-	-	-	-	-	-	-	-	1
4	2	1	1	3	3	-	-	-	-	-	-	-	-	1
5	1	2	1	2	3	-	-	-	-	-	-	-	-	1

UNIT I 8 Hours

SENSORS FUNDAMENTALS AND CHARACTERISTICS

Sensors: Principles of Sensing - Sensor Classification and terminology- Units of Measurements - Measurands- Sensor Characteristics: Static and Dynamic.

UNIT II **8 Hours**

PHYSICAL PRINCIPLES OF SENSING

Electric Charges, Fields, and Potentials; Capacitance; Magnetism; Induction; Resistance; Piezoelectric Effect; Hall Effect; Temperature and Thermal Properties of Material; Heat Transfer; Light; Dynamic Models of Sensor Elements.

UNIT III **9 Hours**

INTERFACE ELECTRONIC CIRCUITS

Input Characteristics of Interface Circuits, Amplifiers, Excitation Circuits, Analog to Digital Converters, Direct Digitization and Processing, Bridge Circuits, Data Transmission, Batteries for Low Power Sensors.

UNIT IV **10 Hours**

SENSORS IN DIFFERENT APPLICATION AREA

Occupancy and Motion Detectors; Position, Displacement, and Level; Velocity and Acceleration; Force, Strain, and Tactile Sensors; Pressure Sensors, Temperature Sensors.

UNIT V **10 Hours**

SENSOR MATERIALS AND TECHNOLOGIES

Materials, Surface Processing- MEMS microsystem components- Microfluidics microsystem components - Nano Technology- Smart Materials.

Total: 45 Hours

Reference(s)

1. J. Fraden, Handbook of Modern Sensors: Physical, Designs, and Applications, AIP Press, Springer, 2016.
2. D. Patranabis, Sensors and Transducers, 2nd Edition, Prentice Hall India Pvt. Ltd, New Delhi, 2009.
3. Guozhen Shen, Zhiyong Fan, “Flexible Electronics: From Materials to Devices”, 1st Edition, World Scientific Publishing Co, Singapore, 2015.
4. Horowitz, P., and W. Hill. The Art of Electronics. 2nd ed. Cambridge University Press, 1989.

22OEI03 FUNDAMENTALS OF VIRTUAL INSTRUMENTATION 3 0 0 3

Course Objectives

- Understand the basic components of Virtual Instrumentation system.
- Learn the developing VIs based on Lab VIEW software.
- To learn to develop applications based on Virtual Instrumentation system.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Outline the concepts of traditional instruments and virtual instruments
2. Conclude the overview of modular programming and the structuring concepts in VI programming
3. Attribute the procedure to install DAQ in various OS and its interfacing methods
4. Implement the VI toolsets for specific applications
5. Generate the applications using Virtual Instrumentation software

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	1	1	-	-	-	-	-	-	-	-	-	-
2	3	3	2	2	2	-	-	-	-	2	2	2	-	-
3	2	2	2	1	-	-	-	-	-	-	-	-	-	-
4	3	3	3	1	2	-	-	-	-	1	2	2	-	-
5	3	2	2	1	2	-	-	-	-	1	2	2	-	-

UNIT I **9 Hours**

INTRODUCTION

Virtual Instrumentation: Historical perspective - advantages - block diagram and architecture of a virtual instrument - Conventional Instruments versus Traditional Instruments - data-flow techniques, graphical programming in data flow, comparison with conventional programming.

UNIT II **9 Hours**

VI PROGRAMMING TECHNIQUES

VIs and sub-VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, State machine, string and file I/O, Instrument Drivers, Publishing measurement data in the web.

UNIT III **9 Hours**

DATA ACQUISITION

Introduction to data acquisition on PC, Sampling fundamentals, Input/output techniques and buses. Latest ADCs, DACs, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements - Issues involved in selection of Data acquisition cards - Data acquisition cards with serial communication - VI Chassis requirements. SCSI, PCI, PXI system controllers, Ethernet control of PXI. Networking basics for office & Industrial applications, VISA and IVI.

UNIT IV **9 Hours**

VI TOOLSETS

Use of Analysis tools, Fourier transforms, power spectrum, correlation methods, windowing and filtering. Application of VI in process control designing of equipments like oscilloscope, Digital multimeter, Design of digital Voltmeters with transducer input Virtual Laboratory, Web based Laboratory.

UNIT V **9 Hours**

APPLICATIONS

Distributed I/O modules- Application of Virtual Instrumentation: Instrument Control, Development of process database management system, Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing, Motion control. Development of Virtual Instrument using GUI, Real-time systems, Embedded Controller, OPC, HMI / SCADA software, Active X programming.

Total: 45 Hours

Reference(s)

1. Lisa K. wells & Jeffrey Travis, LabVIEW for everyone, Prentice Hall, New Jersey,1997.
2. Gary Johnson, LabVIEW Graphical Programming, Second edition, McGraw Hill, Newyork, 1997.
3. Kevin James, PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Newness, 2000.

22OEI04 OPTOELECTRONICS AND LASER INSTRUMENTATION 3 0 0 3

Course Objectives

- To enhance the student knowledge in fiber optics fundamentals and fabrication
- To be recognized with industrial applications of fibers
- To understand the fundamental concepts about lasers
- To identify and describe various fiber optic imaging and optoelectronic sensor applications

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Course Outcomes (COs)

1. Attribute the properties of optical fibers, their light sources and detectors.
2. Implement the fiber-optic sensor for the measurement of various physical quantities.
3. Conclude the fundamentals of laser, types of laser and its working.
4. Outline the applications of laser for industrial applications.
5. Differentiate the use of laser instruments for various medical applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1	-	-	-	-	-	-	-	-	-	-	-
2	3	2	1	2	-	-	-	-	-	-	-	-	-	-
3	3	2	1	-	-	-	-	-	-	-	-	-	-	-
4	3	2	2	2	-	-	-	-	-	-	-	-	-	-
5	3	2	2	2	-	-	-	-	-	-	-	-	-	-

UNIT I **9 Hours**

OPTICAL FIBERS AND THEIR PROPERTIES

Introduction to optical fibers - Light guidance - Numerical aperture - Dispersion - Different types of fibers and their properties - Light Sources for fiber optics, Photo detectors, source coupling, splicing and connectors.

UNIT II **9 Hours**

INDUSTRIAL APPLICATION OF OPTICAL FIBERS

Fiber optics instrumentation system - optical fiber sensors, Measurement of pressure, temperature, current, voltage and liquid level - fiber optic communication set up - different types of modulators - detectors.

UNIT III **9 Hours**

LASER FUNDAMENTALS

Fundamental characteristics of lasers: laser rate equation - three level system - four level system - properties of laser beams - laser modes - resonator configuration - Q- switching and mode locking - cavity dumping - types of lasers: gas lasers, solid state lasers, liquid lasers and semiconductor lasers.

UNIT IV **9 Hours**

INDUSTRIAL APPLICATION OF LASERS

Lasers for measurement of distance and length, velocity, acceleration, atmospheric effects, sonic boom, pollutants - material processing: laser heating, melting, welding and trimming of materials - removal and vaporization - calculation of power requirements of laser for material processing.

UNIT V **9 Hours**

HOLOGRAM AND MEDICAL APPLICATIONS

Holography: basic principle, methods - holographic interferometry and application, holography for non-destructive - medical applications of lasers, laser and tissue interactive - laser instruments for surgery, removal of tumors of vocal cards, brain surgery, plastic surgery, gynaecology and oncology.

Total: 45 Hours

Reference(s)

1. John M. Senior, Optical Fiber Communications - Principles and Practice, Prentice Hall of India, 2010.
2. John F. Ready, Industrial Applications of Lasers, Academic Press, 2012.
3. Gerd Keiser, Optical Fiber Communication, Mc Graw Hill, New York, 2013.
4. S.C. Gupta, Textbook on Fiber Optics Communications and its application, Prentice Hall of India, 2012.
5. John Wilson and J.F.B. Hawkes, Introduction to Opto Electronics, Prentice Hall of India, 2011.
6. R. P. Khare, Fiber Optics and Optoelectronics, Oxford University Press, 2011.

22OME01 **DIGITAL MANUFACTURING** **3 0 0 3**

Course Objectives

- To understand the process of generating 3D Computer Aided Design (CAD) model by different method.
- To explain the constructional features and develop simple program for CNC lathe and Milling machines.
- To provide an exhaustive knowledge on various generic process and benefits of Additive Manufacturing.
- To familiarize about materials and process parameters of liquid and solid based AM techniques.
- To educate powder based methodology and emerging trends with case studies, applications of AM techniques.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PSO1: Demonstrate the knowledge and technical skills in software development. PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Design a 3D model from the 2D data.
2. Develop a CNC program for simple components.
3. Generate stl file and manipulate parameters of AM machine
4. Select appropriate liquid or solid materials based AM process to the respective application
5. Select appropriate process to fabricate a functional/prototype for aerospace, automotive, electronics, manufacturing and medical applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2	-	2	-	-	-	-	-	-	-	1	1
2	2	2	2	-	2	-	-	-	-	-	-	-	1	1
3	2	2	2	-	2	-	-	-	-	-	-	-	1	1
4	2	2	2	-	2	-	-	-	-	-	-	-		
5	2	2	2	-	2	-	-	-	-	-	-	-	1	1

UNIT I **9 Hours**

CAD MODELING
Introduction - Design process - Stages. CAD - Input and Output devices, Modeling methods - Wire frame modelling, Surface modelling, Solid modelling - Constructive Solid Geometry and Boundary Representation Techniques. CAD/CAM data exchange - IGES, STEP. Product Life cycle management (PLM).

UNIT II **10 Hours**

AUTOMATION AND CNC MACHINES
Introduction to Automation - Definition, types, reasons for automating. CNC Machines - Principles, types, features, advantages, applications. CNC Machine structure - Linear motion bearings, Recirculating ball bearings, drive system, and control system. CNC Lathe and Milling programming - Linear and circular interpolation, threading and drilling programs.

UNIT III **7 Hours**

ADDITIVE MANUFACTURING
Introduction - Impact of Additive Manufacturing (AM) and Tooling on Product Development - Distinction between AM and CNC Machining - The Generalized AM Process chain - CAD Model - Input file formats - Generation and Conversion of STL file - File Verification and Repair - Build File Creation - Part Construction
- Part Cleaning and finishing - AM Benefits - Classification of AM process

UNIT IV **8 Hours**

LIQUID AND SOLID MATERIAL BASED SYSTEMS
Stereo lithography Apparatus (SLA), Digital Light Processing (DLP), Fused Deposition Modelling (FDM) and Laminated Object Manufacturing (LOM) - Working Principle, Construction, Process, Materials and Applications

UNIT V **11 Hours**

POWDER BASED PROCESSES AND APPLICATIONS OF ADDITIVE MANUFACTURING
Selective Laser Sintering (SLS), Color Jet Printing (CJP), Electron Beam Melting (EBM) and Laser Engineered Net Shaping (LENS) - Working Principle, Construction, Process Variables, Materials and Applications. Reverse Engineering using 3D scanner. Application of Additive Manufacturing in Medical field, Manufacturing, Automotive industries, Aerospace and Electronics and Retail industries.

Total: 45 Hours

Reference(s)

1. Ibrahim Zeid, R.Sivasubramania, CAD/CAM Theory and Practice, Tata McGraw Hill, 2010.
2. M. Aditan, B.S. Pabala, CNC Machines, New age International, 2012.
3. C. K. Chua, K. F. Leong and C. S. Lim, Rapid prototyping: Principles and applications, Cambridge University Press, 2010.
4. D. T.Pham, S. S.Dimov, Rapid manufacturing, Springer-Verlag, London, 2001.
5. I. Gibson, D. W. Rosen, and B. Stucker, Additive Manufacturing Technologies 3D Printing, Rapid Prototyping and Direct Digital Manufacturing, Springer, 2015 http://www.springer.com/978-1-4939- 2112-6

22OME02 INDUSTRIAL PROCESS ENGINEERING 3 0 0 3

Course Objectives

- To impart the knowledge on production planning methodologies and layout design
- To learn about production planning and its control methods
- To provide the knowledge of work study, process charts and ergonomic condition
- To impart the knowledge on inventory control and material handling
- To learn about system analysis and different types of maintenance processes

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Course Outcomes (COs)

1. Select proper plant layout for the required production system
2. Plan the resources required for the production and to perform the control methods
3. Apply work study method, prepare charts to outline the process and develop ergonomic condition suitable for the processes.
4. Analyze the inventory required based on production needs and material handling
5. Perform system analysis and use different types of maintenance process for smooth operations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	1	-	1	-	-	-	-	-	-	-	-	-
2	3	3	1	-	2	-	-	-	-	-	2	-	-	-
3	1	3	3	-	2	-	-	-	-	-	-	-	-	-
4	2	3	1	-	2	-	-	-	-	-	-	-	-	-
5	2	3	1	-	2	-	-	-	-	-	-	-	-	-

UNIT I **9 Hours**

INDUSTRIAL ENGINEERING AND PRODUCTION SYSTEM

Industrial engineering - Concept, History and development, Applications, Roles of Industrial engineer- Production management, Industrial engineering versus production management, operations management. Plant layout, Criteria for good layout, Types of layout - Process layout, Product layout, Combination layout and fixed position layout, Flow (material movement) pattern, Workstation Selection and design.

UNIT II **10 Hours**

PROCESS PLANNING AND PRODUCTION CONTROL

Introduction to Process planning-Definition, Procedure, Process selection, Machine capacity, Process sheet.Process analysis - Group technology, classification and coding system, formation of component family

- Production planning, loading, scheduling. Production control -dispatching, routing - Progress control bar, curve, Gantt chart, route and schedule chart.

UNIT III **8 Hours**

WORK STUDY AND ERGONOMICS

Work study - Definition, Need, Advantages, objectives of method study and work measurement, method study procedure, Process chart - symbols, outline process chart, flow process chart, principles of motion economy, ergonomics- applications of ergonomic principles in the shop floor- work benches-seating arrangement, Industrial physiology.

UNIT IV **10 Hours**

INVENTORY MANAGEMENT

Inventory control, classification, management, objectives, functions. Economic order quantity, Economic batch quantity, inventory models,ABC analysis, Material Requirement Planning(MRPI), Manufacturing Resource Planning (MRPII), Operating cycle, lean manufacturing, Supply chain management - Material handling.

UNIT V **8 Hours**

SYSTEM ANALYSIS AND MAINTENANCE

System concept - system analysis, systems engineering, value engineering, value control, types of values. Plant maintenance - objectives, importance. Maintenance engineer - duties, functions and responsibilities. Types - breakdown, scheduled, preventive and predictive - Plant maintenance schedule, Condition monitoring.

Total: 45 Hours

Reference(s)

1. Khanna O.P., Industrial Engineering and management, Dhanpat Rai Publications.,2010
2. Martand T.Telsang, Industrial Engineering and Production Management, S Chand Publishers,2006
3. Panneerselvam R., Production and operations management, Heritage Publishers, 2006
4. Ravi Shankar, Industrial Engineering and Management, Golgotia Publications Pvt. Ltd., New Delhi, 2009

22OME03 MAINTENANCE ENGINEERING 3 0 0 3

Course Objectives

- To understand the principles, objectives and importance of maintenance adopted in industry for successful progress.
- To introduce different maintenance categories, its merits and types of lubrication.
- To expose the idea of condition monitoring, methods and instruments used for allied measurements.
- To learn about failure analysis and repair methods for few mechanical elements.
- To promote computerization in maintenance and inventory management.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Explain the principles, objectives and importance of maintenance adopted in industry.
2. Select the suitable maintenance category and lubrication type.
3. Apply the appropriate methods and instruments for condition monitoring.
4. Analyze the failures of mechanical systems and select suitable repair methods.
5. Utilize computers in maintenance and inventory management.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	-	-	-	-	-	-	-	-	-	-	-	2
2	2	2	-	-	-	-	-	-	-	-	-	-	-	2
3	-	-	-	-	2	2	1	-	-	-	-	-	-	2
4	1	2	1	-	2	2	2	-	-	-	-	-	-	2
5	2	2	2	-	1	1	1	-	-	-	-	-	-	2

UNIT I **9 Hours**

PRINCIPLES OF MAINTENANCE PLANNING

Basic principles of maintenance planning - Objectives and principles of planned maintenance activity - Importance and benefits of sound maintenance systems - Maintenance organization - Maintenance economics.

UNIT II **9 Hours**

MAINTENANCE CATEGORIES AND LUBRICATION

Maintenance categories - Comparative merits of each category - Preventive maintenance, Maintenance schedules, Repair cycle - Total Productive Maintenance - Principles and methods of lubrication.

UNIT III **9 Hours**

CONDITION MONITORING

Condition based maintenance - Cost comparison with and without Condition Monitoring - Methods and instruments for condition monitoring - Noise, vibration, wear and temperature measurement.

UNIT IV **9 Hours**

FAILURE ANALYSIS AND REPAIR METHODS

Failure analysis - Failures and their development - Role of Non Destructive Testing in failure analysis - Repair methods for bearings, cylinder block, fuel pump, shaft.

UNIT V **9 Hours**

COMPUTER AIDED MAINTENANCE MANAGEMENT

Approach towards Computerization in maintenance - computer-aided maintenance management system (CAMMS) - Advantages of CAMMS - spare parts and inventory centre performance reporting.

Total: 45 Hours

Reference(s)

1. Srivastava S.K, Maintenance Engineering, S Chand and Company, 2010.
2. Mishra R.C, Pathak K, Maintenance Engineering and Management, Second edition, Prentice Hall India Learning Pvt. Ltd., 2012.
3. Keith Mobley R, Lindley R. Higgins and Darrin J. Wikoff, Maintenance Engineering Handbook, Seventh edition, McGraw-Hill Professional, 2008.
4. Davies A, Handbook of Condition Monitoring: Techniques and Methodology, Springer, 2012.
5. Otegui Jose Luis, Failure Analysis, Fundamentals and Applications in Mechanical Components, Nineteenth edition, Springer, 2014.

22OME04 **SAFETY ENGINEERING** **3 0 0 3**

Course Objectives

- To study the principles of safety management system.
- To introduce the provisions contained in the industrial laws.
- To provide knowledge on safety requirements for engineering industry.
- To learn safety requirement for chemical industry.
- To study the various safety measures adopted in construction industries.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Explain safety management system of an industry.
2. Implement the provisions of acts and rules in industries.
3. Implement and review the safety performance followed in various industries
4. Evaluate safety appraisal in chemical industries.
5. Generate safety reports on construction industries.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	2	1	-	1	-	-	-	-	-	-
2	-	-	-	-	1	-	-	3	-	-	-	-	-	-
3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
4	2	3	-	-	-	-	-	-	2	-	-	-	-	-
5	-	-	-	-	2	-	-	-		3	-	-	-	-

UNIT I **8 Hours**

SAFETY MANAGEMENT

Concepts - Evolution, International Labour Organization (ILO), National Safety Council, Techniques - Job Safety Analysis (JSA), Safety survey, Safety inspection, Safety Sampling, Accident Reporting and Investigation - Concept of an accident, Accident causation models, cost of accident, investigation, Safety Performance Monitoring - Safety indices.

UNIT II **10 Hours**

SAFETY AND LAW

Factory Act 1948-Safety and Health chapters, Tamil Nadu Factories Rules- Safety and Health chapters, Environment and Pollution Laws, ,Building and other construction works act 1996, Electricity Rules.

UNIT III **10 Hours**

SAFETY IN ENGINEERING INDUSTRIES

Safety in machine shop,- Principles of machine guarding - Personal protective equipment- Safety in handling industrial gases - Safety in cold forming and hot working of metals- Safety in finishing, inspection and testing, heat treatment, electro plating, leak test, radiography.

UNIT IV **9 Hours**

SAFETY IN CHEMICAL INDUSTRIES

Safety in process design, unit operations, pressure vessel, heat exchanger, safety valves -Plant commissioning and inspection, pressure vessel, Plant maintenance and emergency planning, management of maintenance HAZOP study.

UNIT V **8 Hours**

SAFETY IN CONSTRUCTION INDUSTRY

Construction regulations, contractual clauses, permit to work, - Education and training-Hazards of construction and prevention- excavation, scaffolding, dismantling, road works, construction of high rise buildings - Working at heights,-Working on fragile roofs, work permit systems-Construction machinery, cranes, chain pulley blocks, earth moving equipment, conveyors- Manual handling, Safety in demolition work,
- Safety in confined spaces

Total: 45 Hours

Reference(s)

1. Blake R.B., Industrial Safety, Prentice Hall, Incorporated, New Jersey,1973.
2. National Safety Council, Accident Prevention Manual for Industrial Operations, Chicago, 1988
3. Subramanian V., The Factories Act, 1948, with Tamil Nadu Factories Rules , 1950, Madras
4. Environmental Pollution Control Act, 1986
5. BOCW Act,1996, Madras Book agency, Chennai-1
6. Explosive Act, 1884, Eastern Book Company, Lucknow -266 001.

22OBT01 BIOFUELS 3 0 0 3

Course Objectives

- To understand and explore the scope of biofuels the most efficient renewable source of energy.
- To develop the expertise in the technology pertaining to their generation and employment in order to surrogate the existing conventional fuels and hence strives towards sustainabledevelopment
- To give way to the bolster green technology and incline towards more ecofriendly options.

Programme Outcomes (POs)

PO1 Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 Problem Analysis: Identify, formulate, review research literature, and analyse complex
engineering problems reaching substantiated conclusions using first principles of mathematics,
natural sciences, and engineering sciences.

PO3 Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO6 The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Apply the bio-resources that can be used for the production of biofuels.
2. Analyze the physical and chemical properties of the biodiesel.
3. Analyze the mechanisms of improvising the quality and performance of engines using biofuels
4. Analyze the bio-fuel conversion technologies and their environmental attributes
5. Evaluate the designing aspects of major unit processes/operations of an integrated bio- refinery

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	2	-	-	-	3	-	-	-	-	-	-	-
2	2	1	-	3	-	-	1	-	-	-	-	-	-	-
3	1	2	-	2	-	-	3	-	-	-	-	-	-	-
4	2	3	-	-	-	2	3	-	-	-	-	-	-	-
5	1	2	-	-	-	2	1	-	-	-	-	-	-	-

UNIT I **9 Hours**

CLASSIFICATION AND RESOURCES

Introduction, biofuel as a renewable energy, classification of biofuels - First, second, third and fourth generation biofuels, different plant sources as biofuel feed stocks, Biogases, physical and chemical characteristics of vegetable oils - iodine number, hydroxyl, acid values, rancidity, hydrogenolysis and hydrolysis, Food vs energy.

UNIT II **9 Hours**

BIODIESEL

Definition, basics and chemistry of biodiesel, vegetable oils in biodiesel production, Trans esterification: Chemical methods, enzymatic methods and types of catalysts, separation and purification, physical properties and characterization of biodiesel - Cloud point, pour point, cold filter plugging point, flash point, viscosity and cetane number.

UNIT III **9 Hours**

QUALITY BIODIESEL AND ENVIRONMENT

Producing Quality Biodiesel, quality control, test methods, ASTM specifications. Oxidative andthermal stability, estimation of mono, di, triglycerides and free glycerol, engine performance test, blending of ethanol with biodiesel, blending of biodiesel with high speed diesel (HSD) and their combustion properties.

UNIT IV **9 Hours**

BIOETHANOL AND BIOGASES

Ethanol as a fuel, microbial and enzymatic production of ethanol from biomass - lignocellulose, sugarcane, sugar beet, corn, wheat starch, purification - wet and dry milling processes, saccharification-chemical and enzymatic. Production of bio methane and bio hydrogen.

UNIT V **9 Hours**

BIOREFINERIES

Definition and types of biorefineries, co-products of biorefineries-oil cake and glycerol, purificationof glycerol obtained in biodiesel plant; anaerobic and thermal gasification of biomass, economics of biorefineries.

Total: 45 Hours

Reference(s)

1. Caye Drapcho, John Nghiem and Terry Walker, Biofuels Engineering process technology,McGraw Hill Professional, 2008.
2. Mousdale, Biofuels, CRC Press, 2008
3. Ahindra Nag, Biofuels Refining and Performance, McGraw-Hill Professional, 2007.
4. Lisbeth Olsson, Biofuels (Advances in Biochemical Engineering/ Biotechnology), Springer,2007

22OFD01 **TRADITIONAL FOODS** **3 0 0 3**

Course Objectives

- Understand the importance of traditional foods and food habits
- Know the traditional processing of snack, sweet and dairy food products
- Infer the wide diversity and common features of traditional Indian foods and meal patterns.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Course Outcomes (COs)

1. Justify the processing methods of traditional foods in terms of its health benefits
2. Assess the production methods of traditional sweets, snacks and dairy products
3. Differentiate Traditional fermented foods products based on its raw material
4. Implement a large scale production of tradition foods for its increased consumption
5. Compare the health aspects of traditional foods with modern foods

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	1	-	-	-	-	-	-	-	-	-	-	-	-
3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	2	-	-	-	-	-	-
5	-	-	-	-	-	-	-	2	-	-	-	-	-	-

UNIT I **9 Hours**

TRADITIONAL METHODS OF FOOD PROCESSING

Introduction - food culture -geographical features and food. Traditional methods of milling grains - rice, wheat and corn - equipment and processes as compared to modern methods. Equipment and processes for edible oil extraction- comparison of traditional and modern methods. Energy costs, efficiency, yield, shelf life and nutrient content comparisons. Traditional methods of food preservation - sun-drying, osmotic drying, brining, pickling and smoking.

UNIT II **9 Hours**

TRADITIONAL SWEETS, SNACKS AND DAIRY PRODUCTS

Production, formulation, preparation and processing of Indian traditional sweet and snack food products:- Rasgolla, Gulab jamun; formulation and preparation of namkeen, potato chips, banana chips. Acid coagulated and fermented dairy products- paneer, dahi, shrikhand, lassi - processing conditions, defects etc. Fat rich products- Butter, ghee and its processing.

UNIT III **9 Hours**

TRADITIONAL FERMENTED FOOD PRODUCTS

Idli, Soya sauce, fish pickle, dry fish, meat and vegetable fermented products. Various alcohol based products. Ways to increase nutritional quality of food such as enrichment, fortification, fermentation and mutual supplementation. Best cooking and processing methods to retain nutrients

UNIT IV **10 Hours**

COMMERCIAL PRODUCTION OF TRADITIONAL FOODS

Commercial production of traditional breads, snacks, ready-to-eat foods and instant mixes, frozen foods - types marketed, turnover; role of SHGs, SMES industries, national and multinational companies; commercial production and packaging of traditional beverages such as tender coconut water, neera, lassi, buttermilk, dahi. Commercial production of intermediate foods - ginger and garlic pastes, tamarind pastes, masalas (spice mixes), idli and dosa batters

UNIT V **8 Hours**

HEALTH ASPECTS OF TRADIONAL FOODS

Comparison of traditional foods with typical fast foods / junk foods - cost, food safety, nutrient composition, bioactive components; energy and environmental costs of traditional foods; traditional foods used for specific ailments /illnesses.

Total: 45 Hours

Reference(s)

1. Sen and Colleen Taylor, Food Culture in India, Greenwood Press, 2005.
2. Davidar, Ruth N. "Indian Food Science: A Health and Nutrition Guide to Traditional Recipes:" East West Books, 2001.
3. Steinkrus.K.H. Handbook of Indigenous Fermented Foods, CRC press, 1995.
4. Aneja. R.P, Mathur.BN, R.C. Chandan,and Banerjee.A.K. Technology of Indian Milk Products. Dairy India Year Book, 2009.

22OFD02 **FOOD LAWS AND REGULATIONS** **3 0 0 3**

Course Objectives

- Introduce the concept of food hygiene, importance of safe food and laws governing it
- Learn common causes of food borne illness - viz. physical, chemical and biological and identification through food analysis
- Understand food inspection procedures employed in maintaining food quality

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Course Outcomes (COs)

1. Analyse the food safety strategies and nutritional quality of the food
2. Check the food regulatory mechanism and mandatory laws for food products
3. Determine the national and international regulatory agencies
4. Understand and apply the voluntary regulatory standards
5. Assess the implementation of food safety for a food processing industry

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1	-	-	-	-	-	-	-	-	-	-	-
2	-	1	-	-	-	1	2	1	-	-	-	-	-	-
3	-	1	-	-	-	-	-	-	-	-	-	-	-	-
4	1	2	-	-	-	-	-	-	-	-	-	-	-	-
5	1	2	-	-	-	-	-	-	-	-	-	-	-	-

UNIT I **10 Hours**

INTRODUCTION

Introduction, concept of food safety and standards, food safety strategies. Food hazards and contaminations - biological (bacteria, viruses and parasites), chemical (toxic constituents / hazardous materials) pesticides residues / environmental pollution / chemicals) and physical hazards. Preventive food safety systems - monitoring of safety, wholesomeness and nutritional quality of food. Prevention and control of physical, chemical and microbiological hazards. Principles of food safety - Establishment: design and facilities - emergency preparedness - Maintenance cleaning and sanitation - personal hygiene - packaging and labelling
- transportation - traceability - recall procedure - visitor policy. Adulteration: Intentional and unintentional - Preservatives - antioxidants, sweeteners, flavours, colours, vitamins, stabilizers - indirect additives - organic resides - inorganic residues and contaminants.

UNIT II **10 Hours**

FOOD LAWS

Indian and Food Regulatory Regime (Existing and new), PFA Act and Rules, Food Safety and Quality Requirements, Additives, Contaminants and Pesticide Residue. Food Safety and Standards Act, 2006, FSSAI roles and responsibilities, Essential Commodities Act, 1955, Global Scenario, Codex Alimentarius, WHO/FAO Expert Bodies (JECFA/ JEMRA/JMPR) WHO/FAO Expert Bodies (JECFA/ JEMRA/JMPR). Food safety inspection services (FSIS) and their utilization.

UNIT III **10 Hours**

REGULATIONS

Introduction to OIE & IPPC, Other International Food Standards (e.g. European Commission, USFDA etc). WTO: Introduction to WTO Agreements: SPS and TBT Agreement, Export & Import Laws and Regulations, Export (Quality Control and Inspection) Act, 1963. Role of Agricultural and Processed Food Products Export Development Authority (APEDA), Customs Act and Import Control Regulations, Other Voluntary and mandatory product specific regulations, Other Voluntary National Food Standards: BIS Other product specific standards; AGMARK. Nutritional Labelling, Health claims.

UNIT IV **10 Hours**

STANDARDS

Voluntary Quality Standards and Certification GMP, GHP, HACCP, GAP, Good Animal Husbandry Practices, Good Aquaculture Practices ISO 9000, ISO 22000, ISO 14000, ISO 17025, PAS 22000, FSSC 22000, BRC, BRCIOP, IFS, SQF 1000, SQF 2000. Role of NABL, CFLS.

UNIT V **5 Hours**

IMPLEMENTATION AND RISK ASSESSMENT

Implementation of food safety for a desired food processing industry. Risk assessment studies: Risk management, risk characterization and communication.

Total: 45 Hours

Reference(s)

1. Singal RS (1997). Handbook of indices of food quality and authenticity. Woodhead Publ. Cambridge, UK.
2. Shapton DA (1994). Principles and practices of safe processing of foods. Butterworth Publication, London. Winton AL (1999) Techniques of food analysis, Allied Science Publications New Delhi.
3. Pomeranze Y (2004). Food analysis - Theory and Practice CBS Publications, New Delhi.
4. Jacob MB (1999). The chemical analysis of foods and food products. CBS Publ. New Delhi

22OFD03 POST HARVEST TECHNOLOGY OF FRUITS AND VEGETABLES 3 0 0 3

Course Objectives

- To understand the importance and different methods of post harvest handling and storage of fruits and vegetables.
- To gain knowledge on different preservation methods of fruits and vegetables
- To familiarize with the value added products from fruits and vegetables

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Implement the different post harvest handling practices for the storage of fruits and vegetables
2. Analyze the suitable preservation method (sugar, salt or dehydration) to produce value added products from fruits and vegetables
3. Evaluate the requirement of low temperature and irradiation methods to preserve specific fruits and vegetables
4. Apply the concentration and fermentation methods to preserve fruits and vegetables
5. Implement the canning method to preserve fruits and vegetables

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	2	1	-	-	1	-	-	-	-	-	-	-
2	1	1	-	-	-	-	-	-	-	-	-	-	-	-
3	1	2	-	-	-	-	-	-	-	-	-	-	-	-
4	1	-	1	-	-	-	-	-	-	-	-	-	-	-
5	2	1	1	-	-	-	-	-	-	-	-	-	-	-

UNIT I **9 Hours**

POST HARVEST PRACTICES AND PROCESSING

Maturity indices for harvesting; pathological spoilage's during storage, ripening and control measures, Post- harvest handling, sorting & grading, packaging, storage, transportation, Methods of pre-cooling, post-harvest treatments to hasten and delay ripening; Methods of storage at farm level - cold storage, controlled/modified atmosphere storage, Quality management, export requirements, Nutritive value, nutraceutical properties

UNIT II **9 Hours**

PRESERVATION AND VALUE ADDITION

General principles and methods of fruit and vegetable preservation. Preservation using sugar: Principle and Preparation of jam, jelly, marmalade, squash, RTS, carbonated beverages, crush, nectar, cordial, fruit bar, preserves, candies and carbonated fruit beverages. Processing using salt: Principle - Brining - Preparation of pickles, chutney and sauces, ketchup.

UNIT III **9 Hours**

PRESERVATION BY LOW TEMPERATURE AND IRRADIATION

Preservation by low temperature: definition, principle, methods - Refrigeration, freezing. Methods of freezing- changes during freezing. Preparation of frozen foods. Minimal Processing of Fruits and Vegetables - techniques involved - Preservation by irradiation: definition- principle, application, irradiation unit.

UNIT IV **9 Hours**

PRESERVATION BY DRYING

Machineries involved in processing of fruits and vegetables products. Drying and dehydration: definition, principle, Types of driers: Solar, cabinet, spray drier, drum drier, fluidized bed drier. Preparation of product for dehydration. Dehydration principles and equipment. Preparation of fruits - powder production. Problems related to storage of dehydrated products.

UNIT V **9 Hours**

PRESERVATION BY CANNING

Canning: principles, Types of cans, packing of canned products-preparation of canned products - general considerations in establishing a commercial fruit and vegetable cannery, machineries involved in canning and bottling unit- spoilage of canned foods. Bottling of fruit and vegetable. Precautions in canning operations.

Total: 45 Hours

Reference(s)

1. S.Ranganna, HandBook of Analysis and Quality Control for Fruit and Vegetable Products, McGraw Hill Education (India) Private Limited, Chennai, 2017
2. N.W. Desrosier, the Technology of Food Preservation, CBS Publisher & Distributions, New Delhi, 1987.
3. R.P. Srivastava and S. Kumar, Fruit and Vegetable Preservation: Principles and Practices, Second Edition, International Book Distribution Co., Lucknow, 1998.
4. G. Lal, G. Siddappa and G.L. Tondon, Preservation of Fruits and Vegetables, Indian Council of Agricultural Research, New Delhi, 1986.
5. Chakraverty, A.S. Mujumdar, G.S.V. Raghavan and H.S. Ramaswamy, Handbook of Post-harvest Technology, Marcel Dekker Press, USA, 2001.
6. D.K. Salunkhe, and S.S. Kadam, Handbook of Fruit Science and Technology: Production, Composition and Processing, Marcel Dekker, New York, 1995.

22OFD04 CEREAL, PULSES AND OILSEED TECHNOLOGY 3 0 0 3

Course Objectives

- Understand the application of scientific principles in the processing technologies specific to the materials
- Understand the storage methods and handling techniques followed for cereals, pulses and oil seeds
- Develop the knowledge in the area of Cereals, pulses and oil seed processing and technology

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Identify the specific processing technologies employed for cereals
2. Analyse the composition of millets and their nutritional importance
3. Relate the compositional changes and processing methods of pulses and legumes
4. Create the competence in processing of oilseeds technology
5. Relate the storage processing of food grains with quality aspects

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	-	2	-	2	-	-	-	-	-	-	-	-
2	1	2	-	2	-	1	-	-	-	-	-	-	-	-
3	2	2	-	1	-	2	-	-	-	-	-	-	-	-
4	2	3	-	2	-	2	-	-	-	-	-	-	-	2
5	2	2	-	2	-	3	-	-	-	-	-	-	-	-

UNIT I 9 Hours

CEREALS

Cereal Grains- Basic agricultural aspects, structure and composition; Storage, Insect control; Processing: Wheat- milling, (Atta and maida), quality aspects of flour, wheat proteins and their function, rheology of flour; wheat based baked products - Bread, Biscuit, Cakes, Extruded products, Pizza, Chapatis, malting and malt products; Rice-Milling, Parboiling, Quick cooking rice, Traditional Indian Products- Puffed Rice, flaked rice, Idli/Dosa/vada mixes and other savouries; Corn- Wet and dry milling, Corn Products - Corn flakes, Corn starch, canned corn products, puffed product; Oats-Milling, Oat Products - Steel cut,rolled oats, quick cooking; Traditional and Fermented cereal products.

UNIT II **9 Hours**

OTHER CEREALS AND MILLETS

Sorghum, Pearl Millet, Finger millet, Foxtail Kodo Millet - Basic agricultural millet, aspects, structure and composition; storage, insect control; processing - pearling, Milling, Malting, Malt based foods, flaked and fermented products; Traditional and Nutritional products based on finger millet.

UNIT III **9 Hours**

PULSES AND LEGUMES

Basic agricultural aspects, structure, composition, storage, insect control, processing Milling/splitting, dhal milling, products - puffed, flakes, flour, legume-based traditional products, flour based Indian sweets and savouries, soya milk, soy protein Isolate, soya paneer

UNIT IV **9 Hours**

OILSEEDS AND NUTS

Basic agricultural aspects structure, composition, Storage, Insect control; processing: traditional and modern methods of oil extraction, refining, bleaching, deodorizing, hydrogenation; oil blends; applications of different oils and fats in food processing & products.

UNIT V **9 Hours**

STORAGE AND HANDLING

Bag Storage - Advantages and Disadvantages, Cover Plinth Storage Structures, CAP storage (Cover and Plinth Storage). Protection against Rodents, Fungi, Pests and Mites. Fumigation Processes for bag storage piles. Bulk Storage in silos and large Bins. Conveyors and Elevators for feeding and discharging.

Total: 45 Hours

Reference(s)

1. Chakraverty, A.: Post Harvest Technology of Cereals, Pulses and Oilseeds. Oxford and IBH Publishing Co, Calcutta, 1995.
2. Delcour, Jan A. and R. Carl Hoseney., Principles of Cereal Science and Technology, 3rd Edition, American Association of Cereal Chemists, 2010.
3. Karl Kulp, Handbook of Cereal Science and Technology, 2nd Rev. Edition, CRC Press, 2000.
4. N.L.Kent and A.D.Evans, Technology of Cereals (4th Edition) Elsevier Science (Pergaman),Oxford, UK, 1994.
5. Matz, Samuel A., The Chemistry and Technology of Cereals as Food and Feed, 2nd Edition,CBS, 1996.
6. Morris, Peter C. and J.H. Bryce., Cereal Biotechnology, CRC/Wood head publishing, 2004.

22OFT01 **FASHION CRAFTSMANSHIP** **3 0 0 3**

Course Objectives

- To impart theoretical and practical knowledge about various handi-craft techniques
- To enhance innovative skills on hand crafts.
- To build confidence on doing handicrafts.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Outline the classification, techniques and criteria for selecting raw materials for making various handicraft materials and produce textile based handicrafts. Produce various decorative and appealing products
2. Design and construct various wall hangings and fashion accessories.
3. Design and construct toys and accessories
4. Design and construct head accessories, home furnishings and paintings
5. Design and construct various decorative and appealing products for interiors

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	3	-	-	-	2	-	2	2	-	2	2	-
2	3	2	3	-	-	-	1	-	2	3	-	2	2	-
3	3	2	3	-	-	-	2	-	2	3	-	2	2	-
4	3	2	3	-	-	-	2	-	2	3	-	2	2	-
5	3	2	3	-	-	-	2	-	2	3	-	2	2	-

UNIT I **9 Hours**

TECHNIQUES OF HANDICRAFT MATERIALS

Definition of Handicraft, Classification: Reusable, Non reusable, Raw materials used in various craft materials: printed, embroidered, stitched and handmade, Criteria for selection of raw materials: material types and end uses.

UNIT II **9 Hours**

DECORATIVE AND APPEALING PRODUCTS - INTERIORS

Designing and Construction procedures for following various decorative and appealing products: Wall hangings - String Art on plywood, Pressed Flower Art frames.

UNIT III **9 Hours**

DECORATIVE AND APPEALING PRODUCTS - ACCESSORIES

Designing and Construction procedures for following various decorative and appealing products: Handbags, Hats, footwear.

UNIT IV **9 Hours**

DECORATIVE AND APPEALING PRODUCTS - ORNAMENTS

Designing and Construction procedures for following various decorative and appealing products: Stone necklace using Macrame Technique, Tribal Jewellery using woollen threads, Floral Jewellery using Resin Technique, Fabric Jewellery using Tie and Dye Technique.

UNIT V **9 Hours**

DECORATIVE AND APPEALING PRODUCTS - FANCY ITEMS

Designing and Construction procedures for following various decorative and appealing products: Jewellery Box, Utility Holder, Gift items. Lampshade decors from cardboard, Driftwood Frames for pictures and Mirrors.

Total: 45 Hours

Reference(s)

1. Handmade in India: A Geographic Encyclopaedia of India Handicrafts. Abbeville press; 1 edition (October 20,2009)
2. Encyclopaedia of Card making Techniques (Crafts), Search Press Ltd, illustrated edition, 2007
3. All about Techniques in Illustration, Barron Educational Series, 2001
4. Printing by Hand: A Modern Guide to printing with Handmade stamps, Stencils and Silk Screens, STC Craft/A Melanie Falick Book, 2008
5. Materials & Techniques in the Decorative Arts: An Illustrated Dictionary, University of Chicago Press, 2000
6. https://www.marthastewart.com/274411/fashion-crafts

22OFT02 **INTERIOR DESIGN IN FASHION** **3 0 0 3**

Course Objectives

- To impart knowledge on interior design.
- To improve the design skills, sustainable with socially-conscious designs

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Interpret the elements of interior design concepts and resolve the personality requirements
2. Develop graphical representations of interior design concepts
3. Resolve the space planning requirements of residential home as per CPWD guidelines
4. Determine the aesthetic requirements of interior design components.
5. Appraise the roles and responsibilities of interior designer.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	3	-	-	1	-	-	-	-	-	-	2	-
2	3	2	3	-	2	3	-	2	-	-	-	-	3	-
3	3	3	3	-	2	2	-	2	-	-	-	-	2	-
4	3	3	3	-	2	3	-	2	-	-	-	-	2	-
5	3	2	-	-	2	-	-	3	-	-	-	-	3	-

UNIT I **9 Hours**

INTRODUCTION

Interior designing - definition, importance, requirements and types - Structural design, Decorative Design - Designing interiors, Good taste; Design themes, types and application. Personality of the Home - Art elements

- Line: types, characteristics and importance; form: size and shape, characteristics; Colour - sources, qualities, emotional effects, colour wheel and schemes.

UNIT II **9 Hours**

GRAPHICAL PRESENTATIONS

3D composition; Isometric and Axonometric- Still life- Furniture Sketching- Object Drawing with color rendering - Interior elements, Lighting, plants. Perspective, Axonometric Isometric drawing. Orthographic Projection - Lifts and escalators.

UNIT III **9 Hours**

SPACE PLANNING

Space planning concepts- interiors, circulation. Definition, application of ergonomic principals in interiors. Residential house space planning case study- CPWD guidelines. Lighting for different locations and activities, measurement, ventilation and indoor air quality, noise control methods.

UNIT IV **9 Hours**

INTERIOR COMPONENTS

Application of colour in interiors; Texture - types and significance; Pattern: types and effects; Light - importance. Importance of Furniture Design for Interiors- Ancient Age / Middle Age / Contemporary. Doors, Windows, Staircase designs, False Ceiling, Partitions, Wall Panelling, Comics, Mosaic, Cladding- Flooring and Wall Cladding

UNIT V **9 Hours**

ROLES AND RESPONSIBILITIES OF INTERIOR DESIGNER

Role of an Interior Designer- Responsibility towards society and need of an Interior Designer to better the environment- Ethics and Code of Conduct- Responsibility towards client, contractor and supplier, Estimation. Professional Fees- Work of an Interior Designer- Making of portfolio, JD Annual Design Awards.

Total: 45 Hours

Reference(s)

1. Joanna Gaines, Homebody: A guide to creating spaces you never want to leave, Harper design, 2018.
2. Erin gates, Elements of Style: Designing a Home and a life, Simon and Schuster, 2014.
3. Simon Dodsworth, The Fundamentals of Interior Design, AVA publishing, 2009.
4. V. Mary. Knackstedt, The Interior Design Business Handbook: A Complete Guide to Profitability, Wiley, New Jersey; 2006.
5. M. G. Shah, C. M. Kale, and S.Y. Patki, Building Drawing with an Integrated Approach to Build Environment, Tata McGraw Hill, 2002.
6. Https://eclectictrends.com

22OFT03 SURFACE ORNAMENTATION 3 0 0 3

Course Objectives

- To familiarize the students about the various techniques of surface embellishment with relevance to garment embellishments.
- To aware of various types of embroidery and methods of producing it.
- To make the students confident about doing surface embellishment work

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PSO1: Demonstrate the knowledge and technical skills in software development. PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Analyze the raw material requirements for surface ornamentation and its application
2. Implement hand embroidery stitches on fabric and show the stitch development procedure in diagrammatic representations
3. Apply the machine and computerized embroidery stitches
4. Analyze the surface embellishment techniques and its application
5. Assess the quality maintenance parameters of all embroidered products and analyze the 6 traditional embroidery techniques

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	2	-	-	-	-	1	-	-	-	-	-	-
2	2	3	2	-	-	-	-	-	2	-	-	-	2	2
3	2	3	2	-	3	-	-	-	-	-	-	-	2	2
4	2	2	2	-	-	-	-	-	2	-	-	-	2	2
5	2	2	2	-	-	-	-	-	2	-	-	-		2

UNIT I **9 Hours**

INTRODUCTION TO SURFACE ORNAMENTATION

Introduction, Definition, Need, Types, Raw materials, Importance of surface ornamentation, Selection of needle, thread and fabric for hand embroidery and machine embroidery. various methods of surface embellishment- embroidery and surface ornamentation.

UNIT II **9 Hours**

HAND EMBROIDERY

General rules for hand embroidery. Types of hand embroidery stitches-Running, Couching, Button hole, Satin, Long & Short, Wheat, Chain, Stem, Herringbone, Cross stitch, Knotted stitches, Fish bone, Fly stitch, Braids, Back, Hem, Seed, Needle weaving, Whip stitches.

UNIT III **9 Hours**

MACHINE EMBROIDERY

General rules for machine embroidery. Types of frames and methods of transferring the designs. Attachments to sewing machines for embroidery, Types of machine embroidery stitches- Eyelet work, Cut work, patch work, Mirror work, Applique, Shaded embroidery, Shadow work, Bead and Sequins work, Vermicelli, Zigzag, Granite stitch. Computerized embroidery machine- Concept of design and development, software used in embroidery machines, process of designing, method and types of stitch application, punching and digitizing.

UNIT IV **9 Hours**

EMBELLISHMENT TECHNIQUES

Materials used and Applications. Types of embellishment techniques- fabric painting-hand, Stencil-dabbing and Spraying. Dyeing and printing-advanced tie and dye techniques, batik and block printing. Trimmings and decorations-Laces, Pompons, Fringes, Tassels, Tucks, Show buttons, Crocheting.

UNIT V **9 Hours**

TRADITIONAL EMBROIDERIES OF INDIA AND CARE

Care and maintenance of embroidered articles-care and maintenance methods for embroidered apparel, pressing. Traditional Embroideries of India-Phulkari, Kasuti, Kashmiri embroidery, Kutch work, Chikkankari, Kantha.

Total: 45 Hours

Reference(s)

1. Ruth Chandler, Modern Hand Stitching-Dozens of stitches with creative free-form variations,2014
2. Sophie Long, Mastering the Art of Embroidery: Traditional Techniques and Contemporary Applications for Hand and Machine Embroidery, Heritage Publishers, London, 2013
3. Christen Brown ,Embroidered & Embellished, C&T Publishing, 2013
4. Sheila Paine, Embroidered Textiles, Thames and Hudson Publisher, UK, 1990.
5. Gail Lawther, Inspirational Ideas for Embroidery on Clothes & Accessories, Search Press Ltd, UK, 1993.
6. http://www.needlenthread.com/tag/hand-embroidery-stitches

22OPH01 **NANOMATERIALS SCIENCE** **3 0 0 3**

Course Objectives

- Impart knowledge on Nanoscience
- Explore different techniques of producing nanomaterials
- Create expertise on the applications of nanomaterials in various fields

Programme Outcomes (POs)

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO12. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Summarize the origin and advance of nanomaterials and its classification
2. Compare the different types of methods adopted for synthesizing nanomaterials
3. Analyze the characterization techniques for analyzing nanomaterials
4. Explain the physical properties exhibited by nanomaterials
5. Organize the nanomaterials developed for advanced technological applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2	1	1	-	-	-	-	-	-	1	-	-
2	3	2	2	1	1	-	-	-	-	-	-	1	-	-
3	3	2	2	1	1	-	-	-	-	-	-	1	-	-
4	3	2	2	1	1	-	-	-	-	-	-	1	-	-
5	3	2	2	1	1	-	-	-	-	-	-	1	-	-

UNIT I **9 Hours**

NANO SCALE MATERIALS

Introduction-Feynman's vision-national nanotechnology initiative (NNI) - past, present, future - classification of nanostructures, nanoscale architecture - effects of the nanometer length scale - changes to the system total energy, and the system structures- effect of nanoscale dimensions on various properties - differences between bulk and nanomaterials and their physical properties.

UNIT II **9 Hours**

NANOMATERIALS SYNTHESIS METHODS

Top down processes - mechanical milling, nanolithography and types based on radiations - Bottom up process physical method: physical vapour deposition, RF sputtering, CVD- chemical method: colloidal and sol-gel methods - template based growth of nanomaterials - ordering of nanosystems, self-assembly and self- organization.

UNIT III **9 Hours**

CHARACTERIZATION TECHNIQUES

General classification of characterization methods - analytical and imaging techniques - microscopy techniques - electron microscopy, scanning electron microscopy, transmission electron microscopy, atomic force microscopy - diffraction techniques - X-ray spectroscopy - thermogravimetric analysis of nanomaterials.

UNIT IV **9 Hours**

SEMICONDUCTOR NANOSTRUCTURES

Quantum confinement in semiconductor nanostructures - quantum wells, quantum wires, quantum dots, super lattices-epitaxial growth of nanostructures-MBE, metal organic VPE, LPE - carbon nano tubes-structure, synthesis and electrical properties -applications- quantum well laser- quantum efficiency of semiconductor nanomaterials

UNIT V **9 Hours**

NANOMACHINES AND NANODEVICES

Microelectromechanical systems (MEMS) and Nanoelectromechanical systems (NEMS)-fabrication, actuators-organic FET- principle, description, requirements, integrated circuits- single electron transistor - - organic photovoltaic cells- spintronics

Total: 45 Hours

Reference(s)

1. Willam A. Goddard, Donald W.Brenner, "Handbook of Nanoscience, Engineering, and Technology", CRC Press, 2012
2. Charles P. Poole Jr and. Frank J. Owens, "Introduction to Nanotechnology", Wiley Interscience, 2007
3. Guozhong Cao, Y. Wang, "Nanostructures and Nanomaterials-Synthesis, Properties & Applications", Imperials College Press, 2011.
4. T. Pradeep, "NANO: The Essentials Understanding Nanoscience and Nanotechnology", McGraw - Hill Education (India) Ltd, 2012
5. Robert W. Kelsall, Ian W. Hamley, Mark Geoghegan, "Nanoscale Science and Technology", John Wiley and Sons Ltd, 2006
6. Viswanathan B, AuliceScibioh M, "Fuel cells: Principles and Applications", University Press, 2009.

22OPH02 SEMICONDUCTOR PHYSICS AND DEVICES 3 0 0 3

Course Objectives

- Impart knowledge in physical properties of semiconducting materials
- Analyze the factors affecting the operation of semiconductor devices
- Apply the physics of semiconductors to develop semiconductor devices

Programme Outcomes (POs)

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO12. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO2 Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Exemplify the band gap, drift and diffusion current densities due to carrier transport in semiconductors
2. Analyze the energy band diagram in thermal equilibrium and space charge width of PN junction
3. Illustrate the operation of Bipolar Junction transistor at different modes and different configurations
4. Illustrate the operation of metal oxide field effect transistor and their memory devices
5. Represent the working mechanism of opto-electronic devices

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2	1	1	-	-	-	-	-	-	1	-	1
2	3	2	2	1	1	-	-	-	-	-	-	1	-	1
3	3	2	2	1	1	-	-	-	-	-	-	1	-	1
4	3	2	2	1	1	-	-	-	-	-	-	1	-	1
5	3	2	2	1	1	-	-	-	-	-	-	1	-	1

UNIT I 9 Hours

ENERGY BANDS AND CARRIER TRANSPORT PROPERTIES

Energy Bands: Formation of energy bands - doping effects - energy levels - electron and hole concept in semiconductor. Carrier transport: Carrier drift-drift current density - conductivity- diffusion current density - total current density

UNIT II **9 Hours**

P-N JUNCTION

Basic structure and fabrication process of p-n junction - current - voltage characteristics - energy band diagram - equilibrium Fermi levels - depletion region - junction breakdown phenomena - zener - avalanche breakdown.

UNIT III **9 Hours**

BIPOLAR JUNCTION TRANSISTOR

The basic transistor action - operation in the active mode - current gain - static characteristics - carrier distribution in emitter, base and collector region - modes of operation - current - voltage characteristics of common base and emitter configuration - frequency response and switching of bipolar transistor

UNIT IV **9 Hours**

MOSFET

The ideal MOS diode - basic fundamentals and characteristics - types - CMOS and BiCMOS - CMOS inverter - MOSFET on insulator - thin film transistor (TFT) - silicon on insulators (SOI) devices - MOS Memory structures - DRAM and SRAM

UNIT V **9 Hours**

PHOTONIC DEVICES

Radiative transitions and optical absorption-light emitting diodes-organic LED - infrared LED - semiconductor laser - temperature effect - photo detector - photo diode - silicon and compound semiconductor solar cells - efficiency

Total: 45 Hours

Reference(s)

1. Donald A Neamen, "Semiconductor Physics and Devices", Tata McGraw Hill, 2012
2. S. M. Sze and M. K. Lee, "Semiconductor Devices, Physics and Technology", John-Wiley & Sons, 2015
3. Ben. G. Streetman and S. K. Banerjee , "Solid State Electronic Devices", Pearson Education Ltd, 2015
4. C. Kittel, "Introduction to Solid State Physics", John-Wiley & Sons, 2012
5. J. Millman and C. Halkias, "Electronic Devices and Circuits", Tata McGraw Hill, 2010
6. Hagen Klauk, "Organic Electronics: Materials, Manufacturing and Applications", Wiley-VCH, 2006

22OPH03 APPLIED LASER SCIENCE 3 0 0 3

Course Objectives

- Impart knowledge on laser science
- Explore different strategies for producing lasers
- Create expertise on the applications of lasers in various fields

Programme Outcomes (POs)

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO12. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Illustrate the transition mechanisms and the components of a laser system
2. Compare the different types of lasers based on pumping method, active medium and energy levels
3. Compute the rotation of earth, velocity and distance using lasers and apply the same for day today applications
4. Analyze the role of lasers in surgical and endoscopy applications
5. Apply the laser techniques in industrial applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2	1	-	-	-	-	-	-	-	1	-	-
2	3	2	2	1	-	-	-	-	-	-	-	1	-	-
3	3	2	2	1	-	-	-	-	-	-	-	1	-	-
4	3	2	2	1	-	-	-	-	-	-	-	1	-	-
5	3	2	2	1	-	-	-	-	-	-	-	1	-	-

UNIT I **9 Hours**

LASER FUNDAMENTALS

Introduction - principle - absorption and emission of light - thermal equilibrium - Einstein's prediction - Einstein's relations - A and B coefficients - condition for large stimulated emission - spontaneous and stimulated emission in optical region - light amplification - condition for light amplification - population inversion- Components of lasers - pumping methods - pumping mechanisms - optical resonator

UNIT II **9 Hours**

LASER BEAM CHARACTERISTICS AND TYPES

Characteristics of laser - Classification of lasers - principle, construction, working, energy level diagram and applications of molecular gas laser (CO2 laser) - liquid laser (dye laser) - excimer laser - Solid state laser (Nd:YAG laser) - semiconductor laser (homojunction laser).

UNIT III **9 Hours**

LASERS IN SCIENCE

Introduction - Harmonic generation (SHG) - Stimulated Raman emission - lasers in chemistry - laser in nuclear energy - lasers and gravitational waves - rotation of the earth - measurement of distance - Light detection And Ranging (LIDER) - velocity measurement - holography

UNIT IV **9 Hours**

LASERS IN MEDICINE AND SURGERY

Light induced biological hazards: Eye and skin - Eye laser surgery - photocoagulations - homeostasis - dentistry - laser angioplasty - different laser therapies - advantages & disadvantages - laser endoscopy.

UNIT V **9 Hours**

LASERS IN INDUSTRY

Applications in material processing: laser welding - hole drilling - laser cutting - Lasers in electronics industry: information storage - bar code scanner- Lasers in defence: laser based military weapons - laser walls.

Total: 45 Hours

Reference(s)

1. K. Thiyagarajan and A. K. Ghatak, "LASERS: Fundamentals and Applications", Springer, USA, 2015
2. M. N. Avadhanulu, "An Introduction to Lasers Theory and Applications", S. Chand Publisher, 2013
3. W. Koechner, M. Bass, "Solid State Lasers: a graduate text", Springer Verlag, New York, 2006
4. K. P. R. Nair, "Atoms, Molecules and Lasers", Narosa Publishing House, 2009
5. K. R. Nambiar, "Lasers: Principles Types and Applications", New Age International Publications, 2006
6. A. Sennaroglu, "Solid-State Lasers and Applications", CRC Press, 2006

22OPH04 **BIOPHOTONICS** **3 0 0 3**

Course Objective:

- To understand the light-matter interaction in biological cells or tissues by using the principles of optics and lasers.
- To apply the properties of biological cells or tissues in biomedical applications by various optical imaging, sensing and activation techniques.
- To analyze the concepts of Modern optical measurement techniques and devices in early detection of disease and cure them.

Programme Outcomes (POs)

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Use research–based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Infer the laws of optics and lasers to interpret the biological cells and tissues.
2. Identify the properties of different optical instruments in biological systems to represent their behavior in structure and design of detection engineering instruments.
3. Use laser tweezers techniques to infer the activities of cells (tissues) and explain the single molecule detection processes in medical diagnosis.
4. Outline the properties of ultra short laser pulses and tissue engineering to rectify the affecting factors in biological cells.
5. Compare the various types of bio-imaging methods to detect the infected cells and molecules in biological science.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	3	2	2	1	-	-	-	-	-	-	-	-	-
2	2	3	2	2	1	-	-	-	-	-	-	-	-	-
3	3	3	2	2	1	-	-	-	-	-	-	-	-	-
4	4	3	2	2	1	-	-	-	-	-	-	-	-	-
5	5	3	2	2	1	-	-	-	-	-	-	-	-	-

UNIT I **9 Hours**

INTRODUCTION TO BIOPHOTONICS

Light as Photon Particles – Coherence of light - lasers – classification of lasers – Mechanisms of Non-linear Optics (NLO) processes associated with Biophotonics - Light scattering mechanisms: Rayleigh scattering, Miescattering, Brillouin Scattering, Raman Scattering -Different light sources – Quantitative description of light: Radiometry

UNIT II **9 Hours**

PHOTOBIOLOGY

Interaction of light with cells and tissues – Light – Tissue Interaction Variables – Light –Tissue Interaction Theory: Radiative Transport Theory – Photo process in biopolymers – In Vivo Photoexcitation – photo-induced physical, chemical, thermal and mechanical effects in biological systems – Optical biopsy – Single molecule detection

UNIT III **9 Hours**

BIONANO PHOTONICS

Laser Microtools, Semiconductor quantum dots for bioimaging, Metallic nanoparticles and nanorods for biosensing – Optical biosensors: Fibre-Optic, evanescent wave, surface Plasmon resonance (SPR) based biosensors – biomaterials for photonics – Principle and design of laser tweezers – laser trapping and dissection for biological manipulation.

UNIT IV **9 Hours**

TISSUE ENGINEERING WITH LIGHT

Basics of tissue optics: Light absorption and scattering in tissues, Wavelength effects and spectra– the therapeutic window, Light penetration in tissues – Absorbing agents in tissues and blood –Skinoptics, response to the UV radiation, Optical parameters of tissues – tissue welding – tissue contouring – tissue regeneration – Femto laser surgery – low level light therapy and photo dynamic therapy

UNIT V **9 Hours**

BIO-IMAGING TECHNIQUES AND ITS APPLICATIONS

An overview of optical imaging – Fluorescence Microscopy – Scanning Microscopy – In vivo Confocal Microscopy – Multi photon Microscopy – Optical Coherence Tomography (OCT) – Fluorescence Resonance Energy Transfer (FRET) imaging – fluorescence lifetime imaging Microscopy (FLIM) – Nonlinear optical imaging – Coherent Anti-stokes Raman Scattering –Bioimaging Applications.

Total: 45 Hours

Reference(s)

1. Introduction to Biophotonics, ParasN.Prasad, WileyInter-science, AJohnWiley & Sons, Inc., Publication (Class notes are developed mainly based on this book.)
2. Introduction to Biomedical Imaging, Andrew G.Webb, 2002, IEEE Press.
3. Biomedical Optics: Principles and Imaging, Lihong.V.Wang, Hsin.-I.Wu, 2007, Wiley Interscience 2007. & "An Introduction to Biomedical Optics", R.Splinterand B.A.Hooper, Taylor & Francis
4. Bioimaging Current Concepts in Light and Electron Microscopy, DouglasE.Chandler & Robert W.Roberson, Jones and Bartlett publishers.
5. Optical Imaging and Microscopy : Techniques and Advanced Systems, Peter Török and Fu-JenKao, 2004, Springer.

22OPH05 PHYSICS OF SOFT MATTER 3 0 0 3

Course Objectives

- To recognize the properties of soft matter and hard matter
- To understand the fundamental interactions of colloids and gels
- To explain the structure and phase behavior of liquid crystals and supramolecules
- To summarize the soft matter proprties of structures and components of life

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Identify the salient features of soft matter and hard matter
2. Exemplify the fundamental interactions and stability of colloids and gels
3. Illustrate the structure and properties of liquid crystals
4. Outline the aggregation and phase behavior of surfactants, polymers, copolymers and block copolymers
5. Analyze the soft matter behavior of nucleic acids, proteins, polysaccharides and membranes

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	-	-	-	-	-	-	-	-	-	-	-	-
2	2	1	-	-	-	-	-	-	-	-	-	-	-	-
3	2	2	-	-	-	-	-	-	-	-	-	-	-	-
4	2	2	-	-	-	-	-	-	-	-	-	-	-	-
5	2	2	-	-	-	-	-	-	-	-	-	-	-	-

UNIT I **9 Hours**

CONDENSED MATTER

Intermolecular forces-Condensation and freezing-mechanical response: Hookean solid-Newtonian liquid-viscoelasticity. Glasses: relaxation time-viscosity- glass forming liquids. Soft matter: length scales-fluctuations and Brownian motion

UNIT II **9 Hours**

COLLOIDAL DISPERSIONS AND GELS

Forces between colloidal particles: vander Waals forces-electrostatic double layer forces-steric hindrance-depletion interactions. Stability and phase behaviour: Crystallisation-strong colloids-weak colloids.Physical and chemical gels-classical theory of gelation-elasticity of gels

UNIT III **9 Hours**

LIQUID CRYSTALS

Liquid crystal phases-distortions and topological defects-electrical and magnetic properties-polymer liquid crystals-Fredricks transition and liquid crystal displays

UNIT IV **9 Hours**

SUPRAMOLECULAR SELF ASSEMBLY

Aggragation and phase separation-types of micelles- bilayers and vesicles. Phase behaviour of concentrated surfactant solutions-phase separation in polymers, copolymers and block copolymers

UNIT V **9 Hours**

SOFT MATTER IN NATURE

Components and structures of life-Nucleic acids-proteins-interaction between proteins-polysaccharides-membranes

Total: 45 Hours

REFERENCES

1. Richard A L Jones, Soft Condensed Matter, Oxford University Press, UK, 2002
2. Masao Doi, Soft Matter Physics, Oxford University Press, UK, 2013.
3. Ian W. Hamley, Introduction to Soft Matter, John Wiley & Sons, 2007
4. A. Fernandez-Nieves, A M Puertas, Fluids, Colloids and Soft materials: An Introduction to Soft Matter Physics, John Wiley & Sons, 2016
5. Maurice Kleman, Oleg D. Lavrentovich, Soft Matter Physics: An Introduction, Springer-Verlag, New York, 2003.

22OCH01 CORROSION SCIENCE AND ENGINEERING 3 0 0 3

Course Objectives

- Analyse the loss incurred due to corrosion in different sectors and terminologies related to corrosion
- Identify forms and types of corrosion with suitable mechanism
- Apply various methods of corrosion control, corrosion testing and monitoring

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Explain if corrosion can occur under specific operating conditions in a given equipment or construction and indicate regions of immunity, corrosion and passivity of a metal
2. Compare different corrosion types on metals when exposed to air, water and at high temperatures (> 100 C)
3. Identify the corrosion mechanism on steel, iron, zinc and copper metal surfaces
4. Calculate the rate of corrosion on metals using electrochemical methods of testing
5. Propose the correct materials, design and operation conditions to reduce the likelihood of corrosion in new equipment and constructions

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	-	-	-	-	-	-	-	-	-	-	-	-
2	2	-	-	-	-	-	1	-	-	-	-	-	-	-
3	1	3	-	-	-	-	-	-	-	-	-	-	-	-
4	2	2	-	-	-	-	-	-	-	-	-	-	-	-
5	3	3	-	-	-	-	1	-	-	-	-	-	-	-

UNIT I **9 Hours**

CORROSION

Importance of corrosion - spontaneity of corrosion - units of corrosion rate (mdd and mpy) - direct and indirect damage by corrosion - importance of corrosion prevention in industries - Pilling Bedworth ratio and its significance - passivation - area relationship in both active and passive states of metals - Pourbaix digrams of Mg, Al and Fe and their advantages and disadvantages

UNIT II **7 Hours**

TYPES OF CORROSION

Eight forms of corrosion: uniform, galvanic, crevice corrosion, pitting, intergranular corrosion, selective leaching, erosion corrosion and stress corrosion-Catastrophic oxidation corrosion

UNIT III **9 Hours**

MECHANISM OF CORROSION

Hydrogen embrittlement - corrosion fatigue - filiform corrosion - fretting damage and microbes induced corrosion. Corrosion mechanism on steel, iron, zinc and copper metal surfaces

UNIT IV **10 Hours**

CORROSION RATE AND ITS ESTIMATION

Rate of corrosion: Factors affecting corrosion. Electrochemical methods of polarization: Tafel extrapolation polarization and linear polarization. Weight loss method - testing for intergranular susceptibility and stress corrosion. Non destructive testing methods: Visual testing - liquid penetrant testing - magnetic particle testing

- Ultrasonic monitoring, and eddy current testing

UNIT V **10 Hours**

CORROSION CONTROL METHODS

Fundamentals of cathodic protection - types of cathodic protection(sacrificial anodic and impressed current cathodic protection). Stray current corrosion, problems and its prevention. Protective coatings: Metal coatings: Hot dipping (galvanizing, tinning and metal cladding) - natural inhibitors. Selection of suitable design for corrosion control

Total: 45 Hours

Reference(s)

1. Mouafak A. Zaher, "Introduction to Corrosion Engineering", CreateSpace Independent Publishing Platform, 2016.
2. E.McCafferty, "Introduction to Corrosion Science", Springer; 2010 Edition, January 2010.
3. R. Winstone Revie and Herbert H. Uhlig, "Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering", 4th Edition, John Wiley & Science, 2008.
4. Mars G. Fontana, "Corrosion Engineering", Tata McGraw Hill, Singapore, 2008
5. David E.J. Talbot (Author), James D.R. Talbot, "Corrosion Science and Technology", Second Edition (Materials Science & Technology), CRC Press; 2nd Edition, 2007.

22OCH02 **POLYMER SCIENCE** **3 0 0 3**

Course Objectives

- Explain the properties of different polymers with its mechanism
- Select the appropriate polymerization techniques to synthesize the polymers
- Identify suitable polymers for various industrial applications

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Course Outcomes (COs)

1. Illustrate the types of mechanism of polymerization reactions and analyze the natural and synthetic polymers
2. Identify the suitable polymerization techniques to synthesize the high quality polymers
3. Identify the structure, thermal, and mechanical properties of polymers for different applications
4. Apply the polymer processing methods to design polymer products
5. Analyze the polymers used in electronic and biomedical applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	-	-	-	-	-	-	-	-	-	-	-	-
2	1	2	-	-	-	-	-	-	-	-	-	-	-	-
3	2	2	-	-	-	-	-	-	-	-	-	-	-	-
4	1	1	2	-	-	-	-	-	-	-	-	-	-	-
5	1	3	2	-	-	-	-	-	-	-	-	-	-	-

UNIT I **10 Hours**

POLYMERS AND ELASTOMERS

Classification of polymers - Mechanism: Addition polymerization - free radical, cationic, anionic and co-ordination (Ziegler-Natta) polymerization - copolymerization - condensation polymerization (nylon-6,6) - ring opening polymerization (nylon-6). Elastomers: Natural rubber and synthetic rubber: styrene - butadiene rubber (SBR), butyl, neoprene, thiocol rubbers. High performance polymers: polyethers, polyether ether ketone (PEEK), polysulphones and polyimides

UNIT II **8 Hours**

POLYMERIZATION TECHNIQUES

Homogeneous and heterogeneous polymerization - bulk polymerization (PMMA, PVC) - solution polymerization - polyacrylic acid, suspension polymerization (ion-exchange resins) - emulsion polymerization (SBR) - advantages and disadvantages of bulk and emulsion polymerization. Melt solution and interfacial poly-condensation

UNIT III **8 Hours**

CHARACTERIZATION AND TESTING

Characterization of polymers by Infrared Spectroscopy (IR) and Nuclear Magnetic Spectroscopy (NMR) - Thermal properties: TGA and DSC - Testing tensile strength - Izod impact - Compressive strength - Rockwell hardness - Vicot softening point - water absorption

UNIT IV **9 Hours**

POLYMER PROCESSING

Moulding: Compression - injection - extrusion and blow mouldings. Film casting - calendering. Thermoforming and vacuum formed polystyrene - foamed polyurethanes. Fibre spinning: melt, dry and wet spinning. Fibre reinforced plastics fabrication: hand-layup - filament winding and pultrusion

UNIT V **10 Hours**

SPECIALITY POLYMERS

Preparation and properties of heat resistant and flame retardant polymers. Polymers for electronic applications: liquid crystalline, conducting and photosensitive polymers – E waste management. Polymer for biomedical applications: artificial organs, controlled drug delivery, Scaffolds in tissue Engineering – waste management.

Total: 45 Hours

Reference(s)

1. V. R. Gowarikar, N. V. Viswanathan and Jayadev Sreedhar, "Polymer Science", New Age International (P) Ltd., New Delhi, 2021
2. Joel R. Fried, "Polymer Science and Technology", Prentice Hall of India (P). Ltd., 2014
3. R. J. Young and P. A. Lovell, "Introduction to Polymers", CRC Press, New York, 2011
4. F. W. Billmeyer,"Text Book of Polymer Science", John Wiley & Sons, New York, 2008
5. Barbara H. Stuart, "Polymer Analysis", John Wiley & Sons, New York, 2008
6. George Odian , "Principles of Polymerization", John Wiley & Sons, New York, 2004

22OCH03 **ENERGY STORING DEVICES** **3 0 0 3**

Course Objectives

- Compare the energy density of commercialized primary and secondary batteries.
- Classify the fuel cells and compare their efficiency in different environmental conditions.
- Demonstrate the various energy storage devices and fuel cells.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Find the parameters required for operation of a cell to evaluate the capacity of energy storage devices.
2. Identify the electrodes, electrolyte and cell reactions of different types of primary, secondary batteries and infer the selection criteria for commercial battery systems with respect to commercial applications.
3. Differentiate fuel cells based on its construction, production of current and applications.
4. Compare different methods of storing hydrogen fuel and its environmental applications.
5. Classify the solar cell based on the materials used in it.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	-	-	-	-	-	-	-	-	-	-	-	-
2	2	3	-	-	-	-	1	-	-	-	-	-	-	-
3	3	1	-	-	-	-	-	-	-	-	-	-	-	-
4	2	2	-	-	-	-	1	-	-	-	-	-	-	-
5	3	3	-	-	-	-	1	-	-	-	-	-	-	-

UNIT I **6 Hours**

BASICS OF CELLS AND BATTERIES

Components - classification - operation of a cell - theoretical cell voltage - capacity - specific energy - energy density of lithium and lead acid battery - charge efficiency- charge rate - charge retention - closed circuit voltage - open circuit voltage current density - cycle life - discharge rate-over charge-over discharge

UNIT II **10 Hours**

BATTERIES FOR PORTABLE DEVICES AND ELECTRIC VEHICLES

Primary batteries: zinc-carbon - magnesium,and mercuric oxide - recycling/safe disposal of used cells. Secondary batteries: lead acid - nickel-cadmium - lithium ion batteries - rechargeable zinc alkaline battery. Reserve batteries: Zinc-silver oxide - lithium anode cell - photogalvanic cells. Battery specifications for cars and automobiles. Extraction of metals from battery materials.

UNIT III **10 Hours**

TYPES OF FUEL CELLS

Importance and classification of fuel cells: Description, working principle, components, applications and environmental aspects of the following types of fuel cells: alkaline fuel cells - phosphoric acid - solid oxide - molten carbonate and direct methanol fuel cells

UNIT IV **10 Hours**

HYDROGEN AS A FUEL

Sources and production of hydrogen: Electrolysis and photocatalytic water splitting. Methods of hydrogen storage: High pressurized gas - liquid hydrogen type - metal hydride. Hydrogen as engine fuel - features, application of hydrogen technologies in the future – limitations.

UNIT V **9 Hours**

ENERGY AND ENVIRONMENT

Future prospects of renewable energy and efficiency of renewable fuels - economy of hydrogen energy. Solar Cells: First, second, third and fourth generation solar cell - photobiochemical conversion cell.

Total: 45 Hours

Reference(s)

1. S.P. Jiang, Q. Li, Introduction to Fuel Cells, Springer, 2021.
2. M.M. Eboch, The Future of Energy, From Solar Cells to Flying Wind Farms, Capstone, 2020.
3. N. Eliaz, E. Gileadi, Physical Electrochemistry, Fundamentals, Techniques and Applications, Wiley, 2019.
4. J. Garche, K. Brandt, Electrochemical Power sources: Fundamentals Systems and Applications, Elsevier, 2018
5. A. Iulianelli, A. Basile, Advances in Hydrogen Production, Storage and Distribution, Elsevier, 2016.

22OGE01 PRINCIPLES OF MANAGEMENT 3 0 0 3

Course Objectives

- To develop cognizance about importance of management principles.
- Extract the functions and responsibilities of managers.
- To Study and understand the various HR related activities.
- Learn the application of the theories in an organization.
- Analyze the position of self and company goals towards business.

Programme Outcomes (POs)

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PSO1: Demonstrate the knowledge and technical skills in software development. PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Students will be able to understand the basic concepts of Management.
2. Have some basic knowledge on planning process and its Tools & Techniques.
3. Ability to understand management concept of organizing and staffing.
4. Ability to understand management concept of directing.
5. Ability to understand management concept of controlling.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	-	-	-	2	-	3	-	1	1
2	-	-	-	-	-	-	-	-	2	-	2	-	1	1
3	-	-	-	-	-	-	-	-	2	-	2	-	1	1
4	-	-	-	-	-	-	-	-	3	-	2	-	1	1
5	-	-	-	-	-	-	-	-	2	-	2	-	1	1

UNIT I **9 Hours**

INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS

Definition of Management Science or Art Manager Vs Entrepreneur-types of managers - Managerial roles and skills Evolution of Management Scientific, Human Relations, System and Contingency approaches Types of Business organization - Sole proprietorship, partnership, Company - public and private sector enterprises - Organization culture and Environment Current Trends and issues in Management.

UNIT II **9 Hours**
PLANNING
Nature and purpose of planning - Planning process - Types of planning – Objectives - Setting objectives - Policies - Planning premises - Strategic Management - Planning Tools and Techniques - Decision making steps and process.

UNIT III **9 Hours**
ORGANISING
Nature and purpose – Formal and informal organization - Organization chart - Organization Structure Types - Line and staff authority - Departmentalization - Delegation of authority - Centralization and decentralization - Job Design - Human Resource - Management - HR Planning, Recruitment, Selection, Training and Development, Performance Management, Career planning and management.

UNIT IV **9 Hours**
DIRECTING
Foundations of individual and group behaviour - Motivation-Motivation theories - Motivational techniques - Job satisfaction - Job enrichment - Leadership-types and theories of leadership - Communication-Process of communication - Barrier in communication Effective communication-Communication and IT.

UNIT V **9 Hours**
CONTROLLING
System and process of controlling - Budgetary and non-Budgetary control techniques - Use of Computers and IT in Management control - Productivity problems and management - Control and Performance-Direct and preventive control - Reporting.

Total: 45 Hours

Reference(s)

1. Robbins S, Management, (13th ed.), Pearson Education, New Delhi, 2017.
2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, Fundamentals of Management, Pearson Education, 7th Edition, 2011.
3. Robert Kreitner and Mamata Mohapatra, Management, Biztantra, 2008.
4. L. M. Prasad, Principles and Practice of Management. 7th Edition, Sultan Chand & Sons, 2007.
5. P. C. Tripathi and P. N. Reddy, Principles of Management, Fourth Edition, Tata McGraw Hill, 2008.

22OGE02 ENTREPRENEURSHIP DEVELOPMENT I 3 0 0 3

Course Objectives

- Learn the basics and scope of the Entrepreneurship
- Understand the generation of ideas of the Entrepreneurship
- Evolve the legal aspects of the business
- Learn to analyze the various business finance
- Learn the basics of the Operations Management

Programme Outcomes (POs)

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PSO1: Demonstrate the knowledge and technical skills in software development. PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Analyze the role of entrepreneurship in economic development.
2. Explain the types of ideas that to be used for entrepreneurship development.
3. Examine the legal aspects of business and its association.
4. Examine the sources of business and its analysis.
5. Analyse the different modes of operation management.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	1	2	-	2	-	-	-	1	1
2	-	-	-	-	-	1	2	-	2	-	-	-	1	1
3	-	-	-	-	-	1	2	-	2	-	-	-	1	1
4	-	-	-	-	-	1	2	-	2	-	-	-	1	1
5	-	-	-	-	-	1	2	-	2	-	-	-	1	1

UNIT I **9 Hours**

BASICS OF ENTREPRENEURSHIP

Nature, scope and types of Entrepreneurship, Entrepreneur Personality Characteristics, Entrepreneurship process. Role of entrepreneurship in economic development

UNIT II **9 Hours**

GENERATION OF IDEAS

Creativity and Innovation, Lateral Thinking, Generation of Alternatives, Fractional, Reversal Method, Brain Storming, Analogies

UNIT III **9 Hours**

LEGAL ASPECTS OF BUSINESS

Contract act-Indian contract act, Essential elements of valid contract, classification of contracts, sale of goods act- Formation of contract of sale, negotiable instruments- promissory note, bills and cheques, partnership, limited liability partnership (LLP), companies act-kinds, formation, memorandum of association, articles of association.

UNIT IV **9 Hours**

BUSINESS FINANCE

Project evaluation and investment criteria (cases), sources of finance, financial statements, break even analysis, cash flow analysis.

UNIT V **9 Hours**

OPERATIONS MANAGEMENT

Importance- functions-deciding on the production system- facility decisions: plant location, plant layout (cases), capacity requirement planning- inventory management (cases)-lean manufacturing, Six sigma.

Total: 45 Hours

Reference(s)

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi: 2005
2. Prasanna Chandra, Projects Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill Publishing Company Limited, New Delhi: 2000.
3. Akhileshwar Pathak, Legal Aspects of Business, Tata McGraw Hill: 2006

22OGE03 ENTREPRENEURSHIP DEVELOPMENT II 3 0 0 3

Course Objectives

- Evolve the marketing mix for promotion the product / services
- Handle the human resources and taxation
- Learn to analyze the taxation
- Understand the Government industrial policies and supports
- Preparation of a business plan

Programme Outcomes (POs)

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PSO1: Demonstrate the knowledge and technical skills in software development. PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Examine the strategies and plans in marketing management.
2. Analyse the cases involved in human resource management.
3. Classify the direct and indirect taxes in business.
4. Analyze the supports given by government for improving the business.
5. Examine the various steps involved in preparing the business plan.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	1	2	-	2	-	-	-	1	1
2	-	-	-	-	-	1	2	-	2	-	-	-	1	1
3	-	-	-	-	-	1	2	-	2	-	-	-	1	1
4	-	-	-	-	-	1	2	-	2	-	-	-	1	1
5	-	-	-	-	-	1	2	-	2	-	-	-	1	1

UNIT I **9 Hours**

MARKETING MANAGEMENT

Marketing environment, Segmentation, Targeting and positioning, Formulating marketing strategies, Marketing research, marketing plan, marketing mix (cases)

UNIT II **9 Hours**

HUMAN RESOURCE MANAGEMENT

Human Resource Planning (Cases), Recruitment, Selection, Training and Development, HRIS, FactoriesAct 1948 (an over view)

UNIT III **9 Hours**

BUSINESS TAXATION

Direct taxation, Income tax, Corporate tax, MAT, Tax holidays, Wealth tax, Professional taxCases). Indirect taxation, Excise duty, Customs, Sales and Service tax, VAT, Octroi, GST (Cases)

UNIT IV **9 Hours**

GOVERNMENT SUPPORT

Industrial policy of Central and State Government, National Institute-NIESBUD, IIE, EDI. State LevelInstitutions-TIIC, CED, MSME, Financial Institutions

UNIT V **9 Hours**

BUSINESS PLAN PREPARATION

Purpose of writing a business plan, Capital outlay, Technical feasibility, Production plan, HR plan, Marketsurvey and Marketing plan, Financial plan and Viability, Government approvals, SWOT analysis.

Total: 45 Hours

Reference(s)

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi: 2005
2. Philip Kotler., Marketing Management, Prentice Hall of India, New Delhi: 2003
3. Aswathappa K, Human Resource and Personnel Management - Text and Cases, Tata McGraw Hill:2007.
4. Jain P C., Handbook for New Entrepreneurs, EDII, Oxford University Press, New Delhi: 2002.
5. Akhileshwar Pathak, Legal Aspects of Business, Tata McGraw Hill: 2006.
6. http://niesbud.nic.in/agencies.html

22OGE04 **NATION BUILDING, LEADERSHIP AND SOCIAL RESPONSIBILITY** **3 0 0 3**

Course Objectives

- To understand the importance of National Integration, Patriotism and Communal Harmony
- To outline the basic awareness about the significance of soft skills in professional and inter-personal communications and facilitate an all-round development of personality
- To analyze the different types of responsibility role of play for the improvement of society

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Understand religo-cultural diversity of the country and its impact on the lives of the people and their beliefs
2. Acquire a sense of responsibility, smartness in appearance and improve self confidence
3. Develop the sense of self-less social service for better social & community life
4. Apply the importance of Physical and Mental health and structure of communication organization and various mode of communication
5. Acquire awareness about the various types of weapon systems in the Armed Forces.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	-	1	-	-	-	1	-	-	-	-	3	-	-
2	2	-	2	-	-	-	2	-	-	-	-	2	-	-
3	2	-	1	-	-	-	1	-	-	-	-	2	-	-
4	2	-	3	-	-	-	3	-	-	-	-	3	-	-
5	2	-	1	-	-	-	1	-	-	-	-	2	-	-

UNIT I **9 Hours**

NATIONAL INTEGRATION

Importance & Necessity, Factors Affecting National Integration, Unity in Diversity. Threats to National Security. Water Conservation and Rain Harvesting, Waste Management and Energy Conservation. Leadership Capsule-Traits-Indicators-Motivation-Moral Values-Honor Code-Case Studies: Shivaji, Jhansiki Rani, Case Studies–APJ Abdul kalam, Deepa Malik, Maharana Pratap, N Narayan Murthy Ratan Tata Rabindra Nath Tagore, role of NCC cadets in 1965 war.

UNIT II **9 Hours**

PERSONALITY DEVELOPMENT AND LEADERSHIP

Intra & Interpersonal skills - Self-Awareness- &Analysis, Empathy, Critical & creative thinking, Decision making and problem solving, Communication skills, Group Discussion – copping with stress and emotions, changing mindset, Public Speaking, Time Management, Social skills, Career counseling, SSB procedure and Interview skills.

UNIT III **9 Hours**

SOCIAL SERVICE, COMMUNITY DEVELOPMENT AND ENVIRONMENTAL AWARENESS

Basics of social service and its need, Types of social service activities, Objectives of rural development programs and its importance, NGO's and their contribution in social welfare, contribution of youth and NCC in Social welfare. Protection of children & women safety, Road/ Rail Travel Safety, New initiatives, Cyber and mobile security awareness. Disaster management Capsule-Organization-Types of Disasters- Essential Services-Assistance-Civil Defence Organization

UNIT IV **9 Hours**

HEALTH, HYGIENE AND COMMUNICATION

Sanitation, First Aid in Common Medical Emergencies. Health, Treatment and Care of Wounds. Yoga-Introduction, Definition, Purpose, Benefits. Asanas-Padamsana, Siddhasana, Gyan Mudra, Surya Namaskar, Shavasana, Vajrasana, Dhanurasana, Chakrasana, Sarvaangasana, Halasanaetc. Obstacle Training Contact: Obstacle training - Intro, Safety measures, Benefits, Straight balance, Clear Jump, Gate Vault, ZigZagBalance, High Wall etc. COMMUNICATION: Basic Radio Telephony (RT) Procedure-Introduction, Advantages, Disadvantages, Need for standard- Procedures-Types of Radio Telephony Communication-Radio telephony procedure, Documentation.

UNIT V **9 Hours**

ARMED FORCES AND NCC GENERAL

Army, navy, Air force and Central armed policed forces- Modes of entry into army, police and CAPF-Naval expeditions & campaigns. History, Geography of Border / Coastal areas. EEZ maritime security & ICG. Modes of Entries in armed forces. Security challenges & role of cadets in Border management. Aims, Objectives and org of NCC- Incentives- Duties of NCC cadets- NCC Camps: types and conduct.

Total: 45 Hours

Reference(s)

1. Lt. Dr S Rajan and Capt. Dr R Latha, NCC Master, Dream Book Publishing, 2024.
2. R. Gupta, NCC National Cadet Corps A, B & C-Certificate Examination Book, 22nd edition, Ramesh Publishing House, 2022.
3. Singh and Neeraj, A Hand Book of NCC, Kanti Prakashan Publishing, 5th edition, 2021.
4. https://nccorissa.org/old/Doc/Ncc-CadetHandbook.pdf

22OBM01 OCCUPATIONAL SAFETY AND HEALTH IN PUBLIC HEALTH EMERGENCIES 3 0 0 3

Course Objectives

- Students will be able to know about Occupational safety and health (OSH)
- Students will be able to discuss about risks faced by emergency responders during disease outbreaks and other emergencies
- Students will be able to create awareness on necessary strategies for managing OSH in emergency situations

Programme Outcomes (POs)

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Practice the occupational safety measures by the scientific knowledge to overcome the risks faced by emergency responders
2. Apply appropriate strategies and tools in Occupational safety and healthcare
3. Analyse common risks for safety and health in emergencies
4. Adapt appropriate occupational safety practices in chemical accidents
5. Guide Occupational safety measures in radiation incidents

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	3	2	1	-	-	-	1	-	-	-	2	-	-
2	-	2	2	2	-	-	-	1	-	-	-	2	-	-
3	-	3	2	2	-	-	-	1	-	-	-	2	-	-
4	-	2	2	2	-	-	-	1	-	-	-	2	-	-
5	-	3	2	2	-	-	-	1	-	-	-	2	-	-

UNIT I **9 Hours**

MANAGEMENT ASPECTS

Management system approach to occupational safety and health hazards and risks – rights, duties and responsibilities of employers and workers during outbreaks and emergencies – Emergency responders health monitoring and surveillance

UNIT II **9 Hours**

STRATEGIES AND TOOLS

International Health Regulations, 2005 – Incident command system for managing outbreaks and emergencies – Occupational safety and health controls – Strategies for infection prevention and control

UNIT III **9 Hours**

COMMON RISKS FOR SAFETY AND HEALTH IN EMERGENCIES

Vector-borne diseases, water and food-borne diseases, Vaccine-preventable diseases – Heat stress - Slips, trips and falls - Road traffic injuries – Ergonomic hazards - Violence – Psychological stress during outbreaks and injuries

UNIT IV **9 Hours**

OCCUPATIONAL SAFETY AND HEALTH IN CHEMICAL INCIDENTS

Emergencies caused by chemical incidents – occupational safety and health hazards and risks of chemicals – Personal Protective Equipment – Decontamination of emergency response personnel – medical surveillance of emergency responders

UNIT V **9 Hours**

OCCUPATIONAL SAFETY AND HEALTH IN RADIATION INCIDENTS

Sources and scenarios of radiation incidents – guidance for protection of emergency responders -Occupational health surveillance of persons occupationally exposed to radiation in emergencies

Total: 45 Hours

Reference(s)

1. Emergency responder health monitoring and surveillance. National Response Team technical assistance document. Atlanta (GA): National Institute for Occupational Safety andHealth; 2012.
2. Emergency response framework (ERF). Geneva: World Health Organization; 2013
3. Guidelines on occupational safety and health management systems, second edition.Geneva: International Labour Organization; 2009.
4. OSH management system: a tool for continual improvement. Geneva: International Labour Organization; 2011
5. OECD Environmental Outlook to 2050: the consequences of inaction. Paris: Organization for Economic Co-operation and Development; 2012.

22OBM02 **AMBULANCE AND EMERGENCY MEDICAL SERVICE MANAGEMENT** **3 0 0 3**

Course Objectives

- Understand the ambulance & transport management and allied services.
- Compare the ambulance design and equipment, transportation and corporate Profit.
- Carry-out various acts governing transport management.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Identify ambulance services, types and allied services
2. Formulate minimum ambulance rescue equipment and developing a transportation Strategy.
3. Understand the Emergency response team, Transportation interfaces, Transportation Service Characteristics& regulatory reforms involved.
4. Identify ambulance services, types and allied services
5. Formulate minimum ambulance rescue equipment and developing a transportation Strategy.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	-	-	-	-	-	-	-	-	-	-	-	-
2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
3	-	2	-	-	-	-	-	-	-	-	-	-	-	-
4	2	2	-	-	-	-	-	-	-	-	-	-	-	-
5	2	-	-	-	-	-	-	-	-	-	-	-	-	-

UNIT I **9 Hours**

INTRODUCTION

Introduction-transportation ambulance types-Advanced Life Support Ambulance-Basic Life Support Ambulance-Patient Transport Ambulance-Emergency services-Ambulances-Allied services-telephone management

UNIT II **9 Hours**

AMBULANCE DESIGN AND EQUIPMENT

Design and Equipment of Ambulances -Minimum Ambulance Rescue Equipment-Emergency drugs medicines Recruitment validation Training to handle in house Ambulance emergency procedures Checklist measures Roles of paramedics, midwives, community nurses, hospice workers in emergency handling via ambulance

UNIT III **9 Hours**

TRANSPORTATION REGULATION FOR EMERGENCY MEDICAL SERVICE

Crisis Management-Anxiety & Stress Management-the Emergency response team-police assistance-Information handling & processing-Establishing customer service levels - Developing and Reporting customer service standards - Impediments to an Effective customer Service strategy - Improving customer Service Performance Transportation

UNIT IV **9 Hours**

AMBULANCE PREVENTIVE MAINTENANCE

Legal obligations Switch Console Front, Main Electrical, Patient Compartment Climate Oxygen system On board Suction system 110/12 VOLT system, Modular Body, Medical Equipment - Cot & Stretcher, safety belts-driver(s), passenger, Patients-child restraint device- incubator

UNIT V **9 Hours**

THE MOTOR VEHICLE ACT

The Motor Vehicle Act, 1988- Rules of the road Regulations 1989- Overall Dimensions of Motor Vehicles (Prescription of conditions for exemption) Rules 1991-Use of Red light on the top front of the vehicle

Total: 45 Hours

Reference(s)

1. Fawcett,"Supply Chain Management", Pearson Education India, 01-Sep-2008 - 600 pages.
2. B. Feroz, A. Mehmood, H. Maryam, S. Zeadally, C. Maple and M. A. Shah, "Vehicle-Life Interaction in Fog-Enabled Smart Connected and Autonomous Vehicles," in IEEE Access, vol. 9,
   pp. 7402-7420, 2021, doi: 10.1109/ACCESS.2020.3049110.
3. R. Jin, T. Xia, X. Liu, T. Murata and K. -S. Kim, "Predicting Emergency Medical Service Demand With Bipartite Graph Convolutional Networks," in IEEE Access, vol. 9, pp. 9903-9915, 2021, doi: 10.1109/ACCESS.2021.3050607.
4. Les Pringle,"Call the Ambulance",Transworld Publishers, 2010.
5. Edward J. Bardi, John Joseph Coyle, Robert A. Novack"Management of Transportation", Thomson/South-Western, 2006

22OBM03 HOSPITAL AUTOMATION 3 0 0 3

Course Objectives

- Introduce the concepts of hospital systems and need for central monitoring
- Exemplify the power generation, utility and protection systems.
- Apply the distributed and central monitoring functions in hospital environment

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Identify the factors in central power generating and monitoring systems
2. Analyze the sensors and actuators for the automation systems
3. Classify the equipment types and its applications.
4. Apply software tools and digital computer for monitoring of parameters and medical data handling
5. Design central monitoring station for hospitals for control and surveillance applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	2	-	-	-	-	-	-	-	-	-	-	-	-
3	-	2	-	-	-	-	-	-	-	-	-	-	-	-
4	-	2	-	-	-	-	-	-	-	-	-	-	-	-
5	3	-	-	-	-	-	-	-	-	-	-	-	-	-

UNIT I 9 Hours

AUTOMATION IN HEALTHCARE

Introduction to automation Role of automation in healthcare Remote Patient Monitoring Maximizing resources on patient care Reducing variability, Automating clinician and patient interactions through products.

UNIT II 9 Hours

POWER GENERATION AND MEDICAL GAS PRODUCTION

Power generator, Battery : Maintenance and troubleshooting, energy conservation and monitoring system - Automation in dryer, compressor, air conditioning, lighting, heating systems.

UNIT III 9 Hours

AUTOMATION IN PIPING

Monitoring of flow and pressure of medical gas System components Vacuum control units Automatic changeover system - Types of Outlets - Leakage test- Prevention and safety automation.

UNIT IV
INSTRUMENTATION SYSTEMS **9 Hours**

Optical sensors , Pressure Sensors - Ultrasonic Sensors - Tactile Sensors - Thermal sensors -Biosensor - Linear Actuators, Central monitoring station - Alarm system - Regulation and standards.

UNIT V
APPLICATIONS **9 Hours**

Business intelligence & executive dashboards - Radio-Frequency Identification (RFID)- based patient and asset tracking solutions - Tablet-based applications for bed side access to doctors/nurses - Healthcare CRM for patient relationship management - Patient kiosk, tele-health – HIS integration.

Total: 45 Hours

Reference(s)

1. Khandpur RS, Handbook of Biomedical Instrumentation, Prentice Hall of India, New Delhi, 3 rd edition, 2014.
2. Joseph J. Carr and John M. Brown, Introduction to Biomedical Equipment Technology, Pearson Education India, Delhi, 4 th edition 2008
3. Curtis Johnson D Process Control Instrumentation Technology, Prentice Hall of India, 8th edition 2006
4. John V. Grimaldi and Rollin H. Simonds., Safety Management, All India Travelers Book seller, New Delhi, 1989
5. N.V. Krishnan, Safety in Industry, Jaico Publisher House, 1996.

22OAG01 RAINWATER HARVESTING TECHNIQUES 3 0 0 3

Course Objectives

- To enhance the awareness about water resources management and conservation.
- To acquire knowledge about water harvesting techniques and their implementation. To practice the design aspects of sustainable rainwater harvesting solutions for communities.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Assess the sources, availability and challenges in water resources management
2. Assess various water harvesting systems in practice
3. Execute design considerations for comparing surface runoff harvesting methods
4. Compare the characteristics and impacts of flood water harvesting techniques
5. Evaluate various rainwater harvesting methods for groundwater recharging

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	-	-	-	-	-	3	-	-	-	-	-	-	-
2	2	1	-	-	-	-	-	-	-	-	-	-	-	-
3	1	1	3	-	-	-	2	-	-	-	-	-	-	-
4	1	2	3	-	-	-	2	-	-	-	-	-	-	-
5	1	1	3	-	-	-	2	-	-	-	-	-	-	-

UNIT I **8 Hours**
WATER RESOURCES
Global water distribution – primary and secondary sources of water – technical, social and cultural aspects; Global challenges in water and climate – water scarcity – water pollution – Indian scenario; Water resources management – public participation – integrated approach; Water governance – water sharing plans – policy, schemes and concerns

UNIT II **10 Hours**

WATER CONSERVATION CHALLENGES

Principles of water harvesting for rural and urban – collection at micro and macro levels, flow control, storage and uses; Rainwater harvesting systems – traditional and contemporary – groundwater recharge; Water resources inventory – site analysis – database collection – water allocation principles based on demand and supply; Traditional water harvesting systems – practices in India – references in old texts – reasons for their deterioration – way forward; Watershed-based approach – project planning at micro and macro levels – community participation – rain centres.

UNIT III **9 Hours**

SURFACE RUNOFF HARVESTING

Short-term and micro-level harvesting techniques for runoff – terracing and bunding – rock and ground catchments; Long-term and macro-level harvesting techniques for runoff – farm ponds – percolation ponds and nala bunds; Design considerations – site selection – selection of runoff coefficients – computation of rainwater runoff volume – hydrograph analysis – cost estimation; Design of storage structures – storage capacity – selection of component – methods of construction

UNIT IV **9 Hours**

FLOOD WATER HARVESTING

Floods – causes of urban floods and droughts – characteristics of water spread – impacts; Flood water harvesting – permeable rock dams – water spreading bunds – flood control reservoir; Design considerations – computation of flood water quantity; Trenching and Diversion Structures – types – site selection – design criteria – most economic section – design consideration of ditch system

UNIT V **9 Hours**

GROUNDWATER HARVESTING

Rooftop rainwater harvesting – recharge pit – recharge trench – tube well – recharge well; artificial recharge – gully plug – dug well – percolation tank – nala bunds – recharge shaft; Groundwater harvesting – aquifer characteristics – subsurface techniques – infiltration wells – recharge wells – groundwater dams; Design of drainage system – types – design criteria – filter design – causes of failures

Total: 45 Hours

Reference(s)

1. Theib YO, Dieter P, Ahmed YH, Rainwater Harvesting for Agriculture in the Dry Areas, CRC Press, Taylor and Francis Group, London, 2012.
2. Lancaster, Brad. Rainwater Harvesting for Drylands and Beyond, Volume 1, 3rd edition, Rainsource Press. 2019.
3. Das M, Open Channel Flow, Prentice Hall of India Pvt. Ltd., New Delhi, 2008.
4. Michael AM, Ojha TP, Principles of Agricultural Engineering, Volume II, 4th Edition, Jain Brothers, New Delhi, 2003.
5. Suresh R, Soil and Water Conservation Engineering, Standard Publisher Distributors, New Delhi, 2014.
6. Singh G, Venkataramanan C, Sastry G, Joshi BP, Manual of Soil and Water Conservation Practices, CSWCR&TI, Dehradun, 1990

22OEE01 VALUE ENGINEERING 3 0 0 3

Course Objectives

- To understand the concept of value engineering in order to reduce cost of product or process or service.
- To implement creative and innovative techniques using FAST diagram.
- To study benefits of Value Engineering for various industries.

Programme Outcomes (POs)

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1: Demonstrate the knowledge and technical skills in software development. PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Apply the concepts of value and value engineering to prepare a job plan.
2. Analyze the cost and worth of a product/service using the principles of economics.
3. Evaluate the value of a product/service to take managerial decisions.
4. Apply the soft skills in understanding team building, team work and report writing.
5. Asses the functions and values of product/services in industries using case studies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	-	-	-	-	-	3	1	1	1
2	-	-	-	-	-	-	-	-	-	1	3	1	1	1
3	-	-	-	-	-	-	-	-	-	-	3	1	1	1
4	-	-	-	-	-	-	-	-	-	1	3	2	1	1
5	-	-	-	-	-	-	-	-	-	2	3	1	1	1

UNIT I **8 Hours**
INTRODUCTION TO VALUE ENGINEERING

Historical perspective of Value Engineering, Aims and objectives of Value Engineering, Concept of Value, Value Engineering concerned with Economic Value, Value Engineering Job plan.

UNIT II **9 Hours**
FUNCTIONAL ANALYSIS

Function-Cost-Worth analysis: Function Analysis System Technique (FAST); Review of principles of engineering economics

UNIT III **10 Hours**
EVALUATION OF VALUE ENGINEERING
Evaluation of function, Problem setting system, problem solving system, setting and solving management - decision - type and services problem, evaluation of value

UNIT IV **9 Hours**
HUMAN ASPECTS IN VALUE ENGINEERING
Team building; Life cycle costing; Managing Value Engineering Study; Value Engineering Report writing; Presentation Skill - Individual and Team Presentations; Implementation and follow-up.

UNIT V **9 Hours**
BENEFITS OF VALUE ENGINEERING
Classification of hazardous zones-intrinsically safe and explosion proof electrical apparatus-increase safe Value Engineering Case studies in the Industries like Manufacturing; Construction; Health Care; Process.

Total: 45 Hours

Reference(s)

1. Anil Kumar Mukhopadhyaya, Value Engineering Mastermind - From Concepts to Certification, Response. Business Books from SAGE, Los Angeles / London / New Delhi / Singapore / Washington DC, 2014.
2. Anil Kumar Mukhopadhyaya, Value Engineering -Concepts, Techniques and Applications, Response Books, A Division of SAGE Publications, New Delhi / Thousand Oaks / London, 2003
3. R. D. Miles, Techniques of Value analysis & Engineering, McGraw Hill, 2000.
4. E. Midge Arthur, Value Engineering -A Systematic Approach, McGraw Hill Book Co., New York, 2000.
5. Zimmerman, Value Engineering - A Practical Approach, CBS Publishers & Distributors, New Delhi, 2000.

22OEE02 ELECTRICAL SAFETY 3 0 0 3

Course Objectives

- To provide knowledge on basics of electrical fire and statutory requirements for electrical safety
- To understand the causes of accidents due to electrical hazards
- To know the various protection systems in Industries from electrical hazards
- To know the importance of earthing
- To distinguish the various hazardous zones and applicable fire proof electrical devices

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Analyze the basic concepts in electrical circuit and hazards involved in it.
2. Analyze the electrical hazards in the workplace and its impacts.
3. Examine the operation of various protection systems from electrical hazards.
4. Analyze the various safety procedures involved in the industries.
5. Explore the different hazardous zones in Industries and their safety measures.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	-	-	-	2	1	-	-	-	-	-	-	-
2	1	1	-	-	-	1	2	2	-	-	-	-	-	-
3	1	1	-	-	-	2		2	1	-	-	-	-	-
4	1	1	-	-	-	2	1	-	-	-	-	-	-	-
5	1	1	-	-	-	2	1	2	1	-	-	-	-	-

UNIT I **9 Hours**

INTRODUCTION

Objectives of safety and security measures - Hazards associated with electric current and voltage - principles of electrical safety - working principles of major electrical equipment - Typical supply situation

- Indian electricity act and rules - statutory requirements from electrical inspectorate-International standards on electrical safety.

UNIT II **9 Hours**

ELECTRICAL HAZARDS

Primary and secondary hazards-shocks, burns, scalds, falls-human safety in the use of electricity-Energy leakage-clearances and insulation-classes of insulation-voltage classifications-excess energy-current surges- over current and short circuit current-heating effects of current- Lightning, hazards, lightning arrestor, - national electrical safety code ANSI.

UNIT III **9 Hours**

ELECTRICAL SAFETY EQUIPMENT

Fuse, circuit breakers and overload relays - safe distance from lines - capacity and protection of conductor joints and connections, overload and short circuit protection - earth fault protection. FRLS insulation - insulation and continuity test - system grounding - equipment grounding - earth leakage circuit breaker (ELCB) - ground fault circuit interrupter - electrical guards - Personal protective equipment.

UNIT IV **9 Hours**

ELECTRICAL SAFETY OPERATION AND MAINTENANCE

Role of environment in selection - protection and interlock - discharge rod and earthing devices - safety in the use of portable tools - preventive maintenance - installation – earthing, specifications, earth resistance, earth pit maintenance - Fire Extinguishers - CO2 and Dry Powder schemes.

UNIT V **9 Hours**

HAZARDOUS AREAS

Classification of hazardous zones-intrinsically safe and explosion proof electrical apparatus-increase safe equipment-their selection for different zones-temperature classification-grouping of gases-use of barriers and isolators-equipment certifying agencies – electrical safety standards. (IS, API and OSHA standards)

Total: 45 Hours

Reference(s)

1. Fordham Cooper, W., “Electrical Safety Engineering, Butterworth and Company”, London, Third Edition, 2013.
2. “Indian Electricity Act and Rules”, Government of India.
3. “Power Engineers”, Handbook of TNEB, Chennai, 2010.
4. “Accident prevention manual for industrial operations”, N.S.C., Chicago, 1982.
5. John Cadick, P.E., Mary Capelli-Schellpfeffer, Dennis K. Neitzel, Al Winfield, “Electrical Safety Handbook”, Fourth Edition, Tata Mcgraw Hill, 2014.

22OCB01 INTERNATIONAL BUSINESS MANAGEMENT 3 0 0 3

Course Objectives

- To enable the students to understand the fundamentals of international business
- To provide competence to the students on making international business decisions
- To enable the students to understand the financial and promotional assistance available for exporters

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PSO1: Demonstrate the knowledge and technical skills in software development. PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Demonstrate the role and importance of digital marketing in today's rapidly changing business environment
2. Discover the techniques to help organizations to utilize social media for digital marketing
3. Analyze the key elements and campaign effectiveness of E-Mail marketing and mobile marketing
4. Evaluate the effectiveness of a digital marketing campaign using Google Analytics
5. Apply advanced practical skills to plan, predict and manage digital marketing campaign

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	-	-	-	-	-	2	-	2	-	-	-	1	1
2	3	-	-	-	-	-	3	-	2	-	-	-	1	1
3	3	-	-	-	-	-	3	-	2	-	-	-	1	2
4	3	-	-	-	-	-	2	-	2	-	-	-	1	2
5	3	-	-	-	-	-	2	-	2	-	-	-	1	1

UNIT I **9 Hours**
INTRODUCTION
Definition, Drivers of International Business, Domestic Vs. International Business, Trade and Investment Theories: Interventionist Theories, Free Trade Theories, Theories Explaining Trade Patterns: PLC Theory, The Porter Diamond, Factor Mobility Theory.

UNIT II **9 Hours**
GLOBALIZATION
Globalization: Implications, Challenges - Protectionism: Tariff Barriers, Non-Tariff Barriers- Forms of Integration, Role of WTO and IMF in International Business, Economic, Political, Cultural and Technological Environments

UNIT III **9 Hours**
INTERNATIONAL BUSINESS STRATEGIES
Market Entry Strategies, Multinational Strategy, Production Strategy, Marketing Strategy, Human Resource Strategy.

UNIT IV **9 Hours**
FOREIGN EXCHANGE
Foreign Exchange Market – Functions, Theories of Exchange Rate Determination, Exchange Rate Forecasting, Convertibility of Currency, Risks associated with Foreign Exchange.

UNIT V **9 Hours**
EXPORTS AND ETHICS IN INTERNATIONAL BUSINESS
Exports – Risks, Management of Exports, Regulatory frameworks, Export financing, Countertrade, Ethics – Issues, Dilemma and Theory.

Total: 45 Hours

Reference(s)

1. John D Daniels, Lee Raudabaugh, and Sullivan, "International Business", New Delhi: Pearson Education, 2018.
2. Charles W L Hill and Arun Kumar Jain, "International Business", New Delhi: Tata McGraw Hill, 2017.
3. Francis Cherunilam, "International Business", New Delhi: Prentice Hall of India, 2020.
4. Simon Collinson, Rajneesh Narula, Alan M. Rugman, "International Business", New Delhi: Pearson Education, 2020.
5. K. Aswathappa, "International Business", New Delhi: Tata McGraw Hill, 2020.

22CT0XA MEAN STACK FOR DYNAMIC WEB APP DEVELOPMENT 1 0 0 1

Course Objectives

- To understand full-stack web applications using the MEAN stack and build a web application using MongoDB, ExpressJS, Angular, and Node.js.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Apply the different technologies in the MEAN stack to build different features of a web application.
2. Analyze full-stack web applications using a well-supported stack.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	2	-	2	-	2	-	-	1	-	1	2	-
2	-	1	2	2	2	1	-	1	-	-	-	-	2	-

Introduction to JavaScript - Functions and DOM Manipulation- Events and Event Handling - Introduction to Angular - Angular Components and Directives- - Building a Simple Angular App - Introduction to MEAN stack - MongoDB basics- Creating a MongoDB database - Node.js basics - Creating a NestJS, Angular and Node.js Application-Integrating MongoDB, Express, Angular, and Node.js-Building a complete MEAN stack application.

Total: 15 Hours

Reference(s)

1. Schwarzmüller, Maximillian. MEAN Stack: The Complete Developer's Guide. Packt Publishing, 2015.
2. Hanson, Jeff. MEAN Stack Handbook. Packt Publishing, 2016.
3. Nadel, Ben. MEAN Stack with Angular 2. Apress, 2016.
4. Papa, John. MEAN Stack with MongoDB, Express, AngularJS and Node.js. Packt Publishing, 2014.
5. SitePoint. MEAN Stack Quick Start Guide. SitePoint, 2014.

22CT0XB COMPONENT BASED UI DEVELOPMENT 1 0 0 1

Course Objectives

- To Learn how to create dynamic and interactive user interfaces using React.
- To Build reusable UI components that respond to user interactions, enabling the development of modern and engaging web applications.
- To Learn how to build composable user interfaces and web applications.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes

- Understand the basics of reactjs, including components, and Hooks.
- Apply reactjs to create interactive and dynamic user interfaces.

Articulation Matrix

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1	-	-	-	1	-	-	1	-	1	1	-
2	-	1	2	2	2	1	-	1	-	-	-	-	1	-

Course Syllabus

JavaScript: Overview - ES6 and Expressions - Node Package Manager (NPM) - React: Basics - Functional vs Class based Components – HTML Components – Grid Layouts - List Layouts and Keys - React Hooks: Use State - Use Effect – React Forms – Event handling – React Routers

Total: 15 Hours

References

1. Alex Banks and Eve Porcello, "Learning React: Modern Patterns for Developing React Apps", 2020.
2. Stoyan Stefanov, "React Up and Running: Building Web Applications", 2015.
3. Kirupa Chinnathambi, "Learning React: A Hands-On Guide to Building Web Applications Using React and Redux", 2017.
4. Anthony Accomazzo, Ari Lerner, and David Guttman, "Fullstack React: The Complete Guide to ReactJS and Friends", 2017.

1 0 0 1

22CT0XC DATA ANALYSIS USING R PROGRAMMING

Course Objectives

- To learn about the basics of R, simulation and usage of built in functions, file processing and graphics programming in application.
- To aims to provide exposure in terms of Statistical Analysis, Hypothesis Testing, Regression and Correlation using R programming language.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

The students will be able to

CO1: Understanding the types, classes and functions of R Programming.

CO2: Create basic data visualizations using R's graphical capabilities.

CO3: Analyze a specific dataset and draw meaningful conclusions.

Articulation Matrix

CO. No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	-	2	3	3	-	-	-	-	-	2	2	2	-
2	2	-	2	3	3	-	-	-	-	-	2	2	2	-
3	2	-	2	3	3	-	-	-	-	-	2	2	2	-

DATA ANALYSIS USING R PROGRAMMING **15 Hours**

R types and classes – Functions, Data Structures – Vector to Matrix, Matrix Access – Data Frames, Data Frame Access – Basic Data Manipulation Techniques– Reading and writing Data from files, Variables – Control Structures – Input Output, Graphics, Data Visualization, Simulation – Generating Random Numbers, Setting the random number seed – Simulating a Linear Model – Random Sampling - Data Analysis Case Study Statistical Inference and Hypothesis Testing – Population and Sample, Null and Alternate Hypothesis, Level of Significance – Analysis of Relationship, Positive and Negative Correlation

Total 15 Hours

References

1. R Programming for Data Science, Roger D Peng, Lean Publication, 2021
2. R for Data Science: Import, Tidy, Transform, Visualize, and Model Data by Hadley Wickham, O'RELLY, 2020
3. Hands-On Programming with R: Write Your Own Functions and Simulations, Garrett Goleman, O'RELLY, 2018 http://cran.r-project.org(link is external)

22CT0XD RAPID API DEVELOPMENT WITH FastAPI 1 0 0 1

Course Objectives

- To learn the fundamentals of FastAPI such as its architecture, routing, dependency injection, and data validation.
- To develop practical skills in creating APIs using FastAPI.
- To deploy FastAPI applications to various platforms, including cloud providers or dedicated servers

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

The students will be able to

CO1: understanding the core concepts of FastAPI.

CO2: Create real-world APIs using FastAPI and deploy applications to the production environment.

Articulation Matrix

CO. No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2	3	3	-	-	-	-	-	2	2	2	-
2	2	2	3	3	3	-	-	-	-	-	3	3	3	-

RAPID API DEVELOPMENT WITH FASTAPI **15 Hours**

Introduction to FastAPI-Installation and setup-Routing and Request Handling-Introduction to Pydantic for data validation-Dependency Injection and Middleware-Authentication and Authorization-Implementing token- based authentication with OAuth2-Database Integration-CRUD operations with databases-Asynchronous database queries-Testing FastAPI Applications- Preparing FastAPI applications for production- Containerization with Docker-Deploying FastAPI applications to cloud platforms-Generating API documentation with Swagger and ReDoc-Building a small FastAPI project from scratch.

Total 15 Hours

References

1. Building Python Web APIs with FastAPI, Abdulazeez Abdulazeez Adeshina, Packt Publication Ltd, 2022.
2. FastAPI: Modern Python Web Development, Bill Lubanovic, O'RELLY INC, 2023
3. High-Performance Web Apps with FastAPI, Malhar Lathkar, APress Media, 2023

22CT0XE **STATISTICS FOR DATA SCIENCE AND BUSINESS ANALYSIS** **1 0 0 1**

Course Objectives

- Understand fundamental statistical concepts and their relevance to data science.
- Calculate the measures of central tendency, asymmetry, and variability
- Analyze various statistical methods for data exploration, inference, and hypothesis testing.
- Develop critical thinking skills for evaluating and interpreting statistical results in data science applications.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

The students will be able to

1. Apply the statistical methods to ccalculate correlation and covariance data.
2. Develop descriptive models to forecast business metrics and optimize decision-making processes.
3. Use Statistical tools to communicate insights effectively to stakeholders.
4. Apply nonparametric methods in data science domains for business analytics.
5. Evaluate the Bayesian modelling and applications in business analytics

Articulation Matrix

CO. No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	1	2	2	-	-	-	2	-	-	-	2	-
2	3	3	1	2	3	-	-	-	2	-	-	-	2	-
3	3	3	1	3	3	-	-	-	2	-	-	-	2	-
4	3	3	1	3	3	-	-	-	2	-	-	-	2	-
5	3	3	1	3	3	-	-	-	2	-	-	-	2	-

Statistics for Data Science and Business Analysis **15 Hours**

Introduction to Statistics and Data Science ,Descriptive Statistics, Probability Distributions ,Statistical Inference: Estimation techniques (point estimation, interval estimation), Hypothesis testing principles and procedures , Parametric and non-parametric tests (t-tests, chi-square tests), Regression Analysis : Simple linear regression and multiple linear regression, Model fitting, interpretation, and validation, Analysis of Variance (ANOVA) , Nonparametric Statistics: Rank-based tests (Mann-Whitney U test, Wilcoxon signed- rank test), Goodness-of-fit tests and contingency table analysis, Applications of nonparametric methods in data science ,Bayesian Statistics : Bayesian inference principles and Bayesian reasoning, Bayesian estimation and hypothesis testing , Bayesian modeling and applications in data science.

References

1. “Introduction to Statistical Learning" by Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani