B.Tech. (Computer Technology)

Revised 2018 Regulations, Curriculum & Syllabi

(Candidates admitted during Academic Year 2021-2022)

Stay Ahead

BANNARI AMMAN INSTITUTE OF TECHNOLOGY

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

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BANNARI AMMAN INSTITUTE OF TECHNOLOGY, SATHYAMANGALAM
REVISED REGULATIONS 2018
(CHOICE BASED CREDIT SYSTEM)

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

Regulation 2018 has been prepared in accordance with the guidelines given by the University Grants Commission, All India Council for Technical Education and affiliating University incorporating the features of the Choice Based Credit System (CBCS). The Regulation 2018 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 2018-2019 for Regular admission (Academic year 2019-2020 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 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 / Directorate of Technical Education (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 Directorate of Technical Education from time to time.

(or)

1.2.2 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 Directorate of Technical Education 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

i. Aeronautical Engineering
ii. Agriculture Engineering
iii. Automobile Engineering
iv. Biomedical Engineering
v. Civil Engineering
vi. Computer Science and Engineering
vii. Electronics and Communication Engineering
viii. Electrical and Electronics Engineering
ix. Electronics and Instrumentation Engineering
x. Information Science and Engineering
xi. Mechanical Engineering
xii. Mechatronics

B. Tech. Programmes

i. Artificial Intelligence and Data Science
ii. Artificial Intelligence and Machine Learning
iii. Biotechnology
iv. Computer Science and Business Systems
v. Computer Technology

vi. Fashion Technology
vii. Food Technology
viii. Information Technology
ix. 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:

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

(ii) **Basic Engineering** courses including Engineering Graphics, Engineering Practices, Basics of Electrical, Electronics, Civil, Mechanical Engineering, Engineering Mechanics and Computer Programming.

(iii) **Humanities and Social Science** courses including Language Courses, Management Courses, Soft Skills and Professional Ethics.

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

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

The medium of instruction is English for all the Courses, 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	Credits
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 First Semester. In the Second Semester, they will be divided into two streams based on their English language proficiency assessed in the Continuous Assessment during semester I, in which the upper segment will be provided an option to enroll and study Communicative English II / German / Japanese / French / Chinese / Hindi while the lower segment will study Communicative English II.

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

3.5 However, out of nine electives, every student shall be required to opt for, a minimum of one and subject to a maximum of three courses as open elective from the list of electives of the branch / branches other than his / her branch of specialisation, if he/she satisfies the prerequisite for that particular course.

3.6 Students can also opt for **one-credit courses** of 15 to 20 hour 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 pre-requisites or the courses that may not require any pre-requisites. 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) 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 only one online course with the approval of the Departmental Consultative Committee constituted by the Head of the Department, subject to a maximum of three credits. The student needs to obtain certification or credit to become eligible for writing the End Semester Examination to be conducted by the CoE. A student can get exemption for a maximum of 3 credits during the entire programme (in lieu of Core elective or Open elective). The Head of the Department may identify a faculty member as coordinator for the course, who is responsible for the evaluation process. The course shall be evaluated through the End Semester Examination only. The evaluation methodology may be decided by the course faculty coordinator.

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 Mark Sheet. If the student earns three credits in Industrial Training / Internship, the student may drop one Professional Elective. 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, in lieu of Industrial training.

Duration of Training / Internship	Credits
2 Weeks	1
4 Weeks	2
6 Weeks	3

3.10 **Socially Relevant Projects**

A Student may be permitted to carry out a socially relevant project 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 the 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.

4. VALUE ADDED COURSES

A Student can opt for the Value Added Courses offered by the various Department / Centres from Semester II to VII. Head of the Department / Centre shall submit the list of such courses, duly approved / ratified by the Academic Council, to the Controller of Examinations to administer the examination process. A separate Certificate will be issued on successful completion of the course by the Office of the Controller of Examinations.

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 90 working days. Head of the Department shall ensure that every faculty member teaches the subject / course as prescribed in the approved curriculum and syllabi.

5.4 Special Theory / Practical Sessions may be conducted for students who require additional inputs over and above the number of periods normally specified (Remedial Classes), 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 Every student shall enroll for the courses of the succeeding semester, in the current semester. However, the student shall confirm the enrollment by registering for the courses within the first five working days after the commencement of the semester concerned.

6.3 After registering for a course, a student shall attend the classes, satisfy the attendance requirements, earn Continuous Assessment marks and appear for the End Semester Examinations.

6.3.1 Each student, on admission to the programme, shall register for **all the courses prescribed in the curriculum** in the **first Semester of study (III Semester** for students admitted under **lateral entry stream).**

6.3.2 The enrollment for all the courses of the Semester II will commence 10 working days prior to the last working day of Semester I. The student shall confirm the enrollment by registering for the courses within the first five working days after the commencement of the Semester II. In case, if a student fails to register in course(s), he/ she may be permitted to register the same, as specified in the Clause 6.5, in the subsequent semesters or when it is offered.

6.3.3 The enrollment for the courses of the Semesters III to VIII will commence 10 working days prior to the last working day of the preceding semester. The student shall enroll for the courses with the guidance of the student's Faculty Advisor. If a student wishes, the student may drop or add courses (vide Clause 6.4) within **five** working days after the commencement of the semester concerned and complete the registration process duly authorized by the Faculty Advisor.

6.4 Flexibility to Add or Drop courses

6.4.1 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.

6.4.2 From the III to VIII semesters (from IV to VIII Semesters in case of lateral entry students), the student has the option of registering for additional courses or dropping existing courses. The total number of credits that a student can add or drop is limited to 8, subject to a maximum of 2 courses in a given Semester. In such cases, the attendance requirement as stated in Clause 7 is mandatory.

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

6.5 Reappearance Registration

6.5.1 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.

6.5.2 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.

6.5.3 However, if a student wishes to improve his/ her continuous assessment, in the second attempt during reappearance, he/she shall satisfy the Clause 6.5.5 and appear for continuous assessment as given for that particular course.

6.5.4 If the theory course, in which the student has failed, is either a professional elective or an open elective, the student may register for the same or any other professional elective or open elective course, respectively in the subsequent semesters. However, the change of elective courses is permitted only once.

6.5.5 In this case (Clause 6.5.4), the student shall attend the classes, satisfy the attendance requirements (vide Clause 7), earn Continuous Assessment marks and appear for the End Semester Examination.

6.5.6 The student who fails in any continuous assessment courses (Laboratory/ Project work / Seminar or any other HSS/EEC courses) shall register for the same in the subsequent semesters or when offered next, and **repeat** the course as per Clause 6.5.5.

6.5.7 If a student is prevented from writing the end semester examination of a course or several courses due to lack of attendance, the student has to register for that / those course(s) again, when offered next, attend the classes and fulfill the requirements as per Clause 6.5.5 & 6.5.6. If the course, in which the student has 'lack of attendance', is a Core Elective or an Open Elective, the student may register for the same or any other Core Elective or Open Elective course(s) respectively in the subsequent semesters and appear in the examination as per Clause 6.5.5.

6.5.8 If a student fails to secure a pass in any theory courses (including elective) he/she is given a maximum of three arrear attempts to complete the courses. If the student still fails to secure a pass, he/she shall register for the same when offered next and repeat the course.

7. REQUIREMENTS FOR APPEARING FOR THE END SEMESTER EXAMINATION 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 End Semester 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% attendance course wise taking into account the number of periods required for that course as specified in the curriculum.

7.2 If a student, secures attendance between 70% and 79% in any course(s) 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 Department (along with Condonation form). Such certificates along with the condonation forms shall be forwarded to 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 (regardless the number of courses).

7.3 A student shall normally be permitted to appear for End Semester 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% attendance in a course will not be permitted to write the End-Semester Examination of that course. The student has to register and repeat this course in the subsequent semesters or when it is offered next (vide Clause 6.5).

7.5 If a student has shortage of attendance in all the registered courses, he/she would not be permitted to move to the higher semester and has to repeat the current semester in the subsequent year.

7.6 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.

7.7 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 shall be:

- To inform the students about the various facilities and activities available to enhance the student's curricular and co-curricular activities.
- To guide student enrollment 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 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, Common Course Committee (without the student representatives) shall meet to ensure uniform evaluation through the common question papers during Continuous Assessment and End Semester 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) End Semester examination at the end of the semester for the regular courses or as given in the Clause 17. However, the final examination in the case of certificate / value added courses may be conducted, as and when the course is completed, through the office of the Controller of Examinations.

10.2 Each course, both theory and laboratory including project work, shall be evaluated as per the Scheme of Assessment given in Clause 17.

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

10.4 For the End Semester examinations, both theory and project work, the internal and external examiners (from Academia or Industry) 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 End Semester Examinations. A student who secures not less than 50% of total marks prescribed for the course [Continuous Assessment + End semester University Examinations] with a minimum of 45% of the marks prescribed for the end-semester University Examination, 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 6.5.4, 6.5.5, 6.5.6 and 6.5.7. However, from the third attempt onwards, the student shall be declared to have passed the course if he/she secures a minimum of 5 Grade Points (C Grade) in the course prescribed during the End Semester 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 End semester 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		
Aeronautical Engineering	163	126
Agriculture Engineering	163	125
Automobile Engineering	161	124
Biomedical Engineering	163	124
Civil Engineering	163	125
Computer Science and Engineering	163	125
Electronics and Communication Engineering	163	122
Electrical and Electronics Engineering	162	123
Electronics and Instrumentation Engineering	161	122
Information Science and Engineering	163	122
Mechanical Engineering	161	122
Mechatronics	162	124
B.Tech. Programmes		
Artificial Intelligence and Data Science	161	123
Artificial Intelligence and Machine Learning	163	126
Biotechnology	163	125
Computer Science and Business Systems	163	119
Computer Technology	161	119
Fashion Technology	163	125
Food Technology	161	123

Information Technology	161	123
Textile Technology	162	124

11.5 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 Institution, if a student migrates from other Autonomous institutions to Bannari Amman Institution of Technology or rejoins from previous regulation to this regulation.

11.6 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 End Semester Examinations and / or Continuous Assessment, carrying marks as specified in Clause 17. Letter Grades (based on Credit Point and Grade Point) are awarded to the students based on the performance in the evaluation process.

12.2 Credit Point is the product of Grade Point and 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 the 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 minimum number of students for applying relative grading system is 30. If the students' strength is less than 30 then absolute grading system shall be followed with the grade range as specified below. The relative grading system shall not be applied for laboratory 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.

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

12.6 A student who does not appear for the End Semester 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 the Clause 17 and shall not be counted for the computation of SGPA/CGPA.

For the Co-curricular activities such as NCC / NSS / NSO / YRC, a satisfactory / not satisfactory grading will appear in the mark 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 during the first year of the programme. However, for valid reasons, the Head of the Institution may permit a student to complete this requirement in the second year. A satisfactory grade in the above co-curricular activities is compulsory for the award of degree.

12.8 **Revaluation:** A student, who seeks the re-valuation of the answer script, is directed to apply through proper application to the Controller of Examinations in the prescribed format through the Head of the Department. The Controller of Examinations shall arrange for the revaluation and declare the results. Revaluation is not permitted to 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 End-Semester examinations and passed all the courses prescribed in all the 8 semesters within a maximum period of 7 years 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 Special Examination**

The special or make-up 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 make-up exams may be conducted after the completion of end-semester examinations and prior to starting of the next semester.

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 to 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, which includes authorized 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 end semester examination due to lack of attendance in any of the courses.

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, which includes one year of authorized break of study (if availed) or prevention from writing the End Semester 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.

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 TEN working days before the commencement of the end semester examination in that course or courses and also recommended by the Head of the Department.

14.3 Notwithstanding the requirement of mandatory TEN 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 end semester examinations, he/she shall register the same in the subsequent semester and write the end semester 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 end semester examinations in the final semester, only if the period of study of the student concerned does not exceed 5 years 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 (for one academic semester or 6 months, whichever is earlier). 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 rejoin 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 rejoining in new Regulations shall apply to the Dean Academics 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 name of the student shall be deleted permanently from the college enrollment. Such students are not entitled to seek readmission under any circumstances.

16. IMPLEMENTATION OF MINOR DEGREE/ HONOURS

The following guidelines shall be implemented for the B.E. / B. Tech. students who have been admitted from the academic year 2021-2022.

16.1 B.E. / B.Tech. Honours (specialization in the same discipline):

- The student should have earned additionally a minimum of 18 credits from a 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. Honours

- 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.

16.3 B.E. / B.Tech. (minor in other specialisation)

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

Vertical I: Fintech and Block Chain
Vertical II: Entrepreneurship
Vertical III: Public Administration
Vertical IV: Business Data Analytics
Vertical V: Environment and Sustainability

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

16.5 B.E./ B. Tech. (Hons) Specialization in the same discipline, B.E. / B.Tech. Honors and B.E. / B.Tech. Minor in other specialization degrees will be optional for students.

16.6 For categories 16.1 and 16.2, the students will be permitted to register for the courses from V Semester onwards provided the marks earned by the students until III semester should be of CGPA 7.50 and above and cleared all the courses in the first attempt.

16.7 For category 16.3, the students will be permitted to register the courses from Semester V onwards provided the marks earned by the students until Semester III is CGPA 7.50 and above.

16.8 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.

16.9 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 number 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 calculation of CGPA.

16.10 Classification of the Degree Awarded

The conditions for First Class with Distinction, First Class, and Second Class are same as Clause 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 (specialization in the same discipline) and 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	**THEORY COURSES**	**Marks**
	Continuous Assessment	**40**
	Distribution of marks for Continuous Assessment:	
	Periodical Test I (12)	
	Periodical Test II (12)	
	Innovative Practices (16)	
	End Semester Examination	**60**
	Total Marks	**100**
II	**THEORY COURSES WITH LAB COMPONENT**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Periodical Test I (15)	
	Periodical Test II (15)	
	Innovative Practices (20)	
	(Laboratory Assessment & Report)	
	End Semester Examination (QP pattern as per (I))	**50**
	Total Marks	**100**
III	**LABORATORY COURSES**	**Marks**
	Continuous Assessment	**100**
	Distribution of marks for Continuous Assessment:	
	Conduct of Experiment	
	i. Preparation (20)	
	ii. Experiment and Analysis of Results (20)	
	iii. Record (10)	
	Test – Cycle I (25)	
	Test – Cycle II (25)	
	Total Marks	**100**
IV	**PROJECT WORK I**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	<u>*Review I*</u>	
	Literature Survey (5)	
	Identification of topic and Justification (5)	
	Work plan (10)	
	<u>*Review II*</u>	
	Approach & Results (15)	
	Conclusion (15)	

	End Semester Examination	
	Report[#] (20)	**50**
	Presentation (20)	
	Viva voce (10)	
	Total Marks	**100**
V	**PROJECT WORK II**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	<u>*Review I*</u>	
	Progress (10)	
	<u>*Review II*</u>	
	Approach & Results (10)	
	<u>*Review III*</u>	
	Conclusion & Final Presentation (10)	
	Report (15)	
	Publication of Paper in Conferences / Journals (5)	
	End Semester Examination	
	Presentation (30)	**50**
	Viva voce (20)	
	Total Marks	**100**
VI	**LANGUAGE ELECTIVE**	**Marks**
	(CONTINUOUS ASSESSMENT ONLY)	
	<u>Test 1</u>	
	Listening (5)	
	Speaking (10)	**25**
	Reading (5)	
	Writing (5)	
	<u>Test 2</u>	
	Listening (5)	
	Speaking (10)	**25**
	Reading (5)	
	Writing (5)	
	Oral Exam	**50**
	Total Marks	**100**
VII	**ONE-CREDIT COURSE**	**Marks**
	(CONTINUOUS ASSESSMENT ONLY)	
	Test I	**50**
	Quiz/ Assignment	**50**
	Total Marks	**100**

[#] *Reports / Record Note / Integrated Lab Manual to be retained for 1 year for Academic Audit, by respective Department*

VIII	**INDUSTRIAL TRAINING/ INTERNSHIP (CONTINUOUS ASSESSMENT ONLY)**	**Marks**
	Assessment by Industry	**30**
	Viva-voce	**20**
	Presentation	**30**
	Case Study / Report	**20**
	Total Marks	**100**

IX	**SOFT SKILLS (CONTINUOUS ASSESSMENT ONLY)**	**Marks**
	Test I	**25**
	Test II	**25**
	Final Examination	**50**
	Total Marks	**100**
	Grades (Excellent / Good / Satisfactory)	

X	**VALUE ADDED / CERTIFICATE COURSES (CONTINUOUS ASSESSMENT ONLY)**	**Marks**
	Test I	**25**
	Test II	**25**
	Final Evaluation / Test	**50**
	Total Marks	**100**
	Grades (Excellent / Good / Satisfactory)	

XI	**ENGINEERING GRAPHICS**	**Marks**
	Continuous Assessment	**100**
	Distribution of marks for Continuous Assessment:	
	Exercise (Minimum 10 Exercises/Modelling)	**60**
	Model Examination	**40**
	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 not conducted for the courses under the categories III, IV, V, VI, VII, VIII, IX, X and XI 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 during the first year. The attendance of the personality and character development courses / events shall be maintained on the regular basis by the concerned First Year Co-ordinators and made available in the Office of the Controller of Examinations before the commencement of Semester examinations of Semester I or Semester II.

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 End Semester / 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 and date of implementation and to introduce Additional Electives, Open Electives, One Credit Courses and Value Added Courses through the Academic Council.

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)

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

b. **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.

c. **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.

d. **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.

e. **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.

f. **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.

g. **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.

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

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

j. **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.

k. **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.

l. **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

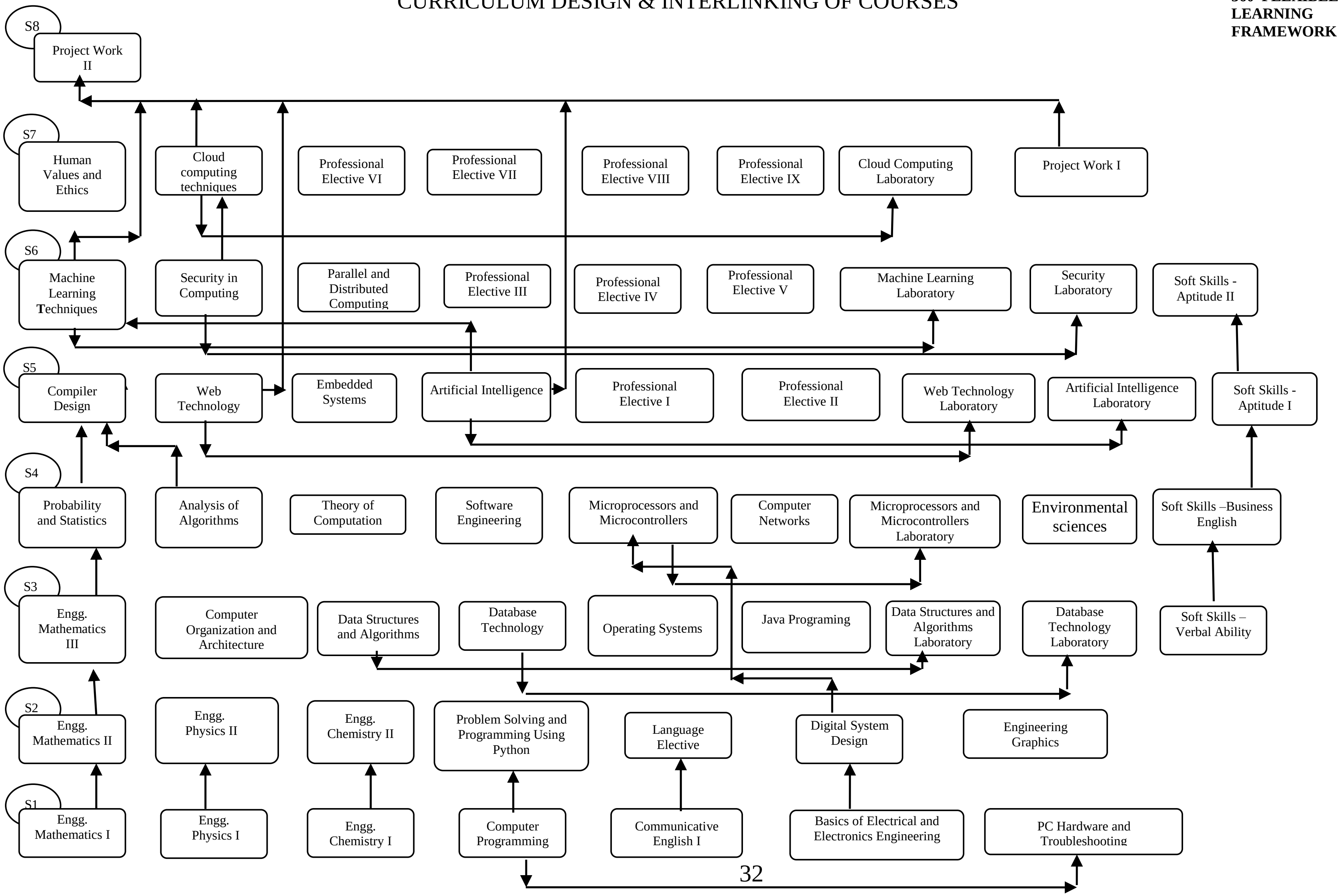
PEO(s)	Programme Outcomes(s)											
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
I	X	X	X	X	X	X	X	X	X			
II	X	X	X	X	X	X		X	X	X	X	
III								X	X	X	X	X

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**	
19CT101	ENGINEERING MATHEMATICS I	3	1	0	4	4	40	60	100	BS
19CT102	ENGINEERING PHYSICS I	2	0	2	3	4	50	50	100	BS
19CT103	ENGINEERING CHEMISTRY I	2	0	2	3	4	50	50	100	BS
19CT104	COMPUTER PROGRAMMING	2	0	2	3	4	50	50	100	ES
19HS101	COMMUNICATIVE ENGLISH I	1	0	2	2	3	100	0	100	HSS
19CT106	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING	2	0	2	3	4	50	50	100	ES
19CT107	PC HARDWARE AND TROUBLESHOOTING	0	0	2	1	2	100	0	100	ES
Total		**12**	**1**	**12**	**19**	**25**	-	-	-	-
II SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
19CT201	ENGINEERING MATHEMATICS II	3	1	0	4	4	40	60	100	BS
19CT202	ENGINEERING PHYSICS II	2	0	2	3	4	50	50	100	BS
19CT203	ENGINEERING CHEMISTRY II	2	0	2	3	4	50	50	100	BS
19CT204	PROBLEM SOLVING AND PROGRAMMING USING PYTHON	3	0	2	4	5	50	50	100	ES
	LANGUAGE ELECTIVE	1	0	2	2	3	100	0	100	HSS
19CT206	DIGITAL SYSTEM DESIGN	3	0	2	4	5	50	50	100	ES
19CT207	ENGINEERING GRAPHICS	1	0	4	3	5	100	0	100	ES
Total		**15**	**1**	**14**	**23**	**30**	-	-	-	-

III SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CIA	SEE	Total	
19CT301	ENGINEERING MATHEMATICS III	3	1	0	4	4	40	60	100	BS
19CT302	COMPUTER ORGANIZATION AND ARCHITECTURE	3	0	0	3	3	40	60	100	ES
19CT303	DATA STRUCTURES AND ALGORITHMS	3	0	0	3	3	40	60	100	PC
19CT304	DATABASE TECHNOLOGY	3	0	0	3	3	40	60	100	PC
19CT305	OPERATING SYSTEMS	3	1	0	4	4	40	60	100	PC
19CT306	JAVA PROGRAMMING	2	0	4	4	6	50	50	100	PC
19CT307	DATA STRUCTURES AND ALGORITHMS LABORATORY	0	0	4	2	4	100	0	100	PC
19CT308	DATABASE TECHNOLOGY LABORATORY	0	0	4	2	4	100	0	100	PC
18GE301	SOFT SKILLS - VERBAL ABILITY	0	0	2	-	2	100	0	100	EEC
Total		**17**	**2**	**14**	**25**	**33**	**-**	**-**	**-**	**-**

IV SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CIA	SEE	Total	
19CT401	PROBABILITY AND STATISTICS	3	1	0	4	4	40	60	100	BS
19CT402	ANALYSIS OF ALGORITHMS	3	1	0	4	4	40	60	100	PC
19CT403	THEORY OF COMPUTATION	3	1	0	4	4	40	60	100	PC
19CT404	SOFTWARE ENGINEERING	3	0	0	3	3	40	60	100	PC
19CT405	MICROPROCESSORS AND MICROCONTROLLERS	3	0	0	3	3	40	60	100	ES
19CT406	COMPUTER NETWORKS	3	0	2	4	5	50	50	100	PC
19CT407	MICROPROCESSORS AND MICROCONTROLLERS LABORATORY	0	0	4	2	4	100	0	100	ES
18HS001	ENVIRONMENTAL SCIENCE	2	0	0	0	2	100	0	100	HSS
18GE401	SOFT SKILLS-BUSINESS ENGLISH	0	0	2	-	2	100	0	100	EEC
Total		**20**	**3**	**8**	**24**	**31**	**-**	**-**	**-**	**-**

V SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
21CT501	COMPILER DESIGN	3	1	0	4	4	40	60	100	PC
21CT502	WEB TECHNOLOGY	3	0	0	3	3	40	60	100	PC
21CT503	EMBEDDED SYSTEMS	3	0	2	4	5	50	50	100	PC
21CT504	ARTIFICIAL INTELLIGENCE	3	0	0	3	3	40	60	100	PC
	PROFESSIONAL ELECTIVE I	-	-	-	3	-	-	-	100	PE
	PROFESSIONAL ELECTIVE II	-	-	-	3	-	-	-	100	PE
21CT507	WEB TECHNOLOGY LABORATORY	0	0	2	1	2	100	0	100	PC
21CT508	ARTIFICIAL INTELLIGENCE LABORATORY	0	0	2	1	2	100	0	100	PC
18GE501	SOFT SKILLS – APTITUDE I	0	0	2	-	2	100	0	100	EEC
Total		**-**	**1**	**-**	**22**	**-**	**-**	**-**	**-**	**-**

VI SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
21CT601	MACHINE LEARNING TECHNIQUES	2	1	0	3	3	40	60	100	PC
21CT602	SECURITY IN COMPUTING	3	0	0	3	3	40	60	100	PC
21CT603	PARALLEL AND DISTRIBUTED COMPUTING	3	0	0	3	3	40	60	100	PC
	PROFESSIONAL ELECTIVE III	-	-	-	3	-	-	-	100	PE
	PROFESSIONAL ELECTIVE IV	-	-	-	3	-	-	-	100	PE
	PROFESSIONAL ELECTIVE V	-	-	-	3	-	-	-	100	PE
21CT607	MACHINE LEARNING LABORATORY	0	0	2	1	2	100	0	100	PC
21CT608	SECURITY LABORATORY	0	0	2	1	2	100	0	100	PC
18GE601	SOFT SKILLS - APTITUDE II	0	0	2	-	2	100	0	100	EEC
Total		**-**	**1**	**-**	**20**	**-**	**-**	**-**	**-**	**-**

VII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
21HS002	HUMAN VALUES AND ETHICS	2	0	0	2	2	40	60	100	HSS
21CT702	CLOUD COMPUTING TECHNIQUES	3	0	0	3	3	40	60	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
21CT707	CLOUD COMPUTING LABORATORY	0	0	2	1	2	60	40	100	PC
21CT708	PROJECT WORK I	0	0	6	3	6	60	40	100	EEC
Total		**-**	**0**	**-**	**21**	**-**	**-**	**-**	**-**	**-**

VIII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
21CT801	PROJECT WORK II	0	0	18	9	18	60	40	100	EEC
Total		**0**	**0**	**18**	**9**	**-**	**-**	**-**	**-**	**-**

ELECTIVES

LANGUAGE ELECTIVES

Code No.	Course	L	T	P	C	Hours/ week	CIA	SEE	Total	Category
18HS201	COMMUNICATIVE ENGLISH II	1	0	2	2	3	100	0	100	HSS
18HSC01	CHINESE	1	0	2	2	3	100	0	100	HSS
18HSF01	FRENCH	1	0	2	2	3	100	0	100	HSS
18HSG01	GERMAN	1	0	2	2	3	100	0	100	HSS
18HSH01	HINDI	1	0	2	2	3	100	0	100	HSS
18HSJ01	JAPANESE	1	0	2	2	3	100	0	100	HSS

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
PROFESSIONAL ELECTIVE COURSES: VERTICALS										
VERTICAL I: DATA SCIENCE										
							CIA	**SEE**	**Total**	
21CT001	EXPLORATORY DATA ANALYSIS	2	0	2	3	4	50	50	100	PE
21CT002	RECOMMENDER SYSTEMS	3	0	0	3	3	40	60	100	PE
21CT003	BIG DATA ANALYTICS	3	0	0	3	3	40	60	100	PE
21CT004	NEURAL NETWORKS AND DEEP LEARNING	2	0	2	3	4	50	50	100	PE
21CT005	NATURAL LANGUAGE PROCESSING	3	0	0	3	3	40	60	100	PE
21CT006	COMPUTER VISION	3	0	0	3	3	40	60	100	PE
VERTICAL II: FULL STACK DEVELOPMENT										
21CT007	AGILE SOFTWARE DEVELOPMENT	3	0	0	3	3	40	60	100	PE
21CT008	UI AND UX DESIGN	3	0	0	3	3	40	60	100	PE
21CT009	WEB FRAMEWORKS	3	0	0	3	3	40	60	100	PE
21CT010	APP DEVELOPMENT	2	0	2	3	4	50	50	100	PE
21CT011	SOFTWARE TESTING AND AUTOMATION	3	0	0	3	3	40	60	100	PE
21CT012	DevOps	3	0	0	3	3	40	60	100	PE
VERTICAL III: CLOUD COMPUTING AND DATA CENTER TECHNOLOGIES										
21CT013	VIRTUALIZATION IN CLOUD COMPUTING	3	0	0	3	3	40	60	100	PE
21CT014	CLOUD SERVICES AND DATA MANAGEMENT	3	0	0	3	3	40	60	100	PE
21CT015	CLOUD STORAGE TECHNOLOGIES	3	0	0	3	3	40	60	100	PE
21CT016	CLOUD AUTOMATION TOOLS AND APPLICATIONS	3	0	0	3	3	40	60	100	PE
21CT017	SOFTWARE DEFINED NETWORKS	2	0	2	3	4	50	50	100	PE
21CT018	SECURITY AND PRIVACY IN CLOUD	3	0	0	3	3	40	60	100	PE

VERTICAL IV: CYBER SECURITY AND DATA PRIVACY										
21CT019	CYBER SECURITY	3	0	0	3	3	40	60	100	PE
21CT020	MODERN CRYPTOGRAPHY	3	0	0	3	3	40	60	100	PE
21CT021	CYBER FORENSICS	3	0	0	3	3	40	60	100	PE
21CT022	ETHICAL HACKING	3	0	0	3	3	40	60	100	PE
21CT023	CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES	2	0	2	3	4	50	50	100	PE
21CT024	MALWARE ANALYSIS	3	0	0	3	3	40	60	100	PE
VERTICAL V: CREATIVE MEDIA										
21CT025	MULTIMEDIA AND ANIMATION	2	0	2	3	4	50	50	100	PE
21CT008	UI AND UX DESIGN	3	0	0	3	3	40	60	100	PE
21CT026	AUGMENTED REALITYAND VIRTUAL REALITY	2	0	2	3	4	50	50	100	PE
21CT027	GAME DEVELOPMENT	2	0	2	3	4	50	50	100	PE
21CT028	VIDEO CREATION AND EDITING	2	0	2	3	4	50	50	100	PE
21CT029	DIGITAL MARKETING	3	0	0	3	3	40	60	100	PE
VERTICAL VI: EMBEDDED TECHNOLOGIES										
21CT030	REAL TIME OPERATING SYSTEM	3	0	0	3	3	40	60	100	PE
21CT031	WIRELESS AND MOBILE COMMUNICATION	3	0	0	3	3	40	60	100	PE
21CT032	DESIGN OF EMBEDDED SYSTEMS	2	0	2	3	4	50	50	100	PE
21CT033	EMBEDDED SYSTEM NETWORKING	3	0	0	3	3	40	60	100	PE
21CT034	EMBEDDED SECURITY	3	0	0	3	3	40	60	100	PE
21CT035	EMBEDDED PROCESSOR DEVELOPMENT	3	0	0	3	3	40	60	100	PE
VERTICAL VII: DIVERSIFIED COURSES										
21CT036	XML AND WEB SERVICES	3	0	0	3	3	40	60	100	PE
21CT037	SOFTWARE PROJECT MANAGEMENT	3	0	0	3	3	40	60	100	PE

21CT038	HUMAN COMPUTER INTERACTION	3	0	0	3	3	40	60	100	PE
21CT039	VISUAL EFFECTS	3	0	0	3	3	40	60	100	PE
21CT040	BUSINESS ANALYTICS	3	0	0	3	3	40	60	100	PE
21CT041	IoT AND USE CASES	3	0	0	3	3	40	60	100	PE

HONOURS: DATA SCIENCE

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CIA	SEE	Total	
21CTH01	EXPLORATORY DATA ANALYSIS	2	0	2	3	4	50	50	100	PE
21CTH02	RECOMMENDER SYSTEMS	3	0	0	3	3	40	60	100	PE
21CTH03	BIG DATA ANALYTICS	3	0	0	3	3	40	60	100	PE
21CTH04	NEURAL NETWORKS AND DEEP LEARNING	2	0	2	3	4	50	50	100	PE
21CTH05	NATURAL LANGUAGE PROCESSING	3	0	0	3	3	40	60	100	PE
21CTH06	COMPUTER VISION	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**	
21OCE01	ENERGY CONSERVATION AND MANAGEMENT	3	0	0	3	3	40	60	100	OE
21OEC01	BASICS OF ANALOG AND DIGITAL ELECTRONICS	3	0	0	3	3	40	60	100	OE
21OEC02	MICROCONTROLLER PROGRAMMING	3	0	0	3	3	40	60	100	OE
21OEC03	PRINCIPLES OF COMMUNICATION SYSTEMS	3	0	0	3	3	40	60	100	OE
21OEC04	PRINCIPLES OF COMPUTER COMMUNICATION AND NETWORKS	3	0	0	3	3	40	60	100	OE
21OEI01	PROGRAMMABLE LOGIC CONTROLLER	3	0	0	3	3	40	60	100	OE
21OEI02	SENSOR TECHNOLOGY	3	0	0	3	3	40	60	100	OE
21OEI03	FUNDAMENTALS OF VIRTUAL INSTRUMENTATION	3	0	0	3	3	40	60	100	OE
21OEI04	OPTOELECTRONICS AND LASER INSTRUMENTATION	3	0	0	3	3	40	60	100	OE
21OME01	DIGITAL MANUFACTURING	3	0	0	3	3	40	60	100	OE
21OME02	INDUSTRIAL PROCESS ENGINEERING	3	0	0	3	3	40	60	100	OE
21OME03	MAINTENANCE ENGINEERING	3	0	0	3	3	40	60	100	OE
21OME04	SAFETY ENGINEERING	3	0	0	3	3	40	60	100	OE
21OBT01	BIOFUELS	3	0	0	3	3	40	60	100	OE
21OFD01	TRADITIONAL FOODS	3	0	0	3	3	40	60	100	OE
21OFD02	FOOD LAWS AND REGULATIONS	3	0	0	3	3	40	60	100	OE
21OFD03	POST HARVEST TECHNOLOGY OF FRUITS AND VEGETABLES	3	0	0	3	3	40	60	100	OE
21OFD04	CEREAL, PULSES AND OIL SEED TECHNOLOGY	3	0	0	3	3	40	60	100	OE
21OFT01	FASHION CRAFTSMANSHIP	3	0	0	3	3	40	60	100	OE
21OFT02	INTERIOR DESIGN IN FASHION	3	0	0	3	3	40	60	100	OE
21OFT03	SURFACE ORNAMENTATION	3	0	0	3	3	40	60	100	OE
21OPH01	NANOMATERIALS SCIENCE	3	0	0	3	3	40	60	100	OE
21OPH02	SEMICONDUCTOR PHYSICS AND DEVICES	3	0	0	3	3	40	60	100	OE
21OPH03	APPLIED LASER SCIENCE	3	0	0	3	3	40	60	100	OE
21OPH04	BIO-PHOTONICS	3	0	0	3	3	40	60	100	OE
21OPH05	PHYSICS OF SOFT MATTER	3	0	0	3	3	40	60	100	OE

21OCH01	CORROSION SCIENCE AND ENGINEERING	3	0	0	3	3	40	60	100	OE
21OCH02	POLYMER SCIENCE	3	0	0	3	3	40	60	100	OE
21OCH03	ENERGY STORING DEVICES	3	0	0	3	3	40	60	100	OE
21OMA01	GRAPH THEORY AND COMBINATORICS	3	0	0	3	3	40	60	100	OE
21OGE01	PRINCIPLES OF MANAGEMENT	3	0	0	3	3	40	60	100	OE
21OGE02	ENTREPRENEURSHIP DEVELOPMENT I	3	0	0	3	3	40	60	100	OE
21OGE03	ENTREPRENEURSHIP DEVELOPMENT II	3	0	0	3	3	40	60	100	OE
21OGE04	NATION BUILDING: LEADERSHIP AND SOCIAL RESPONSIBILITY	3	0	0	3	3	40	60	100	OE

ONE CREDIT COURSES										
19CT0XA	GraphQL USING REST API	-	-	-	1	-	100	0	100	EEC
19CT0XC	GAME PROGRAMMING	-	-	-	1	-	100	0	100	EEC
19CT0XD	LARAVEL	-	-	-	1	-	100	0	100	EEC
19CT0XF	TRANSFER LEARNING IN DATA SCIENCE	-	-	-	1	-	100	0	100	EEC
19CT0XG	DATABASE INTEGRATION IN WEB DEVELOPMENT	-	-	-	1	-	100	0	100	EEC
19CT0XH	VIDEO ANALYTICS USING EDGE COMPUTING	-	-	-	1	-	100	0	100	EEC
19CT0XI	NLP WITH CHATGPT	-	-	-	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	4					28	17.2	15%	20%
2	ES	7	11	3	5					26	15.9	15%	20%
3	HSS	2	2					2		6	3.7	5%	10%
4	PC			18	15	16	11	4		64	39.2	30%	40%
5	PE					6	9	12		27	16.6	10%	15%
6	EEC							3	9	12	7.3	10%	15%
Total		19	23	25	24	22	20	21	9	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 Examination

19CT101 ENGINEERING MATHEMATICS I **3 1 0 4**

Course Objectives

- Interpret the introductory concepts of Matrices and Calculus, which will enable them to model and analyze physical phenomena involving continuous changes of variables
- Summarize and apply the methodologies involved in solving problems related to fundamental principles of Matrices and Calculus.
- 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.

Course Outcomes (COs)

1. Apply the idea of Eigen value and Eigen vectors in data science, data visualization in graphics and solve application problems that can be modelled by systems of linear equations. find the extreme values of the given function
2. Analyze the reliability, safety analysis of engineering systems and design of engineering structures using first order linear differential equations.
3. Analyze the reliability, design of engineering structures using higher order linear differential equations.
4. Apply the techniques of multivariable calculus to problems in mathematics, the physical sciences, and optimize the constrained engineering problems.
5. Compute the area, volume for two dimensional and three-dimensional solid structures through the multiple integral techniques.

Articulation Matrix

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

UNIT I **9 Hours**

MATRICES AND DETERMINANTS

Matrices and determinants- evaluation of determinants, Eigen Values and Eigen Vectors of a real matrix - Properties of Eigen Values, Cayley - Hamilton Theorem.

UNIT II **9 Hours**

ORDINARY DIFFERENTIAL EQUATION OF FIRST ORDER

Formation of differential equations- Leibnitz and Bernoullis first order differential Equations-Exact differential equations.

UNIT III **9 Hours**

ORDINARY DIFFERENTIAL EQUATION OF HIGHER ORDER

Higher order linear differential equation with constant coefficients -Higher order linear differential equations with variable coefficients: Cauchy's differential equation - Method of variation of parameter for second order differential equations.

UNIT IV **9 Hours**

MULTIVARIABLE CALCULUS

Partial Derivatives - Total Derivatives - Jacobians and Properties- Unconstrained maxima and minima.

UNIT V **9 Hours**

MULTIPLE INTEGRALS

Double integration with constant and variable limits - Region of integration - Area as double integral in Cartesian coordinates. Volume as triple integral in Cartesian coordinates

FOR FURTHER READING

Applications of mass spring system in ordinary differential equations of higher order

Total: 45+15=60 Hours

Reference(s)

1. C. Ray Wylie and C Louis Barrett, Advanced Engineering Mathematics, Sixth Edition, Tata McGraw-Hill Publishing Company Ltd, 2003.
2. Erwin Kreyszig, Advanced Engineering Mathematics, Tenth Edition, Wiley India Private Limited, New Delhi 2015
3. Peter V. O'Neil, Advanced Engineering Mathematics, Seventh Edition, Cengage Learning India Private Limited, 2012
4. B.S. Grewal, Higher Engineering Mathematics, Forty Third Edition, Khanna Publications, New Delhi 2014
5. Glyn James, Advanced Engineering Mathematics, Third Edition, Wiley India, 2014.
6. M.D. Greenberg, Advanced Engineering Mathematics, Second Edition, Pearson Education, Inc. 2002.

19CT102 ENGINEERING PHYSICS I

2 0 2 3

Course Objectives

- Understand the transport mechanism of solids based on band gap
- Implement the principles of laser in engineering fields
- Impart knowledge in fiber optics and ultrasonics

Course Outcomes (COs)

1. Outline the electrical and thermal properties of materials based on band theory
2. Apply the phenomenon of superconductivity in memory storage device
3. Analyze the three different types of optical fibers for data networking
4. Infer the interaction of radiation with matter for optical data storage
5. Illustrate the properties, generation of ultrasonic waves for the transducer applications

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	2	1						2	2	2				2
3	2	2						2	2	2				2
4	2	1						2	2	2				2
5	2	2						2	2	2				2

UNIT I **6 Hours**

TRANSPORT PROPERTIES

Classification of solids based on band theory - concept of free electron - law of mass action - classification of semiconductor based on electrical conductivity - variation of Fermi level with temperature in extrinsic semiconductors

UNIT II **5 Hours**

SUPER CONDUCTING COMPUTER ELEMENTS

Superconductivity - transition temperature - Meissner effect - effect of magnetic field - effect of heavy current - classification of critical magnetic field - computer memory: Cryotron - Josephson junction computer

UNIT III **7 Hours**

OPTICAL FIBERS IN DIGITAL DATA NETWORKING

Basic Principles - dielectric waveguides - types - computations of light accepting angle and figure of merit - optical spectral bands (mobile, aero navigation and earth to satellite radar) - schematic representation of digital communication networks – merits

UNIT IV **6 Hours**

LASER PHYSICS FOR INFORMATION SCIENCE

Properties - interaction of radiation with matter - pumping methods - types of coherent light sources - data storage in compact disc: basic configuration - numerical aperture - CD and optical disc - bar code scanners - laser printing

UNIT V **6 Hours**

ULTRASONIC TRANSDUCERS

Classification of sound waves - properties - piezoelectric transducer: generation and detection of ultrasound waves - scan displays: A scan - B scan - C scan - sonogram

EXPERIMENT 1 **2 Hours**

Exposure to engineering physics laboratory and precautionary measures

EXPERIMENT 2 **6 Hours**

Find the band gap value of the given semiconductor diode. Based on the band gap value, identify the given semiconductor

EXPERIMENT 3 **6 Hours**

Based on Hall effect, calculate the charge carrier density of a given material

EXPERIMENT 4 **6 Hours**

Find the refractive index of a transparent solid with the aid of travelling microscope

EXPERIMENT 5 **4 Hours**

Determine the wavelength of given laser source by applying the principle of diffraction

EXPERIMENT 6 **6 Hours**

Determine the
(i) wavelength of ultrasonic in a liquid medium,
(ii) velocity of ultrasonic waves in the given liquid
(iii) compressibility of the given liquid using ultrasonic interferometer.

Total: 30+30=60 Hours

Reference(s)

1. Basics of laser physics: for students of science and engineering http://www.springer.com/978-3-319- 50650-0.
2. Charles Kittel, Introduction to Solid State Physics, 8th edition, Wiley India Pvt. Ltd., New Delhi, 2014.
3. Arthur Beiser, Shobhit Mahajan and S Rai Choudhury, Concepts of Modern Physics, 6th Edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2014.
4. B. K. Pandey and S. Chaturvedi, Engineering Physics, 1st edition, Cengage Learning India Pvt. Ltd., New Delhi, 2017.
5. Halliday and Resnick, Fundamentals of Physics, 11 th edition, John Wiley and Sons, Inc, 2018.

19CT103 ENGINEERING CHEMISTRY I **2 0 2 3**

Course Objectives

- Identify the properties and applications of optical materials for smart screen
- Summarize the terminologies of electrochemistry and explain the applications of electrochemical instruments
- Classify the materials for data storage in electronic devices
- Outline the applications of organic materials in data storage
- Choose the suitable materials for the fabrications of microprocessors in electronic devices

Course Outcomes (COs)

1. Compare the inorganic and organic materials used for smart screen fabrication
2. Demonstrate the fabrication of smart screen using conducting material
3. Analyze the type of materials for data storage in electronic devices
4. Identify various organic nanoscale materials in data storage
5. Select suitable materials for fabrication of microprocessor

Articulation Matrix

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

UNIT I **6 Hours**

OPTICAL MATERIAL FOR SMART SCREEN

Types: Inorganic: Rare earth metals [yttrium, lanthanum, cerium, praseodymium, neodymium, europium, terbium and dysprosium] - organic: Organic dielectric material [Polystyrene, PMMA] - organic light emitting diodes [polythiopene].

UNIT II **6 Hours**

CONDUCTING MATERIALS FOR SMART SCREEN

Conductive components: Indium tin oxide [properties and applications] - touch screen [resistive and capacitive]. Chemical components in glass - alumino silicate - gorilla glass.

UNIT III **5 Hours**

MATERIALS FOR DATA STORAGE

Classification - magnetic storage [Iron oxide, cobalt alloy, chromium oxide and barium ferrite] - optical storage [photochromic materials] - solid storage.

UNIT IV **6 Hours**

ORGANIC NANOSCALE MATERIAL FOR DATA STORAGE

Data Storage - classification [media, access, information and volatility] - flexible data storage [transistor Structure] - flexible floating gate - flexible charge trap- flexible ferroelectric- flexible resistive memory with organic material.

UNIT V **7 Hours**

MATERIALS FOR MICROPROCESSOR FABRICATION

Micro electrical components: Fabrication (CVD method) and use of metal oxide materials. Integrated circuit manufacturing - preparation of silicon wafer - masking - photo-resistant materials - classification. Doping: Atomic diffusion, ion implantation, making successive layers. Micro capacitors: Types - electrochemical capacitors, electrolytic capacitors and super capacitors. Soldering materials: copper, tin and silver.

FURTHER READING

Applications of advanced data storage materials in electronic devices. Conducting materials for smart screen Applications of smart material for microprocessor fabrication.

EXPERIMENT 1 **5 Hours**

Estimation of copper content in a sample solution prepared from copper doped optical light emitting diodes

EXPERIMENT 2 **5 Hours**

Determination of conductivity of aluminum chloride, aluminum silicate and tin oxide compounds using conductivity meter

EXPERIMENT 3 **5 Hours**

Estimation of barium content in a sample solution prepared from iron alloy used in magnetic storage material

EXPERIMENT 4 **4 Hours**

Estimation of iron content in sample solution prepared from ferro electric materials using spectrophotometer

EXPERIMENT 5 **6 Hours**

Electroless plating of copper on polymeric material used in IC fabrication

EXPERIMENT 6 **5 Hours**

Electroless plating of nickel on polymeric material used in IC fabrication

Total:30+30= 60 Hours

Reference(s)

1. Smart Materials Taxonomy, Victor Goldade, Serge Shil'ko, Aleksander Neverov, CRC publication, 2015
2. https://www.dmccoltd.com/english/museum/touchscreens/technologies/projected.asp
3. Advanced Magnetic and Optical Materials, edited by Ashutosh Tiwari, Parameswar K. Iyer, Vijay Kumar, Hendrik Swart, wiley publication, 2016

4. Recent Advances of Flexible Data Storage Devices Based on Organic Nanoscaled Materials- Li Zhou, Jingyu Mao, Yi Ren, Su-Ting Han, V A. L. Roy and Ye Zhou, Small 1703126, 2018
5. Padma L Nayak, Polymer Science, 1st Edition, Kalyani Publishers, New Delhi, 2005
6. G.M. Crean, R. Stuck, J.A. Woollam. Semiconductor Materials Analysis and Fabrication Process Control Elsevier publication, 2012

19CT104 COMPUTER PROGRAMMING **2 0 2 3**

Course Objectives

- Understand the basics of C primitives, operators, expressions and user defined data types.
- Gain knowledge about the structural programming concepts.
- Develop C++ applications using OOP concepts, files, templates and exceptions

Course Outcomes (COs)

1. Explain the basic C programming concepts and implement the control statements
2. Implement the concepts of arrays, strings and functions
3. Analyze the concepts of structures, unions and files in C
4. Interpret the features of object oriented programming and basic files and templates.
5. Develop applications with advanced concepts like inheritance, virtual functions and exceptions.

Articulation Matrix

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

UNIT I **6 Hours**

BASICS OF C LANGUAGES

Overview of 'C' Language - Constants, Variables and Data Types - Operators, Expressions and Assignment statements - Managing Input/Output Operations - Formatted I/O - Decision Making – Branching - Looping

UNIT II **6 Hours**

ARRAYS, POINTERS, AND FUNCTIONS

Arrays - dynamic and multi-dimensional arrays - Character arrays and Strings - String handling Functions - User defined Functions - Categories of Functions – Recursion - Pointers - Declaration, Accessing a variable, dynamic memory allocation – Array Pointer – Pointers and Functions

UNIT III **6 Hours**

STRUCTURES AND UNIONS AND FILE HANLDING

Structures, Unions –File Management in C - Data hierarchy- Files and Streams - Sequential access file- Random access file - Preprocessors.

UNIT IV **6 Hours**

INTRODUCTION TO C++

Basics of C++ - Classes and Objects - Constructor and destructor - Function overloading - Operator overloading - Copy constructor - Assignment operator - Template classes - Static class members - File streams

UNIT V **6 Hours**

INHERITANCE AND POLYMORPHISM

Inheritance - Base classes and derived classes - Inherited member access - Base class initialization - Protected members of a class - Virtual functions - Virtual destructors - Virtual base classes - Virtual base class member access - Exception handling - try...throw...catch block - Nested catch handlers

EXPERIMENT 1 **2 Hours**

Write a C program to perform arithmetic operations on integers and floating point numbers.

EXPERIMENT 2 **2 Hours**

Write a C program to implement ternary operator and relational operators.

EXPERIMENT 3 **2 Hours**

Write a C program to read the values of A,B,C through the keyboard. Add them and after addition check if it is in the range of 100 to 200 or not. Print separate message for each.

EXPERIMENT 4 **2 Hours**

Write a C program to display the roots of a quadratic equation with their types using switch case.

EXPERIMENT 5 **2 Hours**

Write a C program to generate the following triangle. 1

1 2 3

1 2 3 4 5

1 2 3 4 5 6 7

EXPERIMENT 6 **2 Hours**

Write a C program to get a matrix of order 3x3 and display a matrix of order of 4x4, with the fourth row and column as the sum of rows and columns respectively.

EXPERIMENT 7 **2 Hours**

Write a C program to remove the occurrence of "the" word from entered string.

EXPERIMENT 8 **2 Hours**

Write a C program to find the factorial of given number.

EXPERIMENT 9 **2 Hours**

Design a structure to hold the following details of a student. Read the details of a student and display them in the following format Student

details: rollno, name, branch, year, section, cgpa.
****

NAME: ROLL NO: BRANCH: YEAR: SECTION: CGPA:

EXPERIMENT 10 **2 Hours**

Create two files test1.txt and test2.txt and write a C program to read the file text1.txt character by character on the screen and paste it at the end of test2.txt.

EXPERIMENT 11 **2 Hours**

Implementation of operator overloading with class and objects.
1. Write a program to find the square and cube of a number using class and object.
2. Write a program to find the area of rectangle and circle using class and object.
3. Write a program to find whether the given number is an Armstrong number using classes and objects.

EXPERIMENT 12 **2 Hours**

Implementation of operator and function overloading.
1. Write a program to perform conversion from integer to complex number by operator overloading.
2. Write a program to perform from complex number to integer using operator overloading.
3. Write a program to perform addition of two numbers using function overloading.

EXPERIMENT 13 **2 Hours**

Implementation of Class templates and Function templates.
1. Write a program to perform insertion sort using class template.
2. Write a program to perform quick sort using function template.
3. Write a program to perform merge sort using template.

EXPERIMENT 14 **2 Hours**

Implementation of types of Inheritance.
1. Write a program to generate employee payroll using inheritance.
2. Write a program to student details using multilevel inheritances.
3. Write a program to employee details using multiple inheritance.

EXPERIMENT 15 **2 Hours**

Develop a program to implement the concepts in inheritance, virtual functions and exceptions.

Total: 30+30=60 Hours

Reference(s)

1. Byron C Gottried, "Programming with C", Schuams' outline series, 2nd edition, Tata McGraw Hill, 2006.
2. Yashavant P. Kanetkar "Understanding Pointers in C", BPB Publications, NewDelhi, 2009.
3. Richard Johnsonbaugh, "Applications Programming In ANSI C", 3rd edition, Pearson Education, 2003.
4. E.Balagurusamy, " Programming in ANSI C " , 4th Edition, Tata McGraw Hill, 2007.
5. Al Kelley, Ira Pohl, "A Book on C: Programming in C", 4th edition, Addison- Wesley Professional, 2010.
6. M.T. Somashekara, "Programming in C", Prentice-Hall of India Pvt.Ltd, 2005.

19HS101 COMMUNICATIVE ENGLISH I 1 0 2 2

Course Objectives

- Read and understand the main points on familiar matters regularly encountered in work, school, or leisure
- Listen and respond in most common situations where English is spoken
- Write simple connected texts on topics which are familiar or of personal interest
- Describe experiences and events, hopes and ambitions and briefly give reasons and explanations for opinions and plans

Course Outcomes (COs)

1. Use appropriate grammar & vocabulary that is expected at the BEC Preliminary exam level
2. Understand the general meaning of non-routine letters within own work area, and short reports of a predictable nature
3. Write straightforward, routine letters of a factual nature, and make notes on routine matters, such as taking/placing orders
4. Follow simple presentations/demonstrations
5. Deal with predictable requests from a visitor, state routine requirements, and offer advice within own job area on simple matters

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 **9 Hours**

GRAMMER

Tenses Future continuous, Past continuous, Past perfect, Past simple, Past tense responses, Present perfect continuous, Present perfect/past simple Reported speech Adverbs intensifiers Comparatives and superlatives Conditionals 2nd and 3rd Connecting words expressing cause and effect, contrast Phrasal verbs Prepositions of place Simple passive - Wh-questions in the past Question tags Will and going to, for prediction.

UNIT II **9 Hours**

READING

Understanding short real-world notices, messages Detailed comprehension of factual material; skimming and scanning skills - Interpreting visual information Reading for detailed factual information Reading for gist and specific information - Grammatical accuracy and understanding of text structure - Reading and information transfer.

UNIT III **9 Hours**

WRITING

Internal communication including note, message, memo or email - arranging / rearranging appointments, asking for permission, giving instructions - Business correspondence including letter, fax, email apologising and offering compensation, making or altering reservations, dealing with requests, giving information about a product.

UNIT IV **9 Hours**

LISTENING

Listening for specific information Listening for numbers and letters Note completion Listening for gist listening to monologues (presentations, lectures, announcements and briefings) listening to interacting speakers (telephone conversations, face-to-face conversations, interviews and discussions).

UNIT V **9 Hours**

SPEAKING

Exchanging personal and factual information expressing and finding out about attitudes and opinions organise a larger unit of discourse Turn-taking, negotiating, collaborating, exchanging information, expressing and justifying opinions, agreeing and/or disagreeing, suggesting, speculating, comparing and contrasting, and decision-making.

Total:15+30= 45 Hours

Reference(s)

1. Alexander Garrett, Cambridge BEC Preliminary Students Book with Answers, Cambridge University Press, 2016.
2. Lan Wood, Anne Williams and Anna Cowper. Pass Cambridge BEC Preliminary, Second Edition, New Delhi, 2014.
3. Norman Whitby. Cambridge Business Benchmark. Pre-Intermediate to Intermediate, Students Book. South Asian Edition, 2018.

19CT106 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING 2 0 2 3

Course Objectives

- To understand the basic concepts of electric circuits and magnetic circuits.
- To illustrate the construction and operation of various electrical machines and semiconductor devices.
- To learn the fundamentals of communication systems.

Course Outcomes (COs)

1. Understand the basic concepts of electric and magnetic circuits.
2. Summarize the types of DC machines.
3. Classify the static and dynamic AC machines and explain their operation.
4. Interpret the operation of AC and DC drives
5. Illustrate the characteristics of semiconductor devices and communication systems.

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											1
3	2		2											1
4	3	3	3											1
5	3	3	3											1

UNIT I **7 Hours**

ELECTRIC CIRCUITS

Definition of Voltage, Current, Electromotive force, Resistance, Power & Energy, Ohms law and Kirchoffs Law & its applications - Series and Parallel circuits - Voltage division and Current division techniques - Generation of alternating emf - RMS value, average value, peak factor and form factor- Definition of real, reactive and apparent power.

UNIT II **5 Hours**

DC MACHINES

Introduction of magnetic circuits - Law of Electromagnetic induction, Flemings Right & Left hand rule- Types of induced emf - Definition of Self and Mutual Inductance - DC Motor- Contruction - Working Principle- Applications.

UNIT III **6 Hours**

AC MACHINES

Single Phase Transformer - Alternator - Three phase induction motor - Single phase induction motor - Contruction - Working Principle - Applications.

UNIT IV **5 Hours**

ELECTRICAL DRIVES

Speed control of dc shunt motor and series motor - Armature voltage control - Flux control - Construction and operation of DC servo motor - Construction and operation of DC servo motor stepper motor.

UNIT V **7 Hours**

ELECTRON DEVICES AND COMMUNICATION

Characteristics of PN Junction diode and Zener diode - Half wave and Full wave Rectifiers - Bipolar Junction Transistor - Operation of NPN and PNP transistors - Logic gates - Introduction to communication systems.

FOR FURTHER READING

Voltage Regulator - Stepper motor - Energy meter - SMPS, Satellite and Optical communication.

4 Hours

EXPERIMENT 1

Analyze the VI characteristics of a fixed resistor and a lamp by varying its temperature.

3 Hours

EXPERIMENT 2

Apply the voltage division techniques for series and parallel connections of lamp loads.

3 Hours

EXPERIMENT 3

Apply the current division techniques for series and parallel connections of lamp loads.

4 Hours

EXPERIMENT 4

Understand the concept of electromagnetic induction using copper coil.

4 Hours

EXPERIMENT 5

Understand the construction and working principle of DC machines.

4 Hours

EXPERIMENT 6

Determine the VI Characteristics of PN Junction diode and plot the input and output wave shapes of a half wave rectifier.

4 Hours

EXPERIMENT 7

Realize the working of transistor as an electronic switch through experiments.

4 Hours

EXPERIMENT 8

Lighting applications using logic gates principle.

Total:30+30= 60 Hours

Reference(s)

1. T. K. Nagsarkar and M. S. Sukhija, Basic of Electrical Engineering, Oxford University Press, 2011.
2. Smarjith Ghosh, Fundamentals of Electrical and Electronics Engineering, Prentice Hall (India) Pvt. Ltd., 2010

3. A. Sudhakar, Shyammohan S Palli, Circuits and Networks Analysis and Synthesis, Tata McGraw Hill, 2010
4. R. S. Sedha, A Textbook of Applied Electronics, S.Chand & Company Ltd, 2013
5. Muthusubramanian & Salivahanan, Basic Electrical and Electronics Engineering and Communication Engineering, Seventh Edition, Tata MCGraw Hill Education Private Limited, 2011

19CT107 PC HARDWARE AND TROUBLESHOOTING 0 0 2 1

Course Objectives

- Understand the basic hardware components.
- Gain knowledge about installation of operating systems.
- Impart knowledge about hardware assembling and troubleshooting.

Course Outcomes (COs)

1. Identify the basic hardware components.
2. Install and configure Windows and Linux operating systems.
3. Install and configure software packages and drivers.
4. Assemble and troubleshoot hardware devices.
5. Install and work with office automation software.

Articulation Matrix

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

LIST OF EXPERIMENTS

1. Exploring the Functions and Components of a PC
2. Disassembling/Assembling the System Unit and Identifying Internal Components and Connections.
3. Exploring Motherboard Features with CPU
4. Install, upgrade and configure Windows operating systems.
5. Install and configure computer drivers and system components.
6. Install, upgrade and configure Linux operating systems.
7. Disk formatting, partitioning and Configuring the Command-Line Window
8. Remote desktop connections and file sharing.
9. Identify, install and manage network connections Configuring IP address and Domain name system
10. Installation Antivirus and configure the antivirus.
11. Installation of printer and scanner software.
12. Troubleshooting and Managing Systems

Total: 30 Hours

Reference(s)

1. Mike Meyers, “CompTIA A+® Guide to Managing and Troubleshooting PCs Lab Manual”, Fifth Edison,Tata McGraw-Hill, 2016.
2. Craig Zacker& John Rourke, “The complete reference: PC hardware”, Tata McGraw-Hill, 2017.
3. Mike Meyers, “Introduction to PC Hardware and Troubleshooting”, Tata McGraw-Hill, 2017.

19CT201 **ENGINEERING MATHEMATICS II** **3 1 0 4**

Course Objectives

- Understand the concepts of partial derivatives and multiple integrals to define the area, volume and extreme values of various surfaces in engineering fields.
- Classify the sequences and series in linear systems is convergent or divergent.
- Formulate the real time engineering problem into mathematical model using ordinary differential equation and solve it by appropriate method.

Course Outcomes (COs)

1. Illustrate the various parameters in partial differentiation and characterize the maxima and minima functions for signals and systems.
2. Apply multiple integral concepts to calculate the area and volume by appropriate vector integral theorems.
3. Analyse the convergence and divergence of sequences and series by various tests.
4. Construct first order differential equations from real time phenomena and solve it by suitable method.
5. Execute the appropriate method to solve the second order differential equations.

Articulation Matrix

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

UNIT I **9 Hours**

PARTIAL DIFFERENTIATION

Functions of several variables, plotting of 2-variable functions, introduction to cylindrical and spherical coordinates, chain rule, total differential, gradient, directional derivatives, normal lines and tangent planes, extreme of functions of two variables, applications.

UNIT II **9 Hours**

MULTIPLE INTEGRALS

Double integrals, regions of integrations, triple integrals, applications (Cartesian coordinates only-Greens theorem and Gauss Divergence theorem).

UNIT III **9 Hours**

SEQUENCES AND SERIES

Sequences and series, convergence and divergence of series, absolute convergence, conditional convergence, test for convergence and divergence. Power series for functions, interval of convergence, Taylor and Maclaurin series, Taylors Theorem with remainder.

UNIT IV **9 Hours**

FIRST ORDER DIFFERENTIAL EQUATIONS

Separable differential equations, homogeneous differential equations, exact differential equations, integrating factor, Bernoullis equation, applications

UNIT V **9 Hours**

SECOND ORDER DIFFERENTIAL EQUATIONS

Second order homogeneous and non-homogeneous equations with constant coefficients, variation of parameters, method of undetermined coefficients, series solutions of differential equations, applications.

FOR FURTHER READING

Applications of mass spring system in ordinary differential equations of higher order

Total:45+15= 60 Hours

Reference(s)

1. Finney RL, Weir MD and Giordano FR, Thomas Calculus, 10th edition, Addison-Wesley, 2001
2. Smith RT and Minton RB, Calculus, 2nd Edition, McGraw Hill, 2002.Kreysgiz E, Advanced Engineering Mathematics, 8th edition, John Wiley & Sons, 1999.
3. Ray Wylie and C Louis Barrett, Advanced Engineering Mathematics, Sixth Edition, Tata McGraw-Hill Publishing Company Ltd, 2003.
4. Peter V. O Neil , Advanced Engineering Mathematics, Seventh Edition , Cengage Learning India Private Limited, 2012.
5. Glyn James, Advanced Engineering Mathematics, Third Edition,Wiley India, 2014.

19CT202 ENGINEERING PHYSICS II 2 0 2 3

Course Objectives

- understand the applications of laser and fiber optics in the field of engineering
- impart knowledge in crystallography and semiconductors
- differentiate the different types of magnetic materials and their applications

Course Outcomes (COs)

1. Understand the principle, characteristics, different types of lasers and apply the same for optical data storage and retrieval techniques
2. Illustrate the propagation of light through different optical fibers, applications of optical fibers in communication and sensors
3. Identify the seven crystal systems, crystal planes and the stacking sequences in metallic crystal structures
4. Analyse the characteristics of semiconducting materials interms of crystal lattice, charge carriers and energy band diagrams
5. Outline the properties of magnetic materials, domain theory of ferromagnetism and the applications for recording and readout process

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
2	2	1						2	2	2				2
3	2	1						2	2	2				
4	2	1						2	2	2				2
5	2	1						2	2	2				2

UNIT I **7 Hours**

LASER

Principle - interaction of radiation with matter - characteristics of laser radiation - pumping mechanisms - types: CO2 laser- homo junction GaAs laser -applications: optical data storage and retrieval techniques - holography: principle -types - comparison of holography with photography - construction - reconstruction of hologram - applications

UNIT II **7 Hours**

FIBER OPTICS

Principle- conditions to achieve total internal reflection- structure- acceptance angle and numerical aperture (qualitative treatment only)- types- modes of propagation- refractive index profile- block diagram of fiber optic communication system - Visible light communication system - fiber optic sensors- intensity modulated sensor - Displacement and pressure sensors -endoscopy - merits of fiber cables over conventional communication systems

UNIT III **5 Hours**

CRYSTAL PHYSICS

Crystalline and amorphous materials - lattice -lattice point -basis - unit cell - crystal systems - Bravais lattices -planes in crystals- Miller indices -procedure for finding Miller indices- important features of Miller indices- unit cell characteristics of SC, BCC, FCC and HCP structures - crystal growth techniques

UNIT IV **6 Hours**

SEMICONDUCTING MATERIALS

Characteristics -elemental and compound semiconductors - energy band description and current conduction in intrinsic semiconductors- energy band description of n-type and p-type semiconductors- conductivity of extrinsic semiconductors - variation of Fermi level with temperature and impurity concentration- temperature dependence on carrier concentration - Hall effect-applications - solar cells - photodiodes

UNIT V **5 Hours**

MAGNETIC MATERIALS

Fundamental definitions -Bohr magneton- classification of dia, para and ferromagnetic materials - domain theory - hysteresis curve - soft and hard magnetic materials -energy product and its importance - anti-ferromagnetic materials - ferrites -giant magneto resistance (GMR) effect -application: Principles of Magnetic Recording- Magnetic Digital Recording- Magneto-Optic Recording

EXPERIMENT 1 **2 Hours**

Exposure to Engineering Physics Laboratory and precautionary measures

EXPERIMENT 2 **4 Hours**

Determine the wavelength of given laser source by applying the principle of diffraction

EXPERIMENT 3 **4 Hours**

Determination of acceptance angle and numerical aperture of a given fiber

EXPERIMENT 4 **4 Hours**

Evaluation of bandgap of given material using bandgap kit.

EXPERIMENT 5 **4 Hours**

Determine the V-I characteristics of a solar cell

EXPERIMENT 6 **4 Hours**

Using Hall effect, determine the nature of given material

EXPERIMENT 7 **4 Hours**

Find the refractive index of a transparent solid with the aid of travelling microscope

EXPERIMENT 8 **4 Hours**

Determination of energy loss per cycle of a ferromagnetic material using hysteresis curve

Total:30+30= 60 Hours

Reference(s)

1. Balasubramaniam, R. Callisters Materials Science and Engineering. Wiley India Pvt.Ltd, 2014
2. Kasap, S.O. Principles of Electronic Materials and Devices McGraw-Hill Education,2017.
3. Wahab, M.A. Solid State Physics: Structure and Properties of Materials Alpha Science International Ltd., 2017
4. Donald A. Neamen. Semiconductor Physics and Devices, McGraw-Hill, 2011.
5. K. Thiyagarajan and A. K. Ghatak, LASERS: Fundamentals and Applications, Springer, USA, 2015
6. B.D. Cullity, Introduction to Magnetic Materials, Addison-Wesley

19CT203 ENGINEERING CHEMISTRY II 2 0 2 3

Course Objectives

- Classify the traditional and advanced materials used to manage heat developed in electronic devices
- Summaries the terminologies of electrochemistry and explain the applications of energy storage devices for computers
- Indicate the types, properties and applications of nanochips and carbon nanotubes used in electronic devices
- Outline sources of e-wastes and its effects on environment and its management

Course Outcomes (COs)

1. compare the metals and alloys used as thermal management materials in electronic devices
2. interpret the advanced thermal management materials for microelectronics and optoelectronics
3. analyze the importance of primary, secondary batteries and fuel cells used in energy storage devices in computers
4. identify suitable nanomaterial used for diverse applications in electronic devices
5. select a suitable technology to manage e-wastes from various electronic devices

Articulation Matrix

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

UNIT I 6 Hours

THERMAL MANAGEMENT MATERIALS

Heat Generation – purpose - classification of electronic packaging –- types of thermal management materials - traditional thermal management materials : metals [Cu, Al, W and Mo] – compounds [Al_2O_3, BeO, AlN, SiC and Kovar Alloy]

UNIT II 6 Hours

ADVANCED THERMAL MANAGEMENT MATERIALS

Alloys : W-Cu, Mo-Cu, Cu/MoCu/Cu, AlSiC, Cu/SiC and W85-Cu. fiber-reinforced material - sandwich structure of composite – thermal management materials for microelectronics and optoelectronics: carbon nanotubes and aluminium/diamond composites

UNIT III **6 Hours**

ENERGY STORAGE DEVICES FOR COMPUTERS

Cell – cell potential – determination of potential. Batteries –types: primary battery [Zinc-carbon]. Secondary battery: lead-sulphur. Modern battery: lithium polymer battery and fuel cells.

UNIT IV **6 Hours**

NANOMATERIALS

Nano chips – types of material - properties - applications. Carbon nanotubes, fullerene, graphene: types and applications

UNIT V **6 Hours**

E - WASTE MANAGEMENTS

Sources – toxicity due hazardous substances – impact to environment. E-waste management- Hazardous materials recycling (Gallium, Arsenic, etc.,).

EXPERIMENT 1 **6 Hours**

Determination of thermal stability of aluminium oxide using thermo gravimetric analysis

EXPERIMENT 2 **6 Hours**

Determination of thermal stability of copper alloys using thermo gravimetric analysis

EXPERIMENT 3 **6 Hours**

Determination of single electrode potential of zinc and copper electrodes 6 Hours

EXPERIMENT 4 **6 Hours**

Preparation of cadmium nanoparticles and its characterization

EXPERIMENT 5 **6 Hours**

Estimation of chromium and lead content in sample solution prepared from E-Waste [PCB] using spectrophotometer

Total: 30+30=60 Hours

Reference(s)

1. Ravi Kandasamy, Arun S. Mujumdar. Thermal Management of Electronic Components. Lap Lambert Academic Publishing GmbH KG, 2010.
2. Guosheng Jiang, Liyong Diao, Ken Kuang. Advanced Thermal Management Materials. Springer Science & Business Media, 2012.
3. Nihal Kularatna. Energy Storage Devices for Electronic Systems: Rechargeable Batteries and Supercapacitors. Academic Press, 2014.
4. Odne Stokke Burheim. Engineering Energy Storage. Academic Press, 2017.
5. M. S. Dresselhaus, G. Dresselhaus, P. C. Eklund. Science of Fullerenes and Carbon Nanotubes: Their Properties and Applications. Elsevier, 1996.
6. Kazuyoshi Tanaka, S. Iijima. Carbon Nanotubes and Graphene. Edition 2, Newnes, 2014.

19CT204 PROBLEM SOLVING AND PROGRAMMING USING PYTHON 3 0 2 4

Course Objectivs

- Design, write, debug and run python programs using IDE tools
- Develop applications to manipulate the data available in list and set
- Develop applications to manipulate files

Course Outcomes (COs)

1. Implement simple python programs using input output operations.
2. Develop python programs using expressions and statements.
3. Implement python programs using control flow statements and strings.
4. Apply the concepts of functions and files in python programming.
5. Design applications using list, sets, tuples and dictionaries in python.

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	2		3	
2	2	3		3			2		2	2	2		3	
3	2	3		3			2		2	2	2		3	
4	2	3		3			2		2	2	2		3	
5	2	3		3			2		2	2	2		3	

UNIT I **9 Hours**

THEORY COMPONENT CONTENTS BASICS OF PYTHON PROGRAMMING

Introduction-Python interpreter- interactive and script mode; values and types, operators, expressions, statements, precedence of operators, Multiple assignments, comments.

UNIT II **9 Hours**

CONTROL STATEMENTS AND FUNCTIONS IN PYTHON

Conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, Break, continue, pass; Functions: Introduction, inbuilt functions, user defined functions, passing parameters, return values, recursion.

UNIT III **9 Hours**

DATA STRUCTURES: STRINGS, LISTS, SET

Strings: string slices, immutability, string methods and operations; Lists: creating lists, list operations, list methods, mutability, aliasing, cloning lists, list and strings, list and functions ; list processing : list comprehension, searching and sorting, Sets: creating sets, set operations.

9 Hours

UNIT IV

DATA STRUCTURES: TUPLES, DICTIONARIES

Tuples: Tuple assignment, Operations on Tuples, lists and tuples, Tuple as return value; Dictionaries: operations and methods, Nested Dictionaries.

9 Hours

UNIT V

FILES, MODULES, PACKAGES

Files and exception: text files, reading and writing files, format operator, exception handling, modules, packages.

2 Hours

EXPERIMENT 1

Programs using expressions and input and output statements.

2 Hours

EXPERIMENT 2

Programs using operators and built in functions.

2 Hours

EXPERIMENT 3

Programs using conditional statements.

2 Hours

EXPERIMENT 4

Programs performing all string operations.

2 Hours

EXPERIMENT 5

Programs using functions

2 Hours

EXPERIMENT 6

Programs to find square root, GCD, exponentiation, sum an array of numbers

2 Hours

EXPERIMENT 7

Programs to perform linear search, binary search

2 Hours

EXPERIMENT 8

Programs to perform operations on list

2 Hours

EXPERIMENT 9

Programs using dictionary and set

2 Hours

EXPERIMENT 10

Programs to work with Tuples.

2 Hours

EXPERIMENT 11
Programs to sort elements (Selection, Insertion, Merge, Quick)

2 Hours

EXPERIMENT 12
Program to perform word count in file.

2 Hours

EXPERIMENT 13
Program to perform file operations

2 Hours

EXPERIMENT 14
Program to count the number of characters, words and lines in a text file

2 Hours

EXPERIMENT 15
Programs using modules and packages

Total:45+30= 75 Hours

Reference(s)

1. Ashok NamdevKamthane,Amit Ashok Kamthane, Programming and Problem Solving with Python , Mc-Graw Hill Education,2018.
2. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, Second edition, Updated for Python 3, Shroff / O'Reilly Publishers, 2016
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
4. Timothy A. Budd, Exploring Python, Mc-Graw Hill Education (India) Private Ltd., 2015.
5. Kenneth A. Lambert, Fundamentals of Python: First Programs, CENGAGE Learning, 2012.
6. Charles Dierbach, Introduction to Computer Science using Python: A Computational Problem Solving Focus, Wiley India Edition, 2013.

19CT206 DIGITAL SYSTEM DESIGN 3 0 2 4

Course Objectives

- Understand the fundamentals of digital logic
- Understand the implementation of logic circuits.
- Analyse and design various combinational and sequential circuits.

Course Outcomes (COs)

1. Understand the boolean algebra and logic gates.
2. Design and analyze combinational circuits.
3. Implement synchronous sequential logic
4. Understand the procedures in Asynchronous sequential logic
5. Implement the design with MSI devices

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	2	3											2
3	2	2	3											2
4	2	1	1											2
5	2	2	3											2

UNIT I **9 Hours**

BOOLEAN ALGEBRA AND LOGIC GATES

Number systems and conversions - Boolean algebra - Minterm - Maxterm - SOP and POS forms - NAND and NOR implementation - Simplification of Boolean functions: K Map - Don't care conditions - Five variable K map - Quine Maccluskey method - Logic gates.

UNIT II **9 Hours**

COMBINATIONAL LOGIC

Combinational circuits - Analysis procedures - Design procedures - Adders - Subtractors - Binary adder - Carry Look Ahead Adder - BCD Adder - Magnitude comparator - Code Converters - Multiplexers and Demultiplexers- Function realization using multiplexers - Decoders and encoders.

UNIT III **10 Hours**

SYNCHRONOUS SEQUENTIAL LOGIC

Sequential circuits - Flip flops - Flip Flop Conversion - Analysis procedures - Design procedures - Moore and Mealy models - State reduction and state assignment - Shift Registers - Counters.

UNIT IV **10 Hours**

ASYNCHRONOUS SEQUENTIAL LOGIC

Design of Asynchronous sequential circuits - Analysis procedure: Transition Table - Flow Table - Race Condition- stability, Design Procedure: Primitive Flow Table- Reduction- Transition Table- Race Free State Assignment- Hazards

UNIT V **7 Hours**

DESIGN WITH MSI DEVICES

Programmable Logic Devices (PLD) - Programmable Logic Array (PLA) - Programmable Array Logic (PAL) - Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using ROM, PLA, PAL

FOR FURTHER READING

Design of a simple CPU - ASM charts - Hardware Description Language - RTL Design

EXPERIMENT 1 **2 Hours**

Implement Boolean Laws using Logic Gates

EXPERIMENT 2 **4 Hours**

Implement arithmetic circuits (Adder, Subtractor)

EXPERIMENT 3 **2 Hours**

Construct Code convertors (BCD, Gray, Excess -3)

EXPERIMENT 4 **4 Hours**

Construct Parity generator and parity checker

EXPERIMENT 5 **2 Hours**

Construct Magnitude comparator

EXPERIMENT 6 **4 Hours**

Demonstrate Multiplexer and Demultiplexers

EXPERIMENT 7 **2 Hours**

Function realization using multiplexers

EXPERIMENT 8 **4 Hours**

Demonstrate Encoder and Decoder

EXPERIMENT 9 **2 Hours**

Construct synchronous and Ripple counter

EXPERIMENT 10 **4 Hours**

Implement shift register (SISO, SIPO, PISO, PIPO)

Total: 45+30=75 Hours

Reference(s)

1. M.Morris Mano and Michael D Ciletti, Digital Design with an introduction to the VHDL, Pearson Education, 5th Edition, 2013
2. A Anand Kumar, Fundamentals of Digital Circuits, 3rd Edition,2014
3. Charles H.Roth, Jr., Fundamentals of Logic Design, 4th Edition, Jaico Publishing House, 2000
4. Mandal, Digital Electronics Principles & Application, McGraw Hill Edu, 2013.
5. Donald D.Givone, Digital Principles and Design, Tata McGraw-Hill, 2003.
6. John M.Yarbrough, Digital Logic, Application & Design, Thomson, 2002.

18CT207 **ENGINEERING GRAPHICS** **1 0 4 3**

Course Objectives

- Provide knowledge on projection of points and lines.
- Impart skill in drawing projection of simple solids.
- Familiarize creation of orthographic views from isometric projections of simple solids and vice versa.
- Build the proficiency to create two dimensional sketches using software.
- Provide the skill to build three dimensional models and its orthographic views using software.

Course Outcomes (COs)

1. Illustrate the projection of points and lines in different quadrants.
2. Construct orthographic projections of simple solids.
3. Create the orthographic and isometric projections of simple solids.
4. Sketch the two dimensional views of engineering components using software.
5. Construct three dimensional models of engineering components and its orthographic views using software.

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				
4	2							2		2				
5	2							2		2				

UNIT I **3 Hours**

PROJECTION OF POINTS AND LINES

Practices on lettering, numbering and dimensioning of drawings. Principles of projection, Projection of points in four quadrants, first angle projection of straight lines - parallel, perpendicular and inclined to anyone plane.

UNIT II **3 Hours**

PROJECTION OF SOLIDS

Orthographic projection of simple solids - parallel, perpendicular and inclined to one plane using change of position method.

UNIT III **3 Hours**

ISOMETRIC AND PERSPECTIVE PROJECTION

Conversion of isometric to orthographic projection and vice versa. Perspective projection of simple solids.

UNIT IV **3 Hours**

CREATION OF 2D SKETCHES USING SOFTWARE

Sketch Entities Ã¢?? line, circle, arc, rectangle, slots, polygon, text, snap, and grid. Sketch Tools-fillet, chamfer, offset, convert entities, trim, extend, mirror, move, copy, rotate, scale, stretch, sketch pattern. Geometrical constraints, Dimensioning - smart, horizontal, vertical, ordinate

UNIT V **3 Hours**

PART MODELING AND DRAFTING USING SOFTWARE

Part Modeling - extrude, cut, revolve, creation of planes, fillet, chamfer, shell, rib, pattern, mirror, loft, draft and swept. Drafting - Converting 3D models to orthographic views with dimensions.

EXPERIMENT 1 **12 Hours**

Create 2D sketch of different components used in engineering applications.

EXPERIMENT 2 **12 Hours**

Create part model of a component from given isometric drawings.

EXPERIMENT 3 **12 Hours**

Create part model of a component from given orthographic views.

EXPERIMENT 4 **12 Hours**

Create an assembly model of product from detailed parts drawing.

EXPERIMENT 5 **12 Hours**

Create stl file from CAD model, transfer file to 3D printer, setup the machine parameters, build and post process the component using Additive Manufacturing Technology.

Total:15+60= 75 Hours

Reference(s)

1. K Venugpoal, Engineering Drawing and Graphics, Third edition, New Age International,2005.
2. BasantAgrawal, Mechanical drawing, Tata McGraw-Hill Education, 2008.
3. Engineering Drawing Practice for Schools & Colleges, Bureau of Indian Standards-Sp46,2008.
4. N. D. Bhatt and V. M. Panchal, Engineering Drawing, Charotar Publishing House Pvt. Limited, 2008.
5. K.V. Natarajan, A Text Book of Engineering Graphics, Dhanalakshmi Publishers, 2013.

19CT301 ENGINEERING MATHEMATICS III 3 1 0 4

Course Objectives

- Interpret the introductory concepts of Logic, which will enable them to model and analyze physical phenomena involving continuous changes of variables
- Implement the definitions of relevant vocabulary from graph theory and Combinatory and be able to perform related calculations.
- Summarize and apply the methodologies involved in solving problems related to fundamental principles of polynomial equations and Implement the mathematical ideas for interpolation numerically.

Course Outcomes (COs)

1. Interpret the concepts of direct proof, indirect proof and proof by contradiction and verify the validity of an argument using propositional and predicate logic.
2. Apply graph theory models of data structures and state machines to solve problems of connectivity and constraint satisfaction.
3. Demonstrate the equations into Algebraic, Transcendental or simultaneous and apply the techniques to solve them numerically and implement an appropriate numerical method for interpolation.
4. Apply numerical computational techniques to obtain the solutions of first order ordinary differential equations, numerically
5. Develop the identification of Numerical errors arise during computations due to round-off errors and truncation errors.

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 12 Hours

LOGIC

Propositional Logic- Truth tables- Tautologies and Contradictions- Rules of inference- Predicate Logic.

UNIT II 10 Hours

SET THEORY AND GRAPHS

Sets: Relations- Equivalence relations- Functions- Graphs: Graph- Isomorphism- connected graphs Trees- Shortest path problem

UNIT III **9 Hours**

NUMERICAL SOLUTION OF LINEAR EQUATIONS AND INTERPOLATION

Algebraic and transcendental equations: Newton - Raphson method - Solution of system of linear equations: Gauss elimination method - Matrix inversion: Gauss- Jordan method - Eigen value of a matrix by power method-Polynomial interpolation and cubic spline interpolation.

UNIT IV **10 Hours**

NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS

Single and multi-variable nonlinear equations- convergence of fixed point iterations- Least squares approximation- Normal equations- Single step methods- Runge-Kutta methods- Multi-step methods- Finite Difference Methods

UNIT V **4 Hours**

ERROR ANALYSIS

Errors- Truncation and round off errors- measurement errors- Chebychev Polynomial and data filtering.

Total:45+15=60 Hours

Reference(s)

1. Greenberg Michael D,Advanced Engineering Mathematics, Prentice-Hall International Inc, 1998.
2. James Glyn, Advanced Modern Engineering Mathematics, Addison-Wesley, 1993.
3. Kreyszig Erwin, Advanced Engineering Mathematics, 7th Edition, John Wiley, 1993
4. Kenneth H Rosen, Discrete Mathematics and its Applications with Combinatorics and Graph Theory, Seventh Edition, Seventh Edition, Mc Graw Hill Education India Private Limited, New Delhi, 2013.
5. An Introduction to Error Analysis: The Study of Uncertainties Measurements, John R. Taylors University of Science Books, 1996.

19CT302 COMPUTER ORGANIZATION AND ARCHITECTURE 3 0 0 3

Course Objectives

- Understand of the basic structure and operation of a digital computer
- Impart knowledge about the operation of the arithmetic unit including the algorithms & implementation addition, subtraction, multiplication & division.
- Acquire knowledge about the diverse ways of communicating with I/O devices and standard I/O Interfaces

Course Outcomes (COs)

1. Identify the basic structure of a digital computer and instruction sets with addressing modes
2. Comprehend the arithmetic operations of binary number system.
3. Recognize the organization of the basic processing unit and examine the basic concepts of pipe- lining
4. Explicate the standard I/O interfaces and peripheral devices
5. Determine the performance of different types of memory

Articulation Matrix

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

UNIT I **9 Hours**

STRUCTURE OF COMPUTERS

Functional units-Basic operational concepts-Bus structures-Software-performance-Memory locations and addresses- Memory operations- Instruction and instruction sequencing- Addressing modes- Basic I/O operations

UNIT II **9 Hours**

ARITHMETIC OPERATIONS

Addition and subtraction of signed numbers- Design of fast adders- Multiplication of positive numbers- Signed operand multiplication and fast multiplication-Integer division

UNIT III **11 Hours**

BASIC PROCESSING UNIT

Fundamental concepts-Execution of a complete instruction-Multiple bus organization-Hardwired control- Microprogrammed control-Pipelining: Basic concepts-Data hazards-Instruction hazards-Influence on Instruction sets-Data path and control consideration-Superscalar operation

UNIT IV **8 Hours**

INPUT/OUTPUT ORGANIZATION

Accessing I/O devices - Interrupts - Direct Memory Access-Buses - Interface I/O-Interfaces (PCI, SCSI, USB)

UNIT V **8 Hours**

MEMORY UNIT

Basic concepts - Semiconductor RAMs-ROM's-Speed-size and cost-Cache memories-Performance consideration-Virtual memory-Memory Management requirements-Secondary storage.

FOR FURTHER READING

Categories of Instruction Set Architectures (ISA)- Multistage pipelines with variable latencies-branch prediction- Very large Instruction Word (VLIW) architectures- Instruction Level Parallelism (ILP)- Examples of modern processors- Hyper threading (HT)- Simultaneous Multithreading (SMT)- Multicore chips (Chip Multiprocessing)

Total: 45 Hours

Reference(s)

1. CarlHamacher, Zvonko Vranesicand Safwat Zaky, Computer Organization, McGraw-Hill, Third Reprint2015
2. William Stallings,Computer Organization and Architecture Designing for Performance, Pearson Education,2003
3. DavidA, Pattersonand JohnL, Hennessy, Computer Organization and Design: The hardware/software interface, MorganKaufmann,4th edition, 2014.
4. John P.Hayes, Computer Architecture and Organization, McGraw Hill,3rd edition, 2002.

19CT303 DATA STRUCTURES AND ALGORITHMS 3 0 0 3

Course Objectives

- Implement abstract data types for linear data structures.
- Apply the different linear and non-linear data structures to problem solutions.
- Critically analyze the various sorting algorithms.

Course Outcomes (COs)

1. Identify the basic concept of data structure and identify the need for list data structures and its operations
2. Exemplify the concept of stacks and queues with suitable applications.
3. Classify the types of tree data structures and explain its functionalities.
4. Outline the concept of graph data structures with examples.
5. Design the algorithms for searching and sorting techniques

Articulation Matrix

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

UNIT I 9 Hours

LINEAR DATA STRUCTURES - LIST

Pseudo code-Algorithm efficiency -Designing recursive algorithms - Recursive examples. - Abstract Data Types (ADTs) - List ADT - array-based implementation - linked list implementation -singly linked lists- circularly linked lists- doubly-linked lists -applications of lists -Polynomial Manipulation -All operations (Insertion, Deletion, Merge, Traversal).

UNIT II 9 Hours

LINEAR DATA STRUCTURES - STACKS, QUEUES

Stack ADT - Operations - Applications - Evaluating arithmetic expressions- Conversion of Infix to postfix expression - Queue ADT - Operations - Circular Queue - Priority Queue- deQueue -applications of queues.

UNIT III 9 Hours

NON LINEAR DATA STRUCTURES - TREES

Tree ADT - tree traversals - Binary Tree ADT - expression trees - applications of trees - binary search tree ADT - AVL Trees - B-Tree - Heap - Applications of heap.

UNIT IV **9 Hours**

NON LINEAR DATA STRUCTURES - GRAPHS

Definition - Representation of Graph - Types of graph - Breadth-first traversal - Depth-first traversal - Topological Sort - Shortest Path Algorithms: Unweighted Shortest Paths - Dijkstra's Algorithm. Minimum Spanning Tree: Prim's Algorithm Kruskal's Algorithm.

UNIT V **9 Hours**

SEARCHING, SORTING AND HASHING TECHNIQUES

Searching- Linear Search - Binary Search. Sorting - Bubble sort - Selection sort - Insertion sort – Shell sort - Radix sort. Hashing- Hash Functions - Separate Chaining - Open Addressing - Rehashing - Extendible Hashing.

FOR FURTHER READING

Applications of list - Red-Black trees - Splay trees- Bucket hashing - Introduction to NP Completeness

Total: 45 Hours

Reference(s)

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

19CT304 DATABASE TECHNOLOGY 3 0 0 3

Course Objectives

- Understand the data models, conceptualize and depict a database system using E-R diagram.
- Gain knowledge on the design principles of a relational database system and SQL.
- Impart knowledge in transaction processing, concurrency control and recovery techniques.

Course Outcomes (COs)

1. Differentiate database systems from file system by understanding the features of database system and design a ER model for a database system.
2. Develop solutions to a broad range of query and data update problems using relational algebra, relational calculus and SQL.
3. Apply the normalization theory in relational databases for removing anomalies.
4. Compare database storage and access techniques for file organization, indexing methods and Query Processing.
5. Analyze the basic issues of transaction processing, concurrency control, deadlock and its recovery schemes

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	2	3		2								3	
3	2	3											2	
4	2	3											2	
5	1	3	2										2	

UNIT I **8 Hours**

INTRODUCTION

Introduction: Database system application, purpose of database system View of Data - Database Languages-Data Storage and Querying-Database Architecture - Database design and ER model: Overview of the design process-The ER Model - Constraints - Removing redundant attributes in Entity Sets-ER Diagram - Reduction to Relational Schemas - ER Design Issues.

UNIT II **9 Hours**

RELATIONAL MODEL AND DATABASE DESIGN

Introduction to Relational Model - Formal Relational Query Languages - Introduction to SQL: Data definition - Basic structure of SQL Queries - Additional Basic operations - Set operations - Aggregate Functions Nested Sub Queries - Intermediate SQL: Joins – Views - Integrity Constraints.

UNIT III **8 Hours**

NORMAL FORMS

Functional Dependencies - Normal Forms Based on primary Keys-General Definition of Second and Third Normal Form - Boyce Codd Normal Form - Multi valued dependencies and Fourth Normal Form.

UNIT IV **9 Hours**

DATA STORAGE AND QUERY PROCESSING

Overview of Physical Storage Media - Magnetic disk Flash storage -RAID-File and Record Organization -Indexing and Hashing: Ordered Indices - B+Tree Index File-Static Hashing - Dynamic Hashing-Query Processing: Overview-measures of Query Cost.

UNIT V **11 Hours**

TRANSACTION MANAGEMENT

Transactions: Transaction concept-Transaction Atomicity and Durability-Transaction Isolation- Serializability - Transaction Isolation and Atomicity - Transaction Isolation levels-Implementation of Isolation Levels - Concurrency Control: Lock based protocols - Deadlock handling-Time stamp based protocols-Recovery system: Failure classification -Storage-Recovery and atomicity.

FOR FURTHER READING

Introduction to Parallel, Distributed and Object Oriented Databases- Introduction to MySQL and PHP.

Total: 45 Hours

Reference(s)

1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts, McGraw - Hill, 2015
2. Ramez Elmasri and Shamkant B. Navathe, Fundamental Database Systems,Pearson Education, 2008
3. Raghu Ramakrishnan, Database Management System, Tata McGraw-Hill Publishing Company, 2003
4. C.J.Date,An Introduction to Database system, Pearson Education, 2006
5. Peter Rob and Corlos Coronel, Database System, Design, Implementation and Management, Thompson Learning Course Technology, 2003

19CT305 OPERATING SYSTEMS 3 1 0 4

Course Objectives

- To make the students to learn different types of operating systems along with the components and services provided.
- To understand the concept of process management and implementation of process scheduling in a multi-programming environment using scheduling algorithms.
- To provide knowledge on the structure and operations of memory management and storage management.

Course Outcomes (COs)

1. Describe the evolution of operating systems over time from primitive batch systems to sophisticated multi-user systems and implement the usage of different system calls to manage the resources.
2. Analyze the process scheduling algorithms used in a multi-programming environment and explore interprocess communication using shared memory and message passing.
3. Analyze the activities of process synchronization and deadlock towards increasing the throughput of the system.
4. Select the memory-management method for a specific system depends on the hardware design and explore the various memory management techniques of allocating memory to processes.
5. Suggest an appropriate file system and disk organizations methods for a computing and storage scenario.

Articulation Matrix

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

UNIT I **10 Hours**

INTRODUCTION

Components of Computer System - Evolution of operating System. Operating System Components & Services: Process management -Memory Management- Storage Management - Protection & Security - Operating System Services. Computing Environments-Open source operating systems -System Calls & System programs

UNIT II **9 Hours**

PROCESS MANAGEMENT

Process Concepts: The process - Process State - Process Control Block. Process Scheduling: Scheduling Queues -Scheduler - Context Switch. Operations on Processes - Process creation - Process Termination - Cooperating Processes. Interprocess Communication. CPU Scheduling: Basic Concepts - Scheduling Criteria - Scheduling Algorithms.

UNIT III **9 Hours**

PROCESS SYNCHRONIZATION AND DEADLOCK

Process Synchronization: The Critical-Section Problem - Synchronization Hardware - Semaphores - Classic problems of Synchronization. Deadlock: System Model - Deadlock Characterization - Methods for handling Deadlocks –Deadlock Prevention - Deadlock avoidance - Deadlock detection - Recovery from Deadlocks.

UNIT IV **9 Hours**

MEMORY MANAGEMENT

Address Binding - Logical Versus Physical Address Space - Swapping- Contiguous Memory allocation – Fragmentation- Paging - Segmentation. Virtual Memory: Demand Paging - Page Replacement Algorithms - Allocation of frames-Thrashing.

UNIT V **8 Hours**

STORAGE MANAGEMENT

File Management: File Concept - Access Methods - Directory and Disk Structure - File System Mounting- File Sharing. File System Implementation: File system structure - Directory implementation- Allocation Methods - Free-space Management. Secondary Storage Structure: Disk Structure - Disk Scheduling - Disk Management.

FOR FURTHER READING

Case Studies: The Linux System, Windows 7, Influential Operating Systems

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. td, 2014
3. William Stallings, Operating System, Seventh Edition Prentice Hall of India, 2012
4. Harvey M. DeitelM ,Operating Systems, Pearson Education Pvt. Ltd, 2007

19CT306 JAVA PROGRAMMING 2 0 4 4

Course Objectives

- Understand the basic features of OOP in Java
- Summarize the types of Inheritance supported by Java
- Recognize the multithreading process supported by Java

Course Outcomes (COs)

1. Interpret the basic structure of Java program.
2. Implement various types of inheritance and packages under different accessibility
3. Describe the concept of interfaces, exceptions and multithreading nature of Java.
4. Develop applications in Java with files and Strings handling
5. Design desktop based java applications using Java Applet, AWT and its components

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	
3	2	2	2										2	
4	1	2	1										1	
5	2	2	2										2	

UNIT I 6 Hours

JAVA BASICS

The Genesis of Java - Overview of Java - Data Types, Variables, and Arrays - Operators – Control Statements - Introducing Classes - Methods and Classes. I/O Basics - Reading Console Input –Writing Console output.

UNIT II 6 Hours

INHERITANCE AND PACKAGES

Inheritance: Basics - Using Super - Creating a Multilevel Hierarchy - Method overriding - Using Abstract Classes - Packages and Interfaces: Packages - Access Protection - Importing Packages

UNIT III 6 Hours

INTERFACES, EXCEPTIONS AND THREAD

Interfaces Definitions and Implementations - Exception Handling: Types - Try and Catch - Throw - Multi-threaded Programming: Creating Threads - Inter Thread Communication

UNIT IV **6 Hours**

STRING HANDLING AND FILES

File - The Byte Streams - The Character Streams - Using Stream I/ O - Serialization. String Handling: Special String operations and Methods - String Buffer - Exploring java.lang: Simple type Wrappers - System - Math - Utility Classes: String Tokenizer - Date and Time - Collection Interfaces –Collection Classes

UNIT V **6 Hours**

APPLETS, EVENT HANDLING AND AWT

Applet Basics - Applet Architecture - Applet Display Methods - Event Handling Mechanisms – Event Classes - Event Listener - Working with Windows, Graphics, Colors and Fonts - AWT Controls - Layout Managers and Menus - JDBC Concepts

FOR FURTHER READING

Spring framework - Container concepts - DAO Support and JDBC Framework - An introduction to Hibernate 3.5 - Integrating and configuring Hibernate - Building a Sample Application

EXPERIMENT 1 **6 Hours**

Program on Classes and Method

EXPERIMENT 2 **4 Hours**

Implementation of Inheritance

EXPERIMENT 3 **6 Hours**

Implementation of Interfaces and Packages

EXPERIMENT 4 **6 Hours**

Implementation of Multithreaded Programming

EXPERIMENT 5 **4 Hours**

Develop a program to implement String Handling Methods

EXPERIMENT 6 **4 Hours**

Implementation of Exception handling mechanisms

EXPERIMENT 7 **6 Hours**

Implementation of Collections Interfaces and Classes

EXPERIMENT 8 **4 Hours**

Implementation of I/O Streams

EXPERIMENT 9 **4 Hours**

Implementation of Applet Programs

EXPERIMENT 10 **6 Hours**
Implementation of AWT controls

EXPERIMENT 11 **4 Hours**
Write a program to implement Event classes

EXPERIMENT 12 **6 Hours**
Implementation of JDBC concepts

Total:30+60=90 Hours

Reference(s)

1. Herbert Schildt, Java 2-Complete Reference, Tata Mc Graw Hill, 2015
2. Deitel & Deitel, Java How to Program, Prentice Hall of India, 2010
3. Gary Cornell and Cay S.Horstmann, Core Java Vol.1 and Vol.2, Sun Microsystems Press, 2008
4. Jeff Linwood and Dave Minter, Beginning Hibernate Second Edition, Apress 2010
5. Rod Johnson, Juergen Hoeller, Alef Arendsen, Thomas Risberg, Colin Sampaleanu, Java Development with the Spring Framework, Wiley-India, 2012

19CT307 DATA STRUCTURES AND ALGORITHMS LABORATORY 0 0 4 2

Course Objectives

- Understand the principles of linear and non linear data structures.
- Build an applications using sorting and searching.

Course Outcomes (COs)

1. Implement the concept of recursion using C programs.
2. Implement C programs to illustrate linear data structures.
3. Develop C programs to implement nonlinear data structures.

Articulation Matrix

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

EXPERIMENT 1 **4 Hours**

Program to Solve Tower-of-Hanoi Problem using Recursion

EXPERIMENT 2 **4 Hours**

a) Program to implement a Stack ADT using array and write the routine for push operation which represent a function PUSH(X, S), Check for the condition whether S-full or not, if yes display the message otherwise insert the elements into the Stack. Perform POP operation which represents a function POP(S), Check for the condition whether S-Empty, if stack is empty, display the message otherwise delete an element from the Stack. Test your program with at least 5 elements and provide the output.

b) Program to implement the Queue ADT using array and write the routine to enqueue an element X into queue, Check for the conditions Q-full, if yes display the message otherwise insert the data into the queue and dequeue an element from queue, check for the conditions Q-empty, if yes display the message otherwise deleting the element from the queue and display the elements from the Queue ADT. Test your program with at least 6 elements and provide the output

EXPERIMENT 3 **6 Hours**

Linked List Implementation of stack and queue.

EXPERIMENT 4 **4 Hours**

Write a function program to perform the following operations on a singly linked list

i. Create a list

ii. Insert an element to the list

iii. Delete the maximum element from the list iv. Arrange the list as sorted order

v. Display the elements of the list

Write a main method to demonstrate the above functionalities.

EXPERIMENT 5 **4 Hours**

Write a function program to perform the following operations on a doubly linked list

i. Create a list

ii. Insert an element to the list

iii. Delete the maximum element from the list iv. Arrange the list as sorted order

v. Display the elements of the list

Write a main method to demonstrate the above functionalities.

EXPERIMENT 6 **4 Hours**

Program to sort the elements in ascending order using selection sort and bubble sort

EXPERIMENT 7 **4 Hours**

Implementation of quick sort.

EXPERIMENT 8 **4 Hours**

Implementation of heap sort.

EXPERIMENT 9 **4 Hours**

Implementation of shell sort.

EXPERIMENT 10 **4 Hours**

Develop a program to perform linear and binary search

EXPERIMENT 11 **6 Hours**

Program to construct an expression tree for a given expression and perform various tree traversal methods.

EXPERIMENT 12 **6 Hours**

Implement Prims algorithm with the following functionalities

i. Read a set of vertices minimum of six from the keyboard

ii. Get the number of edges and form the graph

iii. Find the value of each edge by using distance formula for two points

iv. Develop a Minimum Spanning Tree for the graph

v. Find the total length of all edges.

Write a main method to execute the above functionalities

EXPERIMENT 13 **6 Hours**

Implementation of hashing technique

Total: 60 Hours

Reference(s)

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

19CT308 DATABASE TECHNOLOGY LABORATORY 0 0 4 2

Course Objectives

- Understand the DDL, DML, TCL and DCL commands in SQL.
- Understand the design principles of a relational database system and SQL.
- Implement programs using SQL and PL/SQL.

Course Outcomes (COs)

1. Differentiate database systems from file system by understanding the features of database system and design a ER model for a database system.
2. Develop solutions to a broad range of query and data update problems using relational algebra, relational calculus and SQL.
3. Apply the normalization theory in relational databases for removing anomalies.
4. Compare database storage and access techniques for file organization, indexing methods and Query Processing.
5. Analyze the basic issues of transaction processing, concurrency control, deadlock and its recovery schemes

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	3	2	2				2	2			2	
3	2	2	2	3	2				2	2			3	
4	2	2	3	2	3				2	2			3	
5	2	2	3	2	3				2	2			3	

EXPERIMENT 1 **4 Hours**
Working with SQL commands like DDL, DML, TCL, and DCL

EXPERIMENT 2 **8 Hours**
Performing Single- row functions and group functions in SQL.

EXPERIMENT 3 **4 Hours**
Execute simple queries using joins and Integrity constraints.

EXPERIMENT 4 **8 Hours**
Creation and manipulation of database objects.

EXPERIMENT 5 **4 Hours**
Simple programs using PL/SQL block.

EXPERIMENT 6 **8 Hours**
Implementation of cursor in PL/SQL block.

EXPERIMENT 7 **8 Hours**

Generate trigger in PL/SQL block.

EXPERIMENT 8 **8 Hours**

Write PL/SQL block Programs using exception handling.

EXPERIMENT 9 **8 Hours**

Design a PL/SQL blocks using subprograms namely functions and procedures

Total: 60 Hours

Reference(s)

1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts, McGraw - Hill, 2015
2. Ramez Elmasri and Shamkant B. Navathe, Fundamental Database Systems, Pearson Education, 2008
3. Raghu Ramakrishnan, Database Management System, Tata McGraw-Hill Publishing Company, 2003
4. C.J.Date,An Introduction to Database system, Pearson Education, 2006
5. Peter Rob and Corlos Coronel, Database System, Design, Implementation and Management, Thompson Learning Course Technology, 2003

18GE301 SOFT SKILLS - VERBAL ABILITY 0 0 2 0

Course Objectives

- To help students gain adequate proficiency in vocabulary
- To help students become proficient in basic writing skills related to workplace communication
- To read and understand unabridged text

Course Outcomes (COs)

1. Take up verbal ability part of the placement tests with confidence
2. Write with confidence in professional and workplace communication
3. Distinguish fact from opinion by reading passages from a text

Articulation Matrix

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

UNIT I 15 Hours

INTRODUCTION

Synonyms - Antonyms - Word Groups - Verbal Analogies - Etymology - Critical Reasoning - Cloze Test - One Word Substitution - Idioms and Phrases - Text & Paragraph Completion.

UNIT II 15 Hours

BASICS OF VERBAL APTITUDE

Sentence Formation - Paragraph Formation - Change of Voice - Change of Speech - Reading Comprehension - Sentence Equivalence - Jumbled Sentences - Spotting Errors -Homophones Homonyms - Commonly Mispronounced/Misspelt Words.

Total: 30 Hours

Reference(s)

1. Murphy, Raymond. English Grammar in Use a Self-Study Reference and Practice Book for Intermediate Learners of English. IV Edition. United Kingdom: Cambridge University Press. 2012.
2. Lewis, Norman. Word Power Made Easy. New York: Pocket Books. 1991.
3. Baron"s The Official Guide for New GMAT Review, New Jersey: John Wiley & Sons, Inc. 2015.

19CT401 PROBABILITY AND STATISTICS 3 1 0 4

Course Objectives

- Understand the basic concepts of probability and the distributions with characteristics and also two-dimensional random variables.
- Apply the basic rules and theorems of probability theory to determine probabilities that help to solve engineering problems.
- Determine the expectation and variance of a random variable from its distribution.
- Learn how to formulate and test hypotheses about means, variances and proportions and to draw conclusions based on the results of statistical tests.

Course Outcomes (COs)

1. Demonstrate and apply the basic probability axioms and concepts in their core areas of random phenomena in their core areas.
2. Calculate the relationship of two dimensional random variables using Correlation techniques and to study the properties of two dimensional random variables
3. Formulate the testing of hypothesis based on different types of hypothesis.
4. Implement one-way and two-way classifications.
5. Summarize the measurements for statistical quality control.

Articulation Matrix

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

UNIT I **9 Hours**

PROBABILITY AND RANDOM VARIABLES

Introduction to probability concepts, Types of Events, axioms, theorems, Conditional probability, Multiplication theorem, Applications. Characteristics of random variables - Discrete case, Probability Mass function, Cumulative distribution function, Applications, Characteristics of random variables - Continuous case. Probability density function, Cumulative distribution function, Applications, Central and Raw Moments, Expectation, variance, Applications, Moment generating function of discrete and continuous random variable

UNIT II **9 Hours**

TWO - DIMENSIONAL RANDOM VARIABLES

Joint Distributions - Marginal And Conditional Distributions - Covariance - Correlation And Linear Regression - Transformation Of Random Variables - Central Limit Theorem (For Independent And Identically Distributed Random Variables).

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 -Tests Based On T, Chisquare And F Distributions For Mean, Variance And Proportion - Contingency Table (Test For Independent) - Goodness Of Fit.

UNIT IV **9 Hours**

DESIGN OF EXPERIMENTS

One Way And Two Way Classifications - Completely Randomized Design - Randomized Block Design - Latin Square Design - 22 Factorial Design.

UNIT V **9 Hours**

STATISTICAL QUALITY CONTROL

Control Charts For Measurements (X And R Charts) - Control Charts For Attributes (P, C And NP Charts) - Tolerance Limits - Acceptance Sampling.

Total: 45+15=60 Hours

Reference(s)

1. Devore. J.L., Probability And Statistics For Engineering And The Sciences, Cengage Learning, New Delhi, 8th Edition, 2012.
2. Walpole. R.E., Myers. R.H., Myers. S.L. And Ye. K., “Probability And Statistics For Engineers And Scientists”, Pearson Education, Asia , 8th Edition, 2007.
3. Ross, S.M., Introduction To Probability And Statistics For Engineers And Scientists, 3rd Edition, Elsevier, 2004.
4. Spiegel. M.R., Schiller. J. And Srinivasan. R.A., Schaum S Outline Of Theory And Problems Of Probability And Statistics, Tata McGraw Hill Edition, 2004.

19CT402 ANALYSIS OF ALGORITHMS 3 1 0 4

Course objectives

- Identify various algorithm design techniques
- Impart knowledge on runtime analysis of algorithms
- Empathize the limits of computation.

Course Outcomes COs)

1. Classify the fundamentals of Algorithmic problem solving methods based on Data Structures
2. Analyze the algorithm efficiency by means of mathematical notations
3. Develop different types of sorting and searching algorithms.
4. Analyze the different techniques in the design of Graph Algorithms
5. Differentiate algorithms design techniques of NP complete with NP hard problems

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	3	3	2							2		2	
3	3	3	3	2							3		3	
4	2	2	3	2							3		3	
5	3	3	3	2							3		3	

UNIT I **7 Hours**

INTRODUCTION

Introduction Fundamentals of Algorithmic Problem Solving Important Problem types: Sorting problem- searching problems - string processing - graph problems - combinatorial problems- Geometric Problems - Numerical problems Fundamental Data structures-Trees and Graphs.

UNIT II **9 Hours**

FUNDAMENTALS OF THE ANALYSIS OF ALGORITHM EFFICIENCY

Analysis Framework - Asymptotic notations - Basic Efficiency classes - Mathematical Analysis of Non-recursive Algorithm - Mathematical Analysis of Recursive Algorithm - Example: Fibonacci Numbers - Empirical Analysis of Algorithms-Algorithm visualization

UNIT III **10 Hours**

ANALYSIS OF SORTING AND SEARCHING ALGORITHMS

Brute Force Strategy: Selection Sort and Bubble Sort, Sequential Search and Brute-force string matching - Divide and conquer: Merge sort, Quick Sort, Binary Search, Binary tree Traversal and Related Properties Decrease and Conquer: Insertion Sort, Depth first Search and Breadth First Search-Pair and Convex-Hull

UNIT IV **10 Hours**

ANALYSIS OF GRAPH ALGORITHMS

Transform and conquer: Presorting, Balanced Search trees AVL Trees, Heaps and Heap sort Dynamic Programming: Warshalls and Floyd Algorithm, Optimal Binary Search trees Greedy Technique: Prims Algorithm, Kruskals Algorithm, Dijkstra Algorithm Huffman trees-The Simplex Method-The Maximum- Flow Problem Ã¢?? Maximum Matching in Bipartite Graphs-The Stable marriage Problem.

UNIT V **9 Hours**

ALGORITHM DESIGN TECHNIQUES TO NP COMPLETE AND NP HARD PROBLEMS

NP Complete problems Backtracking: n-Queens Problem Hamiltonian Circuit problem Subset-Sum problem Branch and bound: Assignment problem, Knapsack problem Traveling salesman problem- Approximation algorithms for NP hard problems: Travelling salesman and knapsack problem-Limitations of Algorithm Power-Lower-Bound Arguments-Decision Trees-P, NP and NP-Complete Problems-Coping with the Limitations.

Total:45+15= 60 Hours

Reference(s)

1. Anany Levitin, Introduction to the Design and Analysis of Algorithms, Third Edition, Pearson Education Asia, 2011
2. T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, Introduction to Algorithms, PHI Pvt. Ltd., 2009
3. Sara Baase and Allen Van Gelder, Computer Algorithms Introduction to Design and Analysis, Pearson Education Asia, 2010
4. A.V.Aho, J.E. Hopcroft and J.D.Ullman, The Design and Analysis of Computer Algorithms, Pearson Education Asia, 2003

19CT403 THEORY OF COMPUTATION 3 1 0 4

Course Objectives

- Understand the mathematical models of computation and design grammars and recognizer for different formal languages
- Identify the relation among regular language, context free language and the corresponding recognizers
- Determine the decidability and intractability of computational problems

Course Outcomes (COs)

1. Explain proofing techniques and construct finite automata
2. Generate finite automata for regular expression using its properties
3. Apply context free grammars and languages
4. Construct Push down Automata and Turing machine
5. Analyze the undecidability of languages.

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	3									2	
3	2	2	3	3									2	
4	3	3	3	3									2	
5	3	3	3	3									2	

UNIT I **9 Hours**

AUTOMATA

Introduction to formal proof - Additional forms of proof - Inductive proofs - Finite Automata (FA) - Deterministic Finite Automata (DFA) – Non - Deterministic Finite Automata (NFA) - Finite Automata with Epsilon transitions

UNIT II **9 Hours**

REGULAR EXPRESSIONS AND LANGUAGES

Regular Expression - FA and Regular Expressions - Arden's theorem - Applications of Regular Expression - Algebraic Laws for Regular Expression - Proving languages not to be regular - Closure properties of regular languages.

UNIT III **9 Hours**

CONTEXT-FREE GRAMMAR AND LANGUAGES

Grammar Introduction- Types of Grammar - Context-Free Grammar (CFG) - Parse Trees – Applications of Context-Free Grammar -Ambiguity in grammars and languages - Normal forms for CFG – Pumping Lemma for CFL - Closure Properties of CFL.

UNIT IV **9 Hours**

PUSH DOWN AUTOMATA AND TURING MACHINES

Definition of the Pushdown automata - Languages of a Pushdown Automata - Equivalence of Pushdown automata and CFG. Turing Machines (TM)- Programming Techniques for TM - Storage in finite control - Multiple tracks - Checking off symbols - Subroutines.

UNIT V **9 Hours**

UNDECIDABILITY

A language that is not Recursively Enumerable (RE) - An undecidable problem that is RE – Undecidable problems about Turing Machine - Post's Correspondence Problem - Rice Theorem.

FOR FURTHER READING

Application of Finite Automata - Text Search Decision Properties of Regular Languages – Ambiguity Resolution in YACC - Extensions to the Basic Turing Machine Introduction to classes - P and NP- completeness

Total: 45+15=60 Hours

Reference(s)

1. John E.Hopcroft, Rajeev Motwani and Jeffrey.D Ullman, Introduction to Automata Theory, Languages and Computations, Pearson Education, Third Edition, 2014
2. Harry R.Lewis and Christos.H.Papadimitriou, Elements of The theory of Computation,Pearson Education/PHI, 2007
3. C.Martin, Introduction to Languages and the Theory of Computation, TMH, 2007
4. Micheal Sipser, Introduction of the Theory and Computation, Thomson Brokecole, 2005

19CT404 SOFTWARE ENGINEERING 3 0 0 3

Course Objectives

- Understand detailed concepts related to software engineering life cycle.
- Gain knowledge about the concepts of software designing and testing.
- Acquire knowledge about an overview of object oriented analysis and design, modeling language.

Course Outcomes (COs)

1. Analyze and identify a suitable software development life cycle model for an application.
2. Develop software requirements specification and cost estimation for an application.
3. Differentiate the design models and testing techniques for implementing a software
4. Apply the object orientation concepts in software development
5. Apply the concept of object oriented methodologies and unified modeling language in software development.

Articulation Matrix

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

UNIT I **7 Hours**

SOFTWARE PROCESS MODELS

The Nature of Software-Software Process Models-Waterfall Model-Incremental Process Models-Evolutionary Process Models- Prototyping-Spiral Model-Concurrent Model-Introduction to Agile Process

UNIT II **11 Hours**

REQUIREMENT ENGINEERING

Requirements Engineering - Establishing the Groundwork - Eliciting Requirements - Building the Requirements Model - Requirements Analysis - Metrics in the Process and Project Domains - Software Measurements - Metrics for Software Quality - Software Project Estimation - Decomposition Techniques - Empirical Estimation Models - The Make/Buy Decision.

UNIT III **8 Hours**

DESIGN CONCEPTS AND PRINCIPLES

The Design Concepts - The Design Model - Architectural Design - User Interface Design: Interface Analysis - Interface Design Steps - Risk Management - Software Engineering Practice - Core Principles - Coding Principles and Concepts.

UNIT IV **10 Hours**

TESTING TACTICS

Software Testing Fundamentals - Internal and External Views of Testing - White-Box Testing – Basis Path Testing - Control Structure Testing - Black Box Testing - Unit Testing - Integration Testing - Validation Testing - System Testing - The Art of Debugging.

UNIT V **9 Hours**

QUALITY MANAGEMENT

Software Quality Assurance - Software Reviews - Formal Technical Reviews - Informal Reviews - Software Reliability - Software Configuration Management - The SCM Process - The Cleanroom Strategy - Software Reengineering Process Model - Reverse Engineering - Forward Engineering.

FOR FURTHER READING

Software Process Improvement - SPI Process - The CMMI - SPI Frameworks.

Total: 45 Hours

Reference(s)

1. Roger S.Pressman, Software Engineering: A Practitioners Approach, McGraw Hill International edition, Seventh edition, 2010
2. Ali Bahrami, Object Oriented Systems Development, Tata McGraw-Hill, 2010
3. Ian Sommerville, Software Engineering, 8th Edition, Pearson Education,2008.
4. Stephan Schach, Software Engineering, Tata McGraw Hill, 2007
5. Pfleeger and Lawrence Software Engineering: Theory and Practice, Pearson Education,second edition, 2001

19CT405 MICROPROCESSORS AND MICROCONTROLLERS 3 0 0 3

Course Objectives

- Understand the architecture and software aspects of 8085, 8086 microprocessors and 8051 microcontroller
- Implement assembly language programs for various applications using the instructions of 8085, 8086 microprocessors and 8051 microcontroller
- Impart knowledge on the methods of interfacing 8085 and 8086 microprocessors with various peripheral devices

Course Outcomes (COs)

1. Analyze the architectural features and develop an ALP using instruction set of 8085
2. Characterize the architecture and timing diagram for minimum and maximum mode in 8086 and classify its addressing modes
3. Develop assembly language programs using 8086 microprocessor instructions
4. Analyze the modes of operations of I/O interface devices
5. Develop programs using the register set and instruction set of 8051 microcontroller

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	1	2	2	1										2
3	2	2	2	2		2								3
4	2	2	2	3		2					3			3
5	2	2	2	3		2					3			3

UNIT I 8 Hours

THE 8085 MICROPROCESSOR

Microprocessor Architecture and its Operations - The 8085 MPU - 8085 Instruction Set - Programming Techniques with Additional Instructions of 8085 microprocessor - The 8085 Interrupt Process - 8085 Vectored Interrupts

UNIT II 11 Hours

THE 8086 MICROPROCESSOR

Register Organisation of 8086 - Architecture - Signal Descriptions of 8086 - Physical memory organization - General bus Operation - I/O Addressing Capability - Special Processor Activities - Minimum Mode 8086 Architecture - Read/Write Cycle Timing Diagram for Minimum mode - Maximum Mode 8086 Architecture - Read/Write Cycle Timing Diagram for Maximum Mode - Addressing Modes of 8086 - Instruction set of 8086

UNIT III **7 Hours**

8086 SYSTEM DESIGN AND RECENT ADVANCES IN MICROPROCESSOR ARCHITECTURES

The Art of Assembly Language Programming with 8086: A few Machine Level Programs - Programming with an Assembler - Special Architecture Features and Related Programming: Introduction to stack - Stack Structure of 8086 - Interrupt and Interrupt Service Routines - Non-Maskable Interrupt - Maskable interrupt - Interrupt programming - Macros.
Intel Pentium 80586 architecture-Branch prediction-Instruction set of Pentium-MMX-Architecture-Data types and Instruction set.

UNIT IV **10 Hours**

PERIPHERAL DEVICES AND I/O INTERFACING

Programmable Interrupt Controller 8259A: Architecture and Signal Descriptions of 8259A - Command Words of 8259A - Operating modes of 8259A - The Keyboard/Display Controller 8279: Architecture and Signal Descriptions of 8279 - Modes of Operation of 8279 - DMA Controller 8257: Internal Architecture and Signal Descriptions of 8257 - DMA Transfers and Operations.

UNIT V **9 Hours**

8051 MICROCONTROLLER

Architecture of 8051 - Signal Descriptions of 8051 - Register Set of 8051 - Memory Addressing - External I/O Interfacing - Addressing modes of 8051 - Instruction Set of 8051.

FOR FURTHER READING

Introduction to PIC Microcontrollers - Architecture of PIC Microcontrollers - Instruction Set of PIC Microcontroller - I/O Port Configuration - PIC Programming.

Total: 45 Hours

Reference(s)

1. Ramesh S.Gaonkar, Microprocessor Architecture, Programming and Applications with the 8085, Penram International publishing private limited, 2013
2. A.K.Ray and K.M.Bhurchandi, Advanced Microprocessors and peripherals- Architectures, Programming and Interfacing, Tata McGraw Hill Education Private Limited, 2013
3. Douglas V.Hall, Microprocessors and Interfacing: Programming and Hardware, TMH, 2010
4. Yu-cheng Liu and Glenn A. Gibson, Microcomputer systems: The 8086 / 8088 Family architecture, Programming and Design, PHI, 2011
5. Mohamed Ali Mazidi, Janice Gillispie Mazidi, The 8051 microcontroller and embedded systems, Pearson education, 2009.

19CT406 COMPUTER NETWORKS 3 0 2 4

Course Objectives

- Understand the state-of-the-art in network protocols, architectures and applications
- Gain knowledge about the functions of different network layers
- Familiarize in the various aspects of computer networks

Course Outcomes (COs)

1. Illustrate the basic concept in modern data communication and computer networking
2. Apply the functions of different layers and in depth knowledge of data link layer
3. Analyze the different protocols and network layer components
4. Outline the basic functions of transport layer and congestion in networks
5. Analyze the working of application layer along with the protocols used

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	3		2
2	2	2	2	2	1		2				2	3		2
3	3	2	2	2	2		2				2	3		2
4	3	3	3	3	2		2				2	3		2
5	3	3	3	3	1		2				2	3		2

UNIT I **10 Hours**

INTRODUCTION

Data Communications - Data Flow - Networks - The Internet - Protocols and Standards – Network Models: Layered Tasks - The OSI Model - TCP/IP Protocol Suite - Addressing - Transmission Media - Connecting LANs, Backbone Networks, and Virtual LANs: Connecting Devices-Circuit Switching and Packet Switching

UNIT II **10 Hours**

DATA LINK AYER

Introduction - Block Coding - Cyclic codes - Checksum -Data Link Control: Framing - Flow and Error Control - Noiseless Channels - Noisy Channels - HDLC -Multiple Access: Random Access - Channelization -Wired LANs: IEEE Standards- Standard Ethernet - Encoding (NRZ, NRZI, Manchester, 4B/5B- WiMax.

UNIT III **9 Hours**

NETWORK LAYER

IPv4 Addresses- IPv6 Addresses - Internetworking - IPv4 - IPv6 - Transition from IPv4 to IPv6 – Network Layer: Delivery, Forwarding and Routing: Address Mapping - Internet Control Message Protocol (ICMP) - Internet Group Management Protocol (IGMP) - Network Layer: Delivery, Forwarding, and Routing.

UNIT IV **9 Hours**

TRANSPORT LAYER

Process-to-Process Delivery - User Datagram Protocol (UDP) - Transmission Control Protocol (TCP) - Stream Control Transmission Protocol (SCTP) - Congestion Control and Quality of Service: Data Traffic - Congestion Control - Quality of Services (QoS)-POP3- IMAP.

UNIT V **7 Hours**

APPLICATION LAYER

Domain Name System (DNS): Domain Name Space - Distribution of Name Space - DNS in the Internet World Wide Web and HTTP - Simple Mail Transfer Protocol - File Transfer Protocol -Secure Shell (SSH)- TELNET - PGP - Firewalls.

FOR FURTHER READING

Network Management: Simple Network Management Protocol (SNMP) - Symmetric key cryptography - Security services - PGP - Firewalls.

EXPERIMENT 1 **4 Hours**

Study of Color coding Jack RJ45 and do the following Cabling works in a network a. Cable Crimping, b. Standard Cabling, c. Cross Cabling and d. Establish a LAN connection using three systems using any topology.

EXPERIMENT 2 **2 Hours**

Configure IP Address in a system in LAN (TCP/IP Configuration) and Implement the client server communication using socket connection.

EXPERIMENT 3 **2 Hours**

Write a program for transferring a file between nodes in a network.

EXPERIMENT 4 **2 Hours**

Perform Bit Stuffing and CRC computation.

EXPERIMENT 5 **2 Hours**

By varying the no of frames, design the Sliding Window Protocol.

EXPERIMENT 6 **2 Hours**

Simulation of ARP/RARP

EXPERIMENT 7 **2 Hours**

Display the routing table for the nodes in a network using Distance Vector Routing (DVR) algorithm.

EXPERIMENT 8 **2 Hours**

Find the minimum cost in the node to node communication by Open Shortest Path First (OSPF) protocol

EXPERIMENT 9 **2 Hours**

Write a program for downloading a file from HTTP server

EXPERIMENT 10 **4 Hours**

Develop a client that contacts a given DNS server to resolve a given host name.

EXPERIMENT 11 **2 Hours**

Configure a Network topology using Packet tracer software.

EXPERIMENT 12 **4 Hours**

Study of Network simulator (NS) and Simulation of any one of routing protocol using NS2.

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

19CT407 MICROPROCESSORS AND MICROCONTROLLERS LABORATORY 0 0 4 2

Course Objectives

- Understand the working of 85 x 86 microprocessors and 8051 microcontrollers.
- Develop ability in assembly language programming using 85x86 microprocessors and 8051 microcontroller.
- Work with I/O interfacing devices

Course Outcomes (COs)

1. Develop assembly language programs using 8085/86 microprocessors and 8051 microcontroller
2. Implement interface between 8085 microprocessor and peripheral devices.
3. Design an interface between LED and 8051 microcontrollers.

Articulation Matrix

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

EXPERIMENT 1 **3 Hours**

8085-Arithmetic operations

EXPERIMENT 2 **3 Hours**

8085-Code conversions

EXPERIMENT 3 **3 Hours**

8085-Matrix Multiplication

EXPERIMENT 4 **6 Hours**

8086-Arithmetic operations

EXPERIMENT 5 **3 Hours**

8086-String Manipulation

EXPERIMENT 6 **6 Hours**

Stepper motor interfacing with 8086

EXPERIMENT 7 **6 Hours**

Counters and time delay using 8086

EXPERIMENT 8 **6 Hours**

Interfcaing 8085 with 8255

EXPERIMENT 9 **6 Hours**

Interfcaing 8085 with 8279

EXPERIMENT 10 **6 Hours**

8051-Arithmetic operations

EXPERIMENT 11 **3 Hours**

8051-Fibonacci series and square of a number

EXPERIMENT 12 **3 Hours**

Unpacked BCD to ASCII

EXPERIMENT 13 **6 Hours**

Interfacing LED with 8051

Total:60 Hours

Reference(s)

1. Ramesh S.Gaonkar, Microprocessor Architecture, Programming and Applications with the 8085, Penram International publishing private limited, 2013
2. K.Ray and K.M.Bhurchandi, Advanced Microprocessors and peripherals- Architectures, Programming and Interfacing, Tata McGraw Hill Education Private Limited, 2013
3. Douglas V.Hall, Microprocessors and Interfacing: Programming and Hardware, TMH, 2010
4. Yu-cheng Liu and Glenn A. Gibson, Microcomputer systems: The 8086 / 8088 Family architecture, Programming and Design, PHI 2011
5. Mohamed Ali Mazidi, Janice Gillispie Mazidi, The 8051 microcontroller and embedded systems, Pearson education, 2009

18HS001 **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

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 Ã¢?? 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)

FOR FURTHER READING

Human rights:Biomedical waste -Identification of adulterants in food materials

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

18GE401 SOFT SKILLS-BUSINESS ENGLISH 0 2 0 0

Course Objectives

- To acquire command of both the receptive skills (Listening, Reading) and the productive skills (Writing and Speaking) of English language
- To understand and make effective use of English language in business contexts

Course Outcomes (COs)

1. Listen, Read, Speak, and Write Business English at the level of independent users
2. Appear for the Business English Certificate (BEC) Vantage level examination conducted by the Cambridge Assessment English

Articulation Matrix

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

UNIT I 15 Hours

LISTENING AND READING

Listening for writing short answers - filling gaps in sentences - identifying topic, context and function - identify different functions of language in business situations - identify prompts -identify paraphrases of required information

Scanning - reading for gist - understanding sentence structure - error identification - identify paraphrases - cohesive words and phrases - understand the importance of analysing the distractors - identify grammatical and semantic relationships

UNIT II 15 Hours

WRITING AND SPEAKING

Business emails - notes - memos to colleagues or friends - giving instructions - explaining a development - asking for comments - requesting information - agreeing to requests - explaining - apologising - reassuring - complaining - describing - summarising - recommending - persuading

turn - taking - sustaining interaction - initiating - responding - giving personal information - talking about present circumstances, past experiences and future plans - expressing opinion - speculating - organising a larger unit of discourse - giving information - expressing and justifying opinions - speculating - comparing and contrasting - agreeing and disagreeing

Total: 30 Hours

Reference(s)

1. Whitehead, Russell and Michael Black. Pass Cambridge BEC Vantage Self - study Practice Tests with Key, Heinle - a part of Cengage Learning, Delhi, 2003.

21CT501 COMPILER DESIGN 3 1 0 4

Course Objectives

- Acquire knowledge in different phases of a Compiler and its applications.
- Understand the categorization of tokens using lexical analyzer and pattern recognition using parsers.
- Familiar with the code generation schemes and optimization methods.

Course Outcomes (COs)

1. Analyze the output generated in each phase of the compiler
2. Construct Finite automata for Regular Expression and apply minimization techniques.
3. Construct Top down and Bottom up parser for context free grammars.
4. Generate intermediate code for programming constructs
5. Apply optimization techniques in code generation and analyze the issues in code generation.

Articulation Matrix

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

UNIT I **8 Hours**

INTRODUCTION TO COMPILER

Language processors - Structure of a compiler - Grouping of phases into passes- Compiler construction tools - Applications of compiler technology: Implementation of high-level programming languages - Optimizations for computer architectures - Design of new computer architecture - Program Translations- Software productivity tools.

UNIT II **9 Hours**

LEXICAL ANALYSIS

Lexical Analysis: Role of Lexical Analyzer - Input Buffering - Lexical Errors - Specification of tokens - Recognition of Tokens - Finite automata - Regular expression to finite automation-Optimization of DFA based Pattern Matchers-LEX-Design of Lexical Analyzer for a sample Language.

UNIT III **11 Hours**

SYNTAX ANALYSIS

Introduction-Role of the parser - Context-Free Grammars -Writing a Grammar-Top Down parsing - Recursive Descent Parsing – Non-recursive Predictive Parsing - Bottom-up parsing - Shift Reduce Parsing- LR Parsers: Simple LR Parser - Canonical LR Parser - LALR Parser - Error Handling and Recovery in Syntax Analyzer-YACC-Design of a syntax Analyzer for a Sample Language.

UNIT IV **8 Hours**

SEMANTIC ANALYSIS

Syntax Directed Translation - Construction of Syntax Tree - Variants of Syntax Trees -Three-Address Code - Types and Declarations - Translation of Expressions - Control Flow - Backpatching - Switch- Statements - Intermediate Code for Procedures.

UNIT V **9 Hours**

CODE OPTIMIZATION

Principal Sources of Optimization-DAG- Optimization of Basic Blocks- Global Data Flow Analysis - Issues in Design of a Code Generator - A Simple Code Generator Algorithm.

FOR FURTHER READING

The evolution of programming languages-The science of building a compiler - Run Time Environments -Storage Organization - Stack Allocation of Space- Heap Management.

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. D. Grune, H.E. Bal, C.J.H. Jacobs, K.G. Langendoen, Modern Compiler Design, Wiley, 2008
3. Kennath C. Louden, Compiler Construction Principles and Practice. New Delhi: Vikas publishing House, 2003.
4. Allen I. Holub, Compiler Design in C, Prentice Hall of India, 2003.

21CT502 WEB TECHNOLOGY 3 0 0 3

Course Objectives

- Understand the scripting languages XHTML, JavaScript and PHP.
- Familiar with the different server technologies.
- Gain knowledge in the concepts of web services.

Course Outcomes (COs)

1. Demonstrate the technologies used to create web pages.
2. Design dynamic and interactive web pages by embedding Java Script in XHTML.
3. Implement server side programming and build web applications using PHP.
4. Develop interactive web applications using ASP.Net.
5. Explain web services and its technologies

Articulation Matrix

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

UNIT I 9 Hours

INTRODUCTION TO WEB AND XHTML

Introduction - Blogging - Social Networking - Social media - Tagging - Software development - Introduction to XHTML and Editing XHTML Headings - Linking - Images - Special characters and Horizon rules - Lists - Tables - Forms -Internal Linking- Meta Elements - Cascading Style Sheets.

UNIT II 9 Hours

JAVASCRIPT

Introduction to scripting - Control statements I, II - Functions: Definition - Random Number Generation - Global function - Recursion - Arrays: Declaring and allocating arrays Multidimensional arrays - Objects : Math object - String object - Date object - Boolean, Number object - Document object - Window object - Events.

UNIT III 9 Hours

INTERNET APPLICATION SERVER TECHNOLOGIES

Web server (IIS and Apache): Multitier Architecture - Client/ Server side scripting - Accessing web services - Microsoft IIS - Apache HTTP server - Database: Relational database - SQL - PHP: Basics - String and Form Processing - connecting to database.

UNIT IV 9 Hours

ASP .NET AND JSP WEB APPLICATIONS

Introduction - creating and running a simple web form - Web controls - session tracking - case study: Connecting to a database in ASP.NET. - Introduction to AJAX- AJAX XML Http request- AJAX Events- Java web technologies (Servlets, JSP) - Creating and running a simple application in Netbeans - JSF components.

UNIT V **9 Hours**

WEB SERVICES

Introduction - Java web services Basics - Creating Publishing, Testing and describing web service - Consuming web service - SOAP - Session Tracking in web services - Consuming a Database driven web service from a web application - Passing an object of a User defined type to a web service

FOR FURTHER READING

Introduction - Java web technologies - Creating and running a simple application in Netbeans – JSF components - Session tracking: Cookies

Total: 45 Hours

Reference(s)

1. P.J. Deitel and H.M. Deitel, Internet and World Wide Web - How to Program, Pearson Education, 2009.
2. Deitel, Deitel and Nieto, Internet and World Wide Web How to Program, Pearson Education,2002.
3. Uttam K.Roy, Web Technologies, Oxford University Press, 2010.
4. Rajkamal, Web Technology, Tata McGraw-Hill, 2009.
5. www.w3schools.com/ajax.

21CT503 EMBEDDED SYSTEMS 3 0 2 4

Course Objectives

- To be familiar with 8051 microcontrollers.
- Understand the basic OS concepts.
- Design and develop embedded systems.

Course Outcomes (COs)

1. Explore the concepts of embedded computing with 8051 microcontrollers.
2. Illustrate the memory and I/O operations.
3. Explain the processes and operating system concepts.
4. Elucidate the embedded software concepts
5. Develop 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													2
2			3											2
3			3											2
4				2										2
5				2										2

UNIT I **9 Hours**

EMBEDDED COMPUTING

Challenges of Embedded Systems - Embedded system design process. Embedded processors - 8051 Microcontroller, ARM processor - Architecture, Instruction sets and programming.

UNIT II **9 Hours**

MEMORY AND I/O MANAGEMENT

Programming Input and Output - Memory system mechanisms - Memory and I/O devices and interfacing Interrupts handling.

UNIT III **9 Hours**

PROCESSES AND OPERATING SYSTEMS

Multiple tasks and processes - Context switching - Scheduling policies - Interprocess communication mechanisms - Performance issues.

UNIT IV **9 Hours**

EMBEDDED SOFTWARE

Programming embedded systems in assembly and C - Meeting real time constraints - Multi-state systems and function sequences. Embedded software development tools - Emulators and debuggers.

UNIT V **9 Hours**

EMBEDDED SYSTEM DEVELOPMENT

Design issues and techniques - Case studies - Complete design of example embedded systems.

FOR FURTHER READING

Embedded programming in C, C++ - Real time operating systems - study of Micro C/OS II.

EXPERIMENT 1 **4 Hours**

Study of ARM evaluation system

EXPERIMENT 2 **2 Hours**

Interfacing ADC and DAC.

EXPERIMENT 3 **4 Hours**

Interfacing LED and PWM.

EXPERIMENT 4 **2 Hours**

Interfacing real time clock and serial port.

EXPERIMENT 5 **4 Hours**

Interfacing keyboard and LCD.

EXPERIMENT 6 **2 Hours**

Interfacing EPROM and interrupt.

EXPERIMENT 7 **2 Hours**

Display the Mailbox.

EXPERIMENT 8 **4 Hours**

Interrupt performance characteristics of ARM and FPGA.

EXPERIMENT 9 **2 Hours**

Flashing of LEDS.

EXPERIMENT 10 **4 Hours**

Interfacing stepper motor and temperature sensor and Implementing ZigBee protocol with ARM.

Total:45+30= 75 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. Steve Heath, Embedded System Design, Elsevier, 2005.
4. Muhammed Ali Mazidi, Janice Gillispie Mazidi and Rolin D. McKinlay, The 8051.
5. Microcontroller and Embedded Systems, Pearson Education, Second edition, 2007.

21CT504 ARTIFICIAL INTELLIGENCE 3 0 0 3

Course Objectives

- Provide comprehensive and in-depth knowledge of AI principles and techniques by introducing AI fundamental problems
- Understand the basic concepts of analytic functions and method of construction in complex analysis
- Acquire the knowledge of complex integration to apply them in areas such as networking, and Machine Learning

Course Outcomes (COs)

1. Compare AI with human intelligence and traditional information processing, and discuss its strengths and limitations and its application to complex and human-centered problems
2. Analyze the structures and algorithms selection in Artificial Intelligence techniques related to searching, reasoning and inference
3. Analyze the Importance of machine learning techniques, training models and its types
4. Apply and evaluate regression, classification and clustering models to given real time dataset
5. Understand the structures of Neural Networks and discuss its 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						1	2	
2	2	2	3		3								2	
3	2	1	3	1	2								2	
4	1	2	2	1	3				1				2	
5	2	2	1		2				1				2	

UNIT I **9 Hours**

INTRODUCTION TO AL

Introduction to AI-Problem formulation, Problem Definition -Production systems, Control strategies, Search strategies. Problem characteristics, - Problem solving methods - Problem graphs, Matching, Indexing and Heuristic functions -Hill Climbing-Depth first and Breath first, Constraints satisfaction - Related algorithms

UNIT II **9 Hours**

KNOWLEDGE REPRESENTATION AND INFERENCE

Game playing - Knowledge representation, Knowledge representation using Predicate logic. Inference - Backward chaining, Forward chaining, Rule value approach, Fuzzy reasoning.

UNIT III **9 Hours**

MACHINE LEARNING INTRODUCTION

Definition of learning systems. Goals and applications of machine learning. Aspects to develop a Learning system: training data, concept representation, function approximation. Learning Techniques Supervised learning, unsupervised learning and Reinforcement learning

UNIT IV **9 Hours**

MACHINE LEARNING ALGORITHMS

Regression- Simple Linear Regression, Logistic Regression, Mean Square Error. Classification - Decision Tree Information Gain and Entropy. Support Vector Machines, Clustering - K Means, Hierarchical Agglomerative Clustering

UNIT V **9 Hours**

ARTIFICIAL NEURAL NETWORKS

Neurons and biological motivation. Linear threshold units. Perceptrons: representational limitation and gradient descent training. Multilayer networks and backpropagation. Hidden layers and constructing intermediate, distributed representations. Overfitting, learning network structure, recurrent networks

FOR FURTHER READING

Text Classification - Information Retrieval, Natural Language Processing

Total: 45 Hours

Reference(s)

1. Deepak Khemani, Artificial Intelligence,, Tata McGraw Hill Education 2013.
2. Mishra R B, Artificial Intelligence, PHI Learning Pvt. Ltd., New Delhi, 2013.
3. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.
4. Christopher M.Bishop, Pattern Recognition and Machine Learning, Springer, 2006.
5. Stuart Russel and Peter Norvig, AI A Modern Approach, 2nd Edition, Pearson Education 2007.
6. Christopher D. Manning, Prabhakar Raghavan and Hinrich Schutze, Introduction to Information Retrieval, Cambridge University Press, Cambridge, 2008.

21CT507 WEB TECHNOLOGY LABORATORY 0 0 2 1

Course Objectives

- Understand and apply the role of scripting languages like XHTML, CSS, JavaScript, ASP, JSP and PHP for designing interactive web applications.
- Familiar with the different types of server technologies.
- Gain knowledge about the concepts of web services.

Course Outcomes (COs)

1. Acquire the knowledge about the usage of various elements used in XHTML.
2. Use Cascading style sheets to implement a variety of presentation effects in XHTML including explicit positioning of elements
3. Create dynamic web pages by incorporating JavaScript in XHTML
4. Design the interactive web applications by connecting SQL with ASP.NET
5. Demonstrate the concepts of web services to build and consume it.

Articulation Matrix

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

EXPERIMENT 1 **2 Hours**

Create a XHTML document for the college website with Text styling, Linking, Images, Lists, Table by highlighting the facilities in the department.

EXPERIMENT 2 **2 Hours**

Create an XHTML document for an online Bookstore that has a Registration form with text box, Radio Button, Selection box, Checkbox, Submit and reset buttons.

EXPERIMENT 3 **4 Hours**

Design a web page using CSS which includes the following:

a) Use different font styles
b) Set background image for both the page and single elements on page.
c) Control the repetition of image with background-repeat property
d) Define style for links as a: link, a: active, a: hover, a: visited

EXPERIMENT 4 **4 Hours**

Write a java script to validate the following fields in a registration page

a) Name (should contains alphabets and the length should not be less than 6 characters)
b) Password (should not be less than 6 characters)
c) E-mail (should not contain invalid addresses)

EXPERIMENT 5 **2 Hours**

Write a JavaScript function to get nth largest element from an unsorted array.

EXPERIMENT 6 **4 Hours**

Create a web page with real time clock using Java script event handling mechanism.

EXPERIMENT 7 **2 Hours**

Write a JSP code to retrieve the xhtml form values and print those values in JSP pages.

EXPERIMENT 8 **2 Hours**

Write a program with ASP .net by connecting with SQL

a. Create login form to enter into website

b. Building web form that displays data from a database

EXPERIMENT 9 **4 Hours**

Write a PHP program for an web application that

a. takes a name as input and on submit it shows a hello page where is taken from the request

b. shows a start time at the right top corner of the page and

c. provides the logout button on clicking this button it should show a logout page with thank you message along with the duration of usage session

EXPERIMENT 10 **4 Hours**

Create a SOAP based web service for a simple Java Calculator class with operations add and subtract then create a web service client which then consumes the web service and displays the result of the invoked web service.

Total: 30 Hours

Reference(s)

1. P.J. Deitel and H.M. Deitel, Internet and World Wide Web - How to Program, Pearson Education, 2009.
2. Deitel, Deitel and Nieto, Internet and World Wide Web How to Program, Pearson Education,2002.
3. Uttam K.Roy, Web Technologies, Oxford University Press, 2010.
4. Rajkamal, Web Technology, Tata McGraw-Hill, 2009.
5. www.w3schools.com/ajax.

21CT508 ARTIFICIAL INTELLIGENCE LABORATORY 0 0 2 1

Course Objectives

- To design and Implement algorithms that allow computers to automatically learn from data to improve their performance of applications
- Learn Techniques for problem specific approaches and design a learning environment and evaluate the goodness of the learned solution

Course Outcomes (COs)

1. To Design and Implement machine learning solutions to classification, regression and clustering problems, evaluate and Interpret the results of the algorithms
2. To carryout forecasting with use of statistics to measure the Seasonality and Stationarity in real time data

Articulation Matrix

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

EXPERIMENT 1 **3 Hours**
Loading Real Time data Set and Python Libraries, Installing Libraries through Anaconda Prompt

EXPERIMENT 2 **3 Hours**
Perform Slicing, Filtering, Group by and other basic operation through Pandas Library

EXPERIMENT 3 **3 Hours**
Linear Regression Model to car dataset with One Dependent Variables to predict the relationship between distance and speed

EXPERIMENT 4 **3 Hours**
Perform Multi-Linear Regression to predict the Price of a House using Boston House Price Prediction Dataset.

EXPERIMENT 5 **3 Hours**
To detect outliers in the cars dataset and compare the results of Linear regression models without outliers

EXPERIMENT 6 **3 Hours**
Apply Binary Classification Algorithms to predict the Onset of diabetes in female Indians from medical data record

EXPERIMENT 7 **3 Hours**
Perform Fruit Classification Algorithms to predict the fruit based on the Classification Algorithms

EXPERIMENT 8 **3 Hours**
Logistic Regression model to predict the outcome whether he will earn more than 50K$ based on the Professional data

EXPERIMENT 9 **3 Hours**
Apply Binary Classification Algorithms to predict the Onset of diabetes in female Indians from medical data record.

EXPERIMENT 10 **3 Hours**
Extract the Trend, Seasonality and Error for a Stock market Time series data

Total: 30 Hours

Reference(s)

1. Deepak Khemani, Artificial Intelligence,, Tata McGraw Hill Education 2013
2. Mishra R B, Artificial Intelligence, PHI Learning Pvt. Ltd., New Delhi, 2013.
3. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
4. Stuart Russel and Peter Norvig,AI A Modern Approach, 2nd Edition, Pearson Education 2007.
5. Christopher D. Manning, Prabhakar Raghavan and Hinrich Schutze, Introduction to Information Retrieval, Cambridge University Press, Cambridge, 2008

18GE501 SOFT SKILLS - APTITUDE I 0 0 2 0

Course Objectives

- Expose the undergraduate students to such methods and practices that help, develop and nurture qualities such as character, effective communication, aptitude and holding ethical values.
- It will provide a lot of activities and examples for a student to learn and develop these life skills.

Course Outcomes (COs)

1. Explain various concepts of number systems and their techniques in solving the percentage, average and age problems.
2. Analyse the profit and loss of real time situations and the relation between ratio, proportion and variation.
3. Apply different techniques to find the distance, speed and time of various moving objects.
4. Understand the concepts of coding, sequences and series, data interpretation and critical reasoning to solve real time logical reasoning problems.

Articulation Matrix

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

1 **2 Hours**

NUMBER SYSTEMS

Introduction - Definition - Classification on Numbers- Power cycles and remainders - Short cut process-Concept of Highest Common Factor-Concept of Least Common Multiple- Divisibility- Number of zeros in an expression.

2 **2 Hours**

PERCENTAGE

Introduction - Definition and Utility of Percentage - Importance of base/denominator for percentage calculations-Concept of percentage values through additions-Fraction to percentage conversion table.

3 **3 Hours**

AVERAGES AND AGES

Introduction-Average of different groups-Addition or removal of items and change in average- Replacement of some of the items.

4 **3 Hours**

RATIO, PROPORTIONS AND VARIATION

Introduction- Ratio- Properties-Dividing a given number in the given ratio-Comparison of ratios-Proportions- Useful results on proportion- Continued proportion-Relation among the quantities more than two-Variation.

5 **2 Hours**

PROFIT AND LOSS

Gain/Loss and percentage gain or percentage loss-Multiplying equivalents to find sale price-Relation among cost price, sale price, gain/loss and percentage gain or percentage loss-An article sold at two different selling price-Two different articles sold at same selling price-Percentage gain or percentage loss on selling price-Percentage gain or percentage loss on whole property.

6 **2 Hours**

TIME AND WORK

Introduction-Basic concepts-Concepts on working with different efficiencies-Pipes and Cisterns-Work Equivalence (Man Days) -Alternative approach.

7 **2 Hours**

TIME, SPEED AND DISTANCE

Definition-Basics of Time, Speed and Distance - Relative speed-Problems based on Trains-Problems based on Boats and Streams-Problems based on Races-Time taken with two difference modes of transport-Time and distance between two moving bodies.

8 **3 Hours**

CODING AND DECODING

Introduction-Description of Coding method-Coding patterns - Concepts of Coding and Decoding-Problems involving Coding and Decoding methods.

9 **2 Hours**

SEQUENCE AND SERIES

Introduction-Sequences of real numbers - Number and Alphabet series-Description of Number and Alphabet series-Analogy-Odd man out-Power series.

10 **3 Hours**

DATA SUFFICIENCY

Introduction to Data Sufficiency - Overview of the wide variety of Data Sufficiency problems - Basic introduction on how to determine what information is sufficient to solve a given problem - Common pitfalls to avoid.

11 **3 Hours**

DIRECTION

Introduction to Direction - sense test - Overview of the wide variety of Direction problems-Direction-Plotting diagrams.

12 **3 Hours**

CRITICAL REASONING

Introduction-Basic concept of critical reasoning- Weaken the argument-Strengthen the argument-Flaw in the argument-Evaluate the conclusion.

Total: 30 Hours

Reference(s)

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Mc Graw Hill Publications.
2. U. Mohan Rao, Quantitative Aptitude for Competitive Examinations, Scitech Publications Pvt Ltd, India.
3. Dinesh Khattar, The Pearson Guide to Quantitative Aptitude for Competitive Examinations, Third Edition, Pearson Education Pvt Ltd, India, 2016.
4. Dr. R S Aggarwal, A Modern Approach to Verbal and Non Verbal Reasoning, Revised Edition, S Chand Publications.
5. Arun Sharma, How to prepare for Logical Reasoning for CAT & other Management Exams, Fifth Edition, Mc Graw Hill Publications.
6. Jaikishan and Premkishan, How to Crack Test of Reasoning in all Competitive Examinations, Revised Edition, Arihant Publications.

21CT601 MACHINE LEARNING TECHNIQUES 2 1 0 3

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.

Course Outcomes (COs)

1. Identify the problems for machine learning. And select the either supervised, unsupervised or reinforcement learning.
2. Explain theory of probability and statistics related to machine learning
3. Investigate concept learning, ANN, Bayes classifier, k nearest neighbor.
4. Implement classification algorithms using R
5. Design and make modifications to existing machine learning algorithms to suit an individual application.

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	1	2	1								2	
5	1	2	2	2									2	

UNIT I **6 Hours**

INTRODUCTION

Well posed learning problems, Designing a Learning system, Perspective and Issues in Machine Learning. Concept Learning: Concept learning task, Concept learning as search, Find-S algorithm, Version space, Candidate Elimination algorithm, Inductive Bias.

UNIT II **6 Hours**

DECISION TREE LEARNING

Decision tree representation, Appropriate problems for decision tree learning, Basic decision tree learning algorithm, hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning.

UNIT III **6 Hours**

ARTIFICIAL NEURAL NETWORKS

Introduction, Neural Network representation, Appropriate problems, Perceptrons, Back propagation algorithm.

UNIT IV **6 Hours**

BAYESIAN LEARNING

Introduction, Bayes theorem, Bayes theorem and concept learning, ML and LS error hypothesis, ML for predicting probabilities, MDL principle, Naive Bayes classifier, Bayesian belief networks, EM algorithm

UNIT V **6 Hours**

HYPOTHESIS, INSTANCE BASED AND REINFORCEMENT LEARNING

Evaluating Hypothesis: Motivation, estimating hypothesis accuracy, Basics of sampling theorem, General approach for deriving confidence intervals, Difference in error of two hypothesis, Comparing learning algorithms. Instance Based Learning: Introduction, k-nearest neighbor learning, locally weighted regression, radial basis function, cased-based reasoning Reinforcement Learning: Introduction, Learning Task, Q Learning

Total:30+15= 45 Hours

Reference(s)

1. Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, h The Elements of Statistical Learning, 2nd edition, springer series in statistics.
3. Ethem AlpaydÃ„Â±n, Introduction to machine learning, second edition, MIT press.
4. John M. Chambers, Software for Data Analysis: Programming with R (Statistics and Computing), Springer, 2008.
5. Jiawei Han, Micheline Kamber and Jian Pei, Data Mining Concepts and Techniques, Second Edition, Elsevier, 2012.
6. Norman Matloff, The Art of R Programming - A Tour of Statistical Software Design, 2011.

21CT602 SECURITY IN COMPUTING **3 0 0 3**

Course Objectives

- To introduce the basic concepts and challenges in security
- To illustrate the use of modern tools to resolve the security issues
- To implement the cyber security principles and methods in organization.

Course Outcomes (COs)

1. Describe the concept of cybercrime in mobile devices
2. Illustrate the cyber security challenges in the modern devices.
3. Analyze the working principle of cyber security tools and methods
4. Apply the concept of cyber forensics to set a cyber-forensics laboratory
5. Implement the process of cyber security systems in the organizations.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO SECURITY AND ATTACKS

The Importance of Information Protection, The Evolution of Information Security, Justifying Security Investment, Security Methodology, how to Build a Security Program, The Impossible Job, The Weakest Link, Strategy and Tactics, Business Processes vs. Technical Controls. Risk Analysis: Threat Definition, Types of Attacks, Risk Analysis. Secure Design Principles: The CIA Triad and Other Models, Defense Models, Zones of Trust, Best Practices for Network Defense.

UNIT II **9 Hours**

AUTHENTICATION & AUTHORIZATION AND DATABASE SECURITY

Authentication, Authorization, Encryption: A Brief History of Encryption, Symmetric-Key Cryptography, Public Key Cryptography, Public Key Infrastructure - Storage Security: Storage Security Evolution, Modern Storage Security, Risk Remediation, Best Practices - Database Security: General Database Security Concepts, Understanding Database Security Layers, Understanding Database-Level Security, Using Application Security, Database Backup and Recovery, Keeping Your Servers Up to Date, Database Auditing and Monitoring.

UNIT III **9 Hours**

INTRODUCTION TO SECURE NETWORK DESIGN

Introduction to Secure Network Design, Performance, Availability, Security. Network Device Security: Switch and Router Basics, Network Hardening. Firewalls: Overview, The Evolution of Firewalls, Core Firewall Functions, Additional Firewall Capabilities, Firewall Design. Wireless Network Security: Radio Frequency Security Basics, Data-Link Layer Wireless Security Features, Flaws, and Threats, Wireless Vulnerabilities and Mitigations, Wireless Network Hardening Practices and Recommendations, Wireless Intrusion Detection and Prevention, Wireless Network Positioning and Secure Gateways.

UNIT IV **9 Hours**

INTRUSION DETECTION AND PREVENTION SYSTEMS

IDS Concepts, IDS Types and Detection Models, IDS Features, IDS Deployment Considerations, Security Information and Event Management (SIEM). Voice over IP (VoIP) and PBX Security: Background, VoIP Components, VoIP Vulnerabilities and Countermeasures, PBX, TEM: Telecom Expense Management. Operating System Security Models: Operating System Models, Classic Security Models, Reference Monitor, Trustworthy Computing, International Standards for Operating System Security.

UNIT V **9 Hours**

SECURITY IN VIRTUAL MACHINES AND CLOUD COMPUTING

Virtual Machines, Cloud Computing. Secure Application Design: Secure Development Lifecycle, Application Security Practices, Web Application Security, Client Application Security, Remote Administration Security. Physical Security: Classification of Assets, Physical Vulnerability Assessment, Choosing Site Location for Security, Securing Assets: Locks and Entry Controls, Physical Intrusion Detection.

FOR FURTHER READING

Impact of security breaches Secure operating systems

Total: 45 Hours

Reference(s)

1. Josiah Dykstra, Essential Cybersecurity Science, O'Reilly, 5^{th} Ed, 2017.
2. Mark Rhodes-Ousley, The Complete Reference: Information Security, McGraw-Hill, 2^{nd} Ed, 2013.
3. Wm.Arthur Conklin, Greg White, Principles of Computer Security: CompTIA Security+ and Beyond, McGraw Hill, 2^{nd} Ed, 2010.
4. MS.M.K.Geetha&Ms.SwapneRaman Cyber Crimes and Fraud Management, MACMILLAN,2012.
5. Pankaj Agarwal : Information Security & Cyber Laws (Acme Learning), Excel, 2013.
6. VivekSood, Cyber Law Simplified, TMH, 2012.

21CT603 PARALLEL AND DISTRIBUTED COMPUTING 3 0 0 3

Course Objectives

- To understand the need and fundamentals of parallel computing paradigms
- To learn the nuances of parallel algorithm design
- To implement the programming principles in parallel and distributed computing architectures

Course Outcomes (COs)

1. Apply parallel and distributed computing architectures for any given problem
2. Apply problem solving (analysis, design, and development) skills to distributed applications
3. Develop applications by incorporating parallel and distributed computing architectures
4. Develop applications by incorporating fault tolerance
5. Implement Convert a sequential algorithm to a parallel one

Articulation Matrix

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

UNIT I 9 Hours

INTRODUCTION TO PARALLEL COMPUTING

Scope of Parallel Computing – Parallel Programming Platforms – Implicit Parallelism – Limitations of Memory System Performance – Control Structure of Parallel Platforms – Communication Model of Parallel Platforms – Physical Organization of Parallel Platforms – Communication Costs in Parallel Machines – Impact of Process - Processor Mapping and Mapping Techniques.

UNIT II 9 Hours

PARALLEL ALGORITHM DESIGN

Preliminaries – Decomposition Techniques – Characteristics of Tasks and Interactions – Mapping Techniques for Load Balancing – Methods for Containing Interaction Overheads – Parallel Algorithm Models – Basic Communication Operations – One-to-All Broadcast and All-to-One Reduction – All-to-All Broadcast and Reduction – All-Reduce and Prefix Sum Operations – Scatter and Gather – All-to-All Personalized Communication- Circular Shift – Improving the Speed of some Communication Operations

UNIT III 9 Hours

PROGRAMMING USING MESSAGE PASSING AND SHARED ADDRESS SPACE

Principles of Message Passing Programming – Building Blocks – Send and Receive Operations – MPI – Message Passing Interface – Topologies and Embedding – Overlapping Communication with Computation – Collective Communication and Computation Operations – Groups and Communicators – POSIX thread API – OpenMP: a Standard for Directive based Parallel Programming – Applications of Parallel Programming - Matrix-Matrix Multiplication – Solving Systems of Equations – Sorting Networks - Bubble Sort Variations – Parallel Depth First Search.

UNIT IV **9 Hours**

DISTRIBUTED COMPUTING PARADIGM

Paradigms for Distributed applications – Basic algorithms in Message passing Systems – Leader Election in Rings – Mutual Exclusion in Shared Memory

UNIT V **9 Hours**

FAULT TOLERANT DESIGN

Synchronous Systems with Crash Failures – Byzantine Failures – Impossibility in Asynchronous Systems - Formal Model for Simulation – Broadcast and Multicast – Specification of a Broadcast Service – Implementing a Broadcast Service – Multicast in Groups – Distributed Shared Memory – Linearizable – Sequentially Consistent Shared Memory – Algorithms

FOR FURTHER READING

Impact of distributed computing in real world problems.

Total: 45 Hours

Reference(s)

1. Ananth Grama, Anshul Gupta, George Karypis and Vipin Kumar, ―Introduction to Parallel Computing‖, Second Edition, Pearson Education, 2009.
2. Haggit Attiya and Jennifer Welch, ―Distributed Computing – Fundamentals, Simulations and Advanced Topics‖, Second Edition, Wiley, 2012.
3. Norman Matloff, ―Parallel Computing for Data Science – With Examples in R, C++ and CUDA‖, Chapman and Hall/CRC, 2015.
4. Wan Fokkink, ―Distributed Algorithms: An Intuitive Approach‖, MIT Press, 2013.
5. M.L. Liu, ―Distributed Computing – Principles and Applications‖, First Edition, Pearson Education, 2011.

21CT607 MACHINE LEARNING LABORATORY 0 0 2 1

Course Objectives

- Make use of Data sets in implementing the machine learning algorithms
- Implement the machine learning concepts and algorithms in any suitable language of choice

Course Outcomes (COs)

1. Implement machine learning algorithms using Java or python.
2. Solve machine learning and problems relevant to machine learning.

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	1	2		2			3					2	

EXPERIMENT 1 **2 Hours**

Demonstrate the FIND-S algorithm for TV shows.

EXPERIMENT 2 **4 Hours**

Implement the candidate elimination algorithm for Enjoysport.

EXPERIMENT 3 **2 Hours**

Build the decision tree using the ID3 algorithm for PlayTennis.

EXPERIMENT 4 **4 Hours**

Implement the backpropagation algorithm, for Students exam score analysis based on the study time.

EXPERIMENT 5 **2 Hours**

Demonstrate the Weather condition with the target variable PlayTennis(Yes/No) using naive bayes classifier.

EXPERIMENT 6 **4 Hours**

Build an app using a naive bayes algorithm for the text documents includes positive and negative comments.

EXPERIMENT 7 **2 Hours**

Implement and predict the heart disease by using the bayesian network algorithm

EXPERIMENT 8 **4 Hours**

Demonstrate the EM algorithm, predict lung cancer using k-means clustering.

EXPERIMENT 9 **2 Hours**

Build an app for Flower dataset classification by applying the KNN algorithm.

EXPERIMENT 10 **4 Hours**

Develop an app using the locally weighted regression algorithm for Tips calculation in the hotel.

Total: 30 Hours

21CT608 SECURITY LABORATORY **0 0 2 1**

Course Objectives

- Make use of basic concepts and challenges in security
- Implement the use of modern tools to resolve the security issues
- Implement the cyber security principles and methods in organization.

Course Outcomes (COs)

1. Acquire the knowledge about the usage of routers and Internet Protocol to implement the connectivity among the devices.
2. Implement the concept of security in computing using security tools to configure the devices.

Articulation Matrix

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

EXPERIMENT 1 **4 Hours**

Implement the OSPF MD5, NTP, Syslog, and SSH on Routers in Enterprise networks.

EXPERIMENT 2 **4 Hours**

Configure the Secure Router Access with Local AAA Authentication in Home networks or Lab environments.

EXPERIMENT 3 **2 Hours**

Configure the Network Control with Extended Numbered ACLs in Cloud environments.

EXPERIMENT 4 **4 Hours**

Implement a IP & IPv6 ACLs for Access Control and Attack Mitigation in financial transactions

EXPERIMENT 5 **2 Hours**

Implement a Zone-Based Policy Firewall Configuration in Educational institutions

EXPERIMENT 6 **2 Hours**

Implement an Enabling and Customizing IOS Intrusion Prevention System using CLI in Telecommunications.

EXPERIMENT 7 **4 Hours**

Implement a Robust Layer 2 Security on the Central Switch in Healthcare Networks.

EXPERIMENT 8 **4 Hours**

Implement a Secure Layer 2 VLANs and Establishing Secure Site-to-Site VPN Connections in Government agencies

EXPERIMENT 9 **4 Hours**

Configure a ASA with CLI for Routing, Access Control, and Services in E-commerce Applications

Total: 30 Hours

Reference(s)

1. Josiah Dykstra, Essential Cybersecurity Science, O'Reilly, 5th Ed, 2017.
2. Mark Rhodes-Ousley, The Complete Reference: Information Security, McGraw-Hill, 2nd Ed, 2013.
3. Wm.Arthur Conklin, Greg White, Principles of Computer Security: CompTIA Security+ and Beyond, McGraw Hill, 2nd Ed, 2010.
4. MS.M.K.Geetha&Ms.SwapneRaman Cyber Crimes and Fraud Management, MACMILLAN,2012.
5. Pankaj Agarwal : Information Security & Cyber Laws (Acme Learning), Excel, 2013.
6. VivekSood, Cyber Law Simplified, TMH, 2012.

18GE601 SOFT SKILLS-APTITUDE II **0 0 2 0**

Course Objectives

- Expose the undergraduate students to such methods and practices that help, develop and nurture qualities such as character, effective communication, aptitude and holding ethical values. It will provide a lot of activities and examples for a student to learn and develop these life skills.

Course Outcomes (COs)

1. Apply the concepts of probability, Sets, Permutation and Combinations in estimating data for real time problems.
2. Understand the concept of logarithms, progressions and Simple and Compound interest to solve various practical problems.
3. Analyse objects involving cubes and cuboids in determining the number of sides colored.
4. Interpret various data from graphs and tables to determine ratio, percentage and averages.
5. Apply the logical reasoning skills for identifying age, relations, visual relations and puzzles.

Articulation Matrix

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

1 **2 Hours**

Definition-Fundamental rules-Theorems on Permutation-Theorems on Combination.

2 **2 Hours**

PROBABILITY

Concept and Importance of Probability-Underlying factors for real Life estimation of probability-Basic facts about probability-Some important consideration while defining event.

3 **2 Hours**

SYLLOGISM AND VENN DIAGRAM

Concepts on Syllogisms-Venn diagram-Interpretation-Venn diagram-solving.

4 **2 Hours**

SIMPLE INTEREST AND COMPOUND INTEREST

Introduction-Definition - Effect of change of P, R, T on simple interest-Amount-Amount becomes N times the principle-Repayment of debt in equal installments-Rate and time are numerically equal-Compound nterest-Conversion period-Basic formula-Special cases-To find the principle / Time /Rate-Difference between Compound Interest and Simple Interest-Equal annual installment to pay the borrowed amount.

5 **2 Hours**

MIXTURES AND ALLIGATION

Definition - Alligation rule-Mean value (cost price) of the mixture-Some typical situations where allegation can be used.

6 **2 Hours**

CUBE AND LOGARITHM

Introduction-Basic Concepts of Cube and Cuboid-Problems involving cubes and cuboids of various dimensions-Problems involving coloured cubes and cuboids - Basic concepts of Logarithm-Laws of Logarithms including change of base-Common logarithm (base 10) - Properties of Logarithms to solve equations involving logarithmic expressions.

7 **2 Hours**

DATA INTERPRETATION

Introduction-Ratio-Percentage-Average-Tables - Graphs and Charts.

8 **2 Hours**

PROGRESSION AND LOGICAL REASONING

Arithmetic progression-Geometric progression-Harmonic progression-Theorems related with progressions.

9 **2 Hours**

PROBLEM ON AGES

Introduction-Basic concept-Usage of Percentage and Averages -Applications.

10 **2 Hours**

ANALYTICAL REASONING

Introduction-Basic concept-Non verbal Analytical Reasoning -Arrangements.

11 **2 Hours**

BLOOD RELATION

Introduction-Basic concept-Kinds of relation-Tree diagram -Relations.

12 **4 Hours**

VISUAL REASONING

Introduction-Basic concepts-Odd man out-Next series-Mirror image and water image

13 **4 Hours**

SIMPLIFICATIONS

Introduction-Basic concepts-Arithmetic operations-Equation solving methods-Puzzles.

Total: 30 Hours

Reference(s)

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Mc Graw Hill Publications.
2. U. Mohan Rao, Quantitative Aptitude for Competitive Examinations, Scitech publications Pvt Ltd, India.
3. Dinesh Khattar, The Pearson Guide to Quantitative Aptitude for Competitive Examinations, Third Edition, Pearson Education Pvt Ltd, India, 2016.

4. Dr. R S Aggarwal, A Modern Approach to Verbal and Non Verbal Reasoning, Revised Edition, S Chand Publications.
5. Arun Sharma, How to prepare for Logical Reasoning for CAT & other Management Exams, Fifth Edition, Mc Graw Hill Publications.
6. Jaikishan and Premkishan, How to Crack Test of Reasoning in all Competitive Examinations, Revised Edition, Arihant Publications.

21HS002 **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.

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

21CT702 CLOUD COMPUTING TECHNIQUES 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

Course Outcomes (COs)

1. Analyze the components of cloud computing showing how business agility in an organization can be created.
2. Design and develop highly scalable cloud-based applications by creating and configuring virtual machines on the cloud.
3. Analyze the key concepts of AWS storage for load balancing in cloud architecture.
4. Investigate how a Windows Azure solution can be optimized so that it can be delivered successfully from the windows cloud
5. Identify the risks and benefits of implementing cloud computing.

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								2	
5	1		3		2								2	

UNIT I **9 Hours**

INTRODUCTION TO CLOUD COMPUTING

Cloud computing at a glance - Historical developments -building cloud computing environments -Cloud Computing Architecture: The cloud reference model, deployment model & service model - computing platforms and technologies.

UNIT II **9 Hours**

VIRTUALIZATION

Introduction & benefit of Virtualization -Implementation Levels of Virtualization- Virtualization at OS level - Virtualization structure - Xen Virtualization Architecture - Binary Translation with full Virtualization - Para Virtualization with Compiler Support - Virtualization in Intex x86processor

UNIT III **9 Hours**

AMAZON WEB SERVICES

AWS Infrastructure - AWS ecosystem - AWS API & security - Amazon Storage - Simple Storage Service(S3) - Elastic Block Storage (EBS) - AWS Security policies, AWS compliance initiatives, Understanding public/private keys - AWS networking and databases service.

UNIT IV **9 Hours**

WINDOWS AZURE

Windows Azure Architecture and components of the Windows Azure Platform, Role of the Fabric Controller - Web worker, VM in Windows Azure, Azure Storage, SQL Azure - Windows Azure Web roles - Windows Azure API- Windows Azure local storage- Blob Storage & Table Storage

UNIT V **9 Hours**

SECURITY

Security for Virtualization Platform - Host security for SaaS, PaaS and IaaS - Data Security - Data Security Concerns - Data Confidentiality and Encryption - Data Availability - Data Integrity - Cloud Storage Gateways - Cloud Firewall.

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.
   https://www.oreilly.com/library/view/cloud-security-and/9780596806453/ch04.html

21CT707 CLOUD COMPUTING LABORATORY 0 0 2 1

Course Objectives

- Understand the basic networking fundamentals to use different devices to build network
- To install, use, and manage virtual machines in Oracle VirtualBox
- To deploy applications on Windows Azure, Amazon Webservices and Google Cloud

Course Outcomes (COs)

1. Understand the fundamental concepts of networking and analyze the networking components for communication
2. To Install, Configure and administer Windows and Linux OS on Virtualbox
3. Deploy virtual machines in openstack cloud through horizon dashboard.
4. Deploy applications in Microsoft Windows Azure platform
5. Deploy applications in Amazon Web Services and Google Cloud

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	2	1	3											
2	3	2	3											
3	2	2	2										2	
4	2	3	1											2
5	2	3	3											2

EXPERIMENT 1 **3 Hours**
Set up a small local area network (LAN) using routers, switches, and computers.

EXPERIMENT 2 **3 Hours**
Configure a Virtual Box or VMware Workstation with different flavors of Linux or Windows OS on top of Windows 10 or 11.

EXPERIMENT 3 **5 Hours**
Configure the Virtualbox to boot from the installation media (ISO).

EXPERIMENT 4 **5 Hours**
Configure and launch a new instance in OpenStack.

EXPERIMENT 5 **6 Hours**
Configure the Azure portal to create a new Storage Account for Blob Storage.

EXPERIMENT 6 **4 Hours**
Create and Deploy a simple static website on AWS S3

EXPERIMENT 7 **4 Hours**
Create and Deploy a Node.js App on Google App Engine

Total: 30 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
   https://www.oreilly.com/library/view/cloud-security-and/9780596806453/ch04.html

21CT708 **PROJECT WORK I** **0 0 6 3**

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.

Course Outcomes (COs)

1. Formulate a real-world problem, identify the requirement, and develop the design solutions.
2. Identify technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare 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	3	2	3	3
4	2	2	3	3	3	3	3	3	3	3	3	2	3	3
5	2	2			2			3	3	3		2	3	3

21CT801 **PROJECT WORK II** **0 0 18 9**

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.

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare 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

18HS201 **COMMUNICATIVE ENGLISH II** **1 0 2 2**

Course Objectives

- Read and understand ideas of complex text on both concrete and abstract topics
- Listen and understand technical discussions in his/her field of specialization
- Produce clear, detailed text on a wide range of subjects and explain a viewpoint on a topical issue giving the advantages and disadvantages of various options
- Interact with a degree of fluency and spontaneity that makes regular interaction without strain

Programme Outcomes (POs)
Course Outcomes (COs)

1. Use appropriate grammar and vocabulary that is expected at the BEC Vantage exam level.
2. Understand the general meaning of non-routine letters, and of a report of predictable / unpredictable topic
3. Write simple reports of factual nature and factual non-routine letters
4. Ask for factual information and understand the answer; and take/pass on workplace messages
5. Express opinions and present arguments to a limited extent; and give simple, prepared presentations on familiar topics

Articulation Matrix

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

UNIT I **9 Hours**

GRAMMAR3

Tenses - Future continuous, Future perfect, Future perfect continuous, Past perfect, Past perfect continuous - Adjectives and adverbs - Mixed conditionals - Modals - can't have, needn't have - Modals of deduction and speculation - Narrative tenses - Passives - Phrasal verbs, extended - Relative clauses - Reported speech - Will and going to, for prediction - Wish - Would expressing habits, in the past.

UNIT II **9 Hours**

READING

Scanning and reading for gist - Understanding text structure - Reading for gist and specific information - Vocabulary and structure - Understanding sentence structure and error identification

UNIT III **9 Hours**

WRITING

A message, memo or email, Giving instructions, explaining a development, asking for comments, requesting information, agreeing to requests - Business correspondence: explaining, apologising, reassuring, complaining, short report: describing, summarising - proposal: describing, summarising, recommending, persuading.

UNIT IV **9 Hours**

LISTENING

Listening for and noting specific information - Listening to identify topic, context, Function - Following the main points and retrieving specific information from the text.

UNIT V **9 Hours**

SPEAKING

Giving personal information: Talking about present circumstances, past experiences and future plans, expressing opinions, speculating - Organising a larger unit of discourse: Giving information and expressing and justifying opinions - Turn-taking: negotiating, collaborating, exchanging information, expressing and justifying opinions, agreeing/disagreeing, suggesting, speculating, comparing and contrasting, and decision- aking. 1.A Horse and Two Goats - R K Narayan 2.My Lord the Baby - Rabindranath Tagore 3.Twist in the Tale - Jeffery Archer.4.The Third and Final Continent - Jhumpa Lahiri 5.The Gift of the Magi - O Henry

Total: 45 Hours

Reference(s)

1. Guy Brook-Hart, "BEC Vantage: Business Benchmark Upper-Intermediate- Student's Books" 1st Edition, Cambridge University Press, New Delhi, 2006.
2. Ian Wood, Paul Sanderson, Anne Williams with Marjorie Rosenberg, "Pass Cambridge BEC Vantage- Student's Book" 2nd Edition, Cengage Learning, New Delhi, 2014
3. Michael Handford, Martin Lisboa, Almut Koester, Angela Pitt, "Business Advantage - Student's Book Upper-Intermediate" Cambridge University Press, New Delhi, 2014.
4. Cambridge Examinations Publishing, "Cambridge BEC VANTAGE - Self-study Edition", Cambridge University Press, UK, 2005.

18HSC01 **CHINESE** **1 0 2 2**

Course Objectives

- To help students appear for HSK Level 1 Exam
- To help students acquire the basics of Chinese language
- To teach the students how to converse in Chinese in various situations

Programme Outcomes (POs)
Course Outcomes (COs)

1. listen and identify individual sounds of Chinese
2. use basic sounds and words while speaking
3. read and understand short passages on familiar topics
4. use basic sentence structures while writing
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										2				
2										2				
3										3				
4										2				
5										3				

UNIT I **9 Hours**

Hello | 1.Initials and Finals of Chinese | b,p,m,f,d,,n,l,g,k,h,j,q,x | 2. Tones Four | 3.Chinese Syllables | 4.Tone S

UNIT II **9 Hours**

Thank you | Initials and Finals of Chinese | The Neutral Tone | Rules of Tone Marking and Abbreviation

UNIT III **9 Hours**

1. What""s your name - In the school; -In the classroom; -In the school | The Interrogative Pronoun | 2 The Sentence | 3 Interrogative Sentences with

UNIT IV **9 Hours**

She is my Chinese teacher | In the library | The Interrogative Pronouns | The Structural Particle | The interrogative Particle

UNIT V **9 Hours**

Her daughter is 20 years old this year | 1.The Interrogative Pronoun | 2. Numbers below 100 | 3.Indicating a Change | The Interrogative Phrase

Total: 45 Hours

18HSF01 **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)
Course Outcomes (COs)

1. To 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										2				
2										2				
3										3				
4										2				
5										3				

UNIT I **9 Hours**

ENTRER EN CONTACT

La langue francaise, alphabets, les numeros, les jours, les mois.| Grammaire Les verbes s appeler,etre, avoir, les articles definis, indefinis | Communication - Saluer, s informer sur quelquun, demander de se presenter | Lexique - Les alphabets, les nationalites, 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, d ecrire son voisin, s informer sur un logement | Lexique - L habitat, les pieces, l equipement, la description physique

UNIT III **9 Hours**

VIVRE AU QUOTIDIEN

Grammaire - Articles contractes, verbes vouloir, pouvoir, devoir, adjective interrogative, 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**

COMPREHENDRE SON ENVIRONNEMENT - OUVRIR -Ãƒ?Ã‚Â LA CULTURE

Grammaire - Verbes - Finir, Sortir, les adjectifs demonstratifs, le passe compose, l imparfait | Communication - Propose quelqu un de faire quelque chose, raconteur une sortie au passe parler un film | Lexique - Les sorties, la famille, 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 refuse rune invitation, donner des instructions, commander au restaurant | Lexique Les services et les commerces, les aliments, les ustensiles, argent

Total: 45 Hours

Reference(s)

1. Saison A1, Methode de francais
2. Hachette FLE

18HSG01 **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)

Course Outcomes (COs)

1. Listen and identify individual sounds of German
2. Use basic sounds and words while speaking
3. Read and understand short passages on familiar topics
4. Use basic sentence structures while writing
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										2				
2										2				
3										3				
4										2				
5										3				

UNIT I **9 Hours**

Introduction to German language: Alphabet - Numbers - Greetings - Days and Seasons- Working with Dictionary.

UNIT II **9 Hours**

Nouns - articles - Speaking about one self - Listening to CD supplied with the books, paying special attention to pronunciation

UNIT III **9 Hours**

Regular & Irregular verbs - Personal pronouns - family - Introduction to types of sentences

UNIT IV **9 Hours**

Question words-Types of Questions - Nominative case- Verb Conjugation - country - nationalities

UNIT V **9 Hours**

Verbs - to be & to have - conjugation - Hobbys - Framing basic Questions and answers

Total: 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.

18HSH01 **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 acquire the ability to understand a simple technical text in Hindi

Programme Outcomes (POs)

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. Appear for 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										2				
2										2				
3										3				

UNIT I **9 Hours**

Hindi Alphabet: Introduction - Vowels - Consonants - Plosives - Fricatives - Nasal sounds - Vowel Signs - Chandra Bindu & Visarg -Table of Alphabet -Vocabulary.

UNIT II **9 Hours**

Nouns: Genders (Masculine & Feminine Nouns long vowels and short vowels - -Masculine & Feminine - Reading Exercises.

UNIT III **9 Hours**

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: Parts of body - Relatives - Spices - Eatables - Fruit & Vegetables - Clothes - Directions - Seasons - Professions.

UNIT V **9 Hours**

Speaking: Model Sentences and Rhymes - Speaking practice for various occasions.

Total: 45 Hours

Reference(s)

1. Hindi Prachar Vahini-1 by Dakshin Bharat Hindi Prachar Sabha Chennai
2. B.R. Kishore, Self Hindi Teacher for Non-Hindi Speaking People,Vee Kumar Publications(P)Ltd., New Delhi,2009
3. Videos, Stories, Rhymes and Songs

18HSJ01 **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 etiquettes

Programme Outcomes (POs)

Course Outcomes (COs)

1. Recognise 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										2				
2										2				
3										3				
4										2				
5										3				

UNIT I **9 Hours**

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. N1 wa N2 desu - N1 wa N2 ja arimasen - S ka N1 mo - N1 no N2 - san - Kore - Sore - Are - Kono N - Sono N - Ano N - Sou desu - Sou ja Arimasen - S1 ka - S2 ka - N1 no N2 - Sou desu ka - Koko - Soko - Asoko - Kochira - Sochira Achira - N1 wa N2 (place) desu - Doko - Dochira - N1 no N2 - Ko - So - A - Do (Demonstrative words) - O kuni Kanji10 - Technical Japanese Vocabulary (30 Numbers)

UNIT II **9 Hours**

Introduction to time - Ji - Fun - Pun - Introduction of verbs - V Masu - V Masen - V Mashita - V Masendeshita N (Time) Ni V - N1 Kara - N2 Made - N1 to N2 - S Ne - N (Place) e Ikimasu - Kimasu - Kaerimasu - Doko (e) Mo Ikimasen - Ikimasendeshita - N (Vechile) de Ikimasu - Kimasu - Kaerimasu - N (Person / Animal) to V - Itsu - S Yo N o (transitive) - N o Shimasu - Nani o Shimasuka - Nan and Nani - N (place) de V - V Masenka - V Mashou - o - Kanji 10 - Technical Japanese Vocabulary (30 Numbers) .

UNIT III **9 Hours**

N (tool/means) de V - Word/Sentence wa Go de Nani desu ka - N (person) Ni Agemasu, etc - N (person) Ni Moraimasu etc - Mou V Mashita - Introduction to Adjectives - N wa Na adj (Na) desu - N wa II adj (II) desu - Na adj Na n - II adj (II) N - Totemo - Amari - N wa Dou desuka - N1 wa Donna N2 desuka - S1 Ga S2 - Dore N ga Arimasu - Wakarimasu - N Ga Sukidesu - Kiraidesu - Jozu desu - Heta desu - Donna N -

Yoku - Daitai - Takusan - Sukoshi - Amari - Zenzen - S1 kara S2 - Doushite - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

UNIT IV **9 Hours**

N ga Arimasu - Imasu - N1 (place) Ni N2 ga Arimasu - Imasu - N1 (thing/person/place) no N2 (position) - N1 ya N2 - Word (s) desuka - Chirisosu wa Arimasuka - Saying numbers - Quantifier (period) Ni kai V - Quantifier Dake - N dake - Past tense of Noun sentences and Na adjective sentences - Past tense of ii adjective sentences - N1 wa N2 yori adjective desu - N1 to N2 to dochira ga adjective desu ka - N1/N2 no houga adjective desu - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

UNIT V **9 Hours**

N ga hoshi desu - V masu form tai desu - N (place) e V masu form - N Ni - ikimasu - kimasu - kaerimasu N ni V - N o V - dou ko ka - nani ka - go chuu mon - Verb conjugation - Verb groups - Verb te form - V te form kudasai - V te form imasu - V masu from mashouka - S1 ga S2 - N ga V - V te form mo ii desu - V te form wa ikemasen - V te form imasu Shrimasen - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

Total: 45 Hours

Text Book(s)

1. Japanese for Everyone: Elementary Main Textbook 1-2, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

Reference(s)

1. Japanese for Everyone: Elementary Main Textbook1-1, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

21CT001 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.

Course Outcomes (COs)

1. Understand the fundamentals of exploratory data analysis.
2. Implement the data cleaning and preparation techniques.
3. Apply advanced data visualization techniques to explore complex relationships and patterns in the data.
4. Analyze and interpret 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 5 Hours

Explore the Titanic dataset using descriptive statistics and data visualization.

1. Load the Titanic dataset.
2. Calculate the descriptive statistics for each variable.
3. Create a variety of data visualizations to explore the relationships between variables.
4. Interpret the results of the descriptive statistics and data visualizations.

EXPERIMENT 2 5 Hours

Clean and prepare the California housing dataset for analysis.

1. Identify and handle missing data.
2. Identify and remove outliers.
3. Convert categorical variables to numerical variables.
4. Explore the distribution of the data after cleaning and preparing it.

EXPERIMENT 3 5 Hours

Perform univariate analysis on the Iris dataset.

1. Calculate the descriptive statistics for each variable.
2. Create a variety of data visualizations to explore the distribution of each variable.
3. Interpret the results of the descriptive statistics and data visualizations.

EXPERIMENT 4 5 Hours

Perform bivariate analysis on the Boston housing dataset.

1. Explore the relationship between housing prices and different features of the houses, such as the number of rooms, the lot size, and the crime rate.
2. Use data visualization to explore the relationships between variables.
3. Interpret the results of the bivariate analysis.

EXPERIMENT 5 5 Hours

Perform multivariate analysis on the Wine dataset.

1. Explore the relationships between different features of the wine, such as the color, the acidity, and the alcohol content.
2. Use data visualization to explore the relationships between variables.
3. Interpret the results of the multivariate analysis.

EXPERIMENT 6 **5 Hours**

Apply dimensionality reduction techniques to the MNIST dataset.
1. Use PCA to reduce the dimensionality of the dataset from 784 dimensions to 2 dimensions.
2. Visualize the reduced data using a scatter plot.
3. Interpret the results of the dimensionality reduction.

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

21CT002 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

Course Outcomes (COs)

1. Understand the basic concepts of recommender systems.
2. Implement machine-learning and data-mining algorithms in recommender systems data sets.
3. Implementation of Collaborative Filtering in carrying out performance evaluation of recommender systems based on various metrics.
4. Implement a simple recommender system.
5. Learn about Evaluating Paradigms of recommender systems and its applications.

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	
2	1	2	1	1	1								3	
3	2	3	1	1	1								2	
4	3	2	2	2	1								2	
5	2	2	1	2	1								3	

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

21CT003 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

Course Outcomes (COs)

1. Understand the big data and use cases from selected business domains.
2. Understand NoSQL big data management.
3. Utilize map reduce analytics and related tools.
4. Understand the basics of Hadoop.
5. Apply the usage of 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	2	2	3		3								2	
3	1	3	3		3								2	
4	2	2	2		3								3	
5	2	2	1		3								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.

FOR FURTHER READING

Selecting NoSQL / SQL based on applications – Bigquery – Data analytics with R language – Connecting to Mongo DB – Connecting to Cassandra – Linear Regression – Clustering – Collaborative filtering – Association rule mining – Decision tree.

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.

21CT004 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

Course Outcomes (COs)

1. Apply Convolution Neural Network for any suitable applications.
2. Analyze the various categories of associative memory and unsupervised learning networks.
3. Apply Convolutional Neural Networks and its variants for any suitable applications.
4. Analyze the key computations underlying deep learning and use them to build and train deep neural networks for various tasks.
5. Apply autoencoders and generative models for suitable applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	1		1								2	
2	2	2	3		3								2	
3	2	3	3		3								2	
4	2	2	2		3								2	
5	2	2	1		3								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-Auto associative Memory Network-Hetero associative Memory Network-Bidirectional Associative Memory (BAM)-Hopfield Networks-Iterative Auto associative Memory Networks-Temporal Associative Memory Network-Fixed Weight Competitive Nets-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 – Structured Outputs – Data Types – Efficient Convolution Algorithms – Neuroscientific Basis – Applications: Computer Vision, Image Generation, Image Compression.

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- VC Dimension and Neural Nets.

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. Complete Auto encoder, Regularized Autoencoder, Stochastic Encoders and Decoders, Contractive Encoders.

FOR FURTHER READING

Neocognition architecture – Neocognition Data processing – Generative Deep Learning- Deep Learning for Time Series

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. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2016.
5. Francois Chollet, “Deep Learning with Python”, Second Edition, Manning Publications, 2021. 6. Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020
6. Josh Patterson, Adam Gibson, “Deep Learning: A Practitioner’s Approach”, O’Reilly Media, 2017.

21CT005 NATURAL LANGUAGE PROCESSING 3 0 0 3

Course Objectives

- To understand basics of linguistics, probability and statistics
- To study statistical approaches to NLP and understand sequence labeling
- To outline different parsing techniques associated with NLP
- To explore semantics of words and semantic role labeling of sentences
- To understand discourse analysis, question answering and chatbots

Course Outcomes (COs)

1. Understand basics of linguistics, probability and statistics associated with NLP
2. Implement a Part-of-Speech Tagger
3. Design and implement a sequence labeling problem for a given domain
4. Implement semantic processing tasks and simple document indexing and searching system using the concepts of NLP
5. Implement a simple chatbot using dialogue system concepts

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	3		3								2	
3	2	3	3		3								2	
4	3	2	2		3								2	
5	2	2	1		3								2	

UNIT I **9 Hours**

INTRODUCTION

Natural Language Processing – Components - Basics of Linguistics and Probability and Statistics – Words-Tokenization-Morphology-Finite State Automata.

UNIT II **9 Hours**

STATISTICAL NLP AND SEQUENCE LABELING

N-grams and Language models –Smoothing -Text classification- Naïve Bayes classifier –Evaluation - Vector Semantics – TF-IDF - Word2Vec- Evaluating Vector Models –Sequence Labeling – Part of Speech – Part of Speech Tagging -Named Entities –Named Entity Tagging

UNIT III **9 Hours**

CONTEXTUAL EMBEDDING

Constituency –Context Free Grammar –Lexicalized Grammars- CKY Parsing – Earley's algorithm Evaluating Parsers -Partial Parsing – Dependency Relations- Dependency Parsing –Transition Based - Graph Based.

UNIT IV **9 Hours**

COMPUTATIONAL SEMANTICS

Word Senses and WordNet – Word Sense Disambiguation – Semantic Role Labeling – Proposition Bank FrameNet- Selectional Restrictions - Information Extraction - Template Fill

UNIT V **9 Hours**

DISCOURSE ANALYSIS AND SPEECH PROCESSING

Discourse Coherence – Discourse Structure Parsing – Centering and Entity Based Coherence – Question Answering –Factoid Question Answering – Classical QA Models – Chatbots and Dialogue systems – Frame-based Dialogue Systems – Dialogue–State Architecture.

FOR FURTHER READING

Frame-based Dialogue Systems – Dialogue–State Architecture

Total: 45 Hours

Reference(s)

1. Daniel Jurafsky and James H.Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition" (Prentice Hall Series in Artificial Intelligence), 2020.
2. Jacob Eisenstein. "Natural Language Processing ", MIT Press, 2019.
3. Samuel Burns "Natural Language Processing: A Quick Introduction to NLP with Python and NLTK, 2019.
4. Christopher Manning, "Foundations of Statistical Natural Language Processing", MIT Press,2009.
5. Nitin Indurkhya,Fred J. Damerau, "Handbook of Natural Language Processing", Second edition, Chapman & Hall/CRC: Machine Learning & Pattern Recognition, Hardcover,2010.

21CT006 COMPUTER VISION 3 0 0 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 and motion estimation
- To develop skills on 3D reconstruction
- To understand image based rendering and recognition

Course Outcomes (COs)

1. To understand basic knowledge, theories and methods in image processing and computer vision.
2. To implement basic and some advanced image processing techniques in OpenCV.
3. To apply 2D a feature-based based image alignment, segmentation and motion estimations.
4. To apply 3D image reconstruction techniques
5. To design and develop innovative image processing and computer vision applications.

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		1		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 **9 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 **9 Hours**

FEATURE DETECTION, MATCHING AND SEGMENTATION

Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge - Mean shift and mode finding - Normalized cuts - Graph cuts and energy-based methods.

UNIT III **9 Hours**

FEATURE-BASED ALIGNMENT & MOTION ESTIMATION

2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration - Triangulation - Two-frame structure from motion - Factorization - Bundle adjustment - Constrained structure and motion - Translational alignment - Parametric motion - Spline-based motion - Optical flow - Layered motion.

UNIT IV **9 Hours**

3D RECONSTRUCTION

Shape from X - Active range finding - Surface representations - Point-based representations Volumetric representations – Model-based reconstruction - Recovering texture maps and albedosos.

UNIT V **9 Hours**

IMAGE-BASED RENDERING AND RECOGNITION

View interpolation Layered depth images - Light fields and Lumigraphs - Environment mattes – Video based Rendering-Object detection - Face recognition - Instance recognition - Category recognition -Context and scene understanding- Recognition databases and test sets.

Total: 45 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.

21CT007 **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.

Course Outcomes (COs)

1. Understand genesis of Agile and driving forces for choosing Agile techniques.
2. Apply the Agile Scrum framework and development practices.
3. Apply iterative software development processes by planning and executing them.
4. Analyze the impact of the success of social aspects behind the software testing.
5. Analyze techniques and tools for improving team collaboration and management.

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	2	2	2										2	
3	1		2		2							2	2	
4	1		2		2							2	2	
5	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 – institutional knowledge 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.

21CT008 **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

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	2	2		1									2
3		3	3		1									2
4		2	2											2
5		2	2											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 & WIREFRAMING

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.
7. Baecker, Ronald M., Jonathan Grudin, et al. Readings in Human-Computer Interaction: Toward the Year 2000. 2nd ed. Morgan Kaufmann, 1995. ISBN: 9781558602465.
8. Shneiderman, Ben, and Catherine Plaisant. Designing the User Interface: Strategies for Effective Human-Computer Interaction. 4th ed. Addison Wesley, 2004. ISBN: 9780321197863.
9. Dix, Alan J., Janet E. Finlay, et al. Human-Computer Interaction. 2nd ed. Prentice Hall, 1998. ISBN: 9780132398640.
10. Olsen, Dan R. Developing User Interfaces (Interactive Technologies). Morgan Kaufmann, 1998. ISBN: 9781558604186.

21CT009 **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

Course Outcomes (COs)

1. Apply modules and components and Animations for creating Forms and developing webpages
2. Create web applications by performing CRUD operations in database using webframeworks
3. Design Progressive Web Application with dynamic HTML web pages using Angular.
4. Design single page applications with reusable UI components using React CSS andSaaS
5. Use 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	1		1		3								3	
3	1		2		2								3	
4	1		1		3								2	
5	1		1		3								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

21CT010 APP DEVELOPMENT 2 0 2 3

Course Objectives

- To facilitate students to understand android SDK
- To help students to gain a basic understanding of Android application development
- To inculcate working knowledge of Android Studio development tool

Course Outcomes (COs)

1. Identify fundamental concepts of mobile programming that make it unique from programming for other platforms
2. Analyze the essential 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								2	
2	1	2	2		3								2	
3	1		2		3								2	
4	1	1	2		3								2	
5	1	2	2		3								2	

UNIT I 6 Hours

INTRODUCTION TO ANDROID

The Android Platform, Android SDK, Eclipse Installation, Android Installation, building your First Android application, Understanding the Android Manifest file.

UNIT II 6 Hours

ANDROID APPLICATION DESIGN ESSENTIALS

Anatomy of Android applications, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Using Intent Filter, Permissions.

UNIT III 6 Hours

COMMON ANDROID APIs

Testing Android applications, Publishing Android applications, Using Android Data and Storage APIs, managing data using Sqlite, Using Android Web APIs, Using Android Telephony APIs, Deploying Android Applications to the World.

UNIT IV 6 Hours

IoS USER INTERFACE DESIGN ESSENTIALS

Ios features, UI implementation, Touch frameworks, Data persistence using Core Data and SQLite, Integrating calendar and address book with social media application, Using Wifi, iPhonemarketplace.

UNIT V 6 Hours

APP DEVELOPMENT WITH FLUTTER

Flutter Introduction, Create First Flutter Application, exploring commonly used flutter widgets: Container, Margin, Padding and Box Constraints, Custom Fonts, Column and Expanded Widgets, Image Asset, Raised Button, and Alert Dialog.

EXPERIMENT 1 **5 Hours**

Develop a new Android application for Android Text to Speech converter.

EXPERIMENT 2 **5 Hours**

Create an application to design a Visiting Card for the travel agency using a Business card template.

EXPERIMENT 3 **5 Hours**

Develop a program for dynamic wallpaper on a PC.

EXPERIMENT 4 **5 Hours**

Implement the program for medicine schedule tracker in SQLite Database.

EXPERIMENT 5 **5 Hours**

Develop a mobile app for making phone calls using android intent.

EXPERIMENT 6 **5 Hours**

Design a simple webpage for an institution with the basic properties of Flutter app bar.

Total: 30+30=60 Hours

Reference(s)

1. Lauren Darcey and Shane Conder, "Android Wireless Application Development",Pearson Education, 2nd ed. (2011)
2. Reto Meier, "Professional Android 2 Application Development", Wiley India Pvt Ltd.
3. Mark L Murphy, "Beginning Android", Wiley India Pvt Ltd 3. R3. Android Application Development All in one for Dummies by Barry Burd.
4. Alberto Miola, "Flutter Complete Reference: Create beautiful, fast and native apps forany device" ISBN-13 9780141044804.
5. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, "Beginning iOS6Development: Exploring the iOS SDK", Apress, 2013.55.

21CT011 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

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.

21CT012 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

Course Outcomes (COs)

1. Understand 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. Ability to Perform Automated Continuous Deployment.
4. Ability to do configuration management using Ansible.
5. Understand to leverage Cloud-based DevOps tools using Azure DevOps.

Articulation Matrix

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

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/

21CT013 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.

Course Outcomes (COs)

1. Analyze the concept of virtualization and its properties.
2. Apply different forms of virtualization.
3. Implement various architectures for implementing virtualization methods.
4. Create 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		1	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 & 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 & 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

21CT014 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.

Course Outcomes (COs)

1. Evaluate the performance of the virtual machines and deployed applications. Apply Cloud Computing reference architecture for developing clouds
2. Analyze the different forms of cloud service models
3. Apply the characteristics and architecture of IaaS using various real-world applications.
4. Evaluate PaaS concepts and architectures with real-world examples.
5. Analyze, 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

21CT015 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

Course Outcomes (COs)

1. Analyze 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. Evaluate various storage networking architectures - SAN, including storage subsystems and virtualization.
4. Execute the different roles in providing disaster recovery and remote replication technologies.
5. Implement 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.

21CT016 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

Course Outcomes (COs)

1. Implement cloud native applications on AWS, Terraform etc.
2. Apply VM provisioning and migration in the cloud.
3. Analyze cloud automation and configuration.
4. Apply balance load and auto scaling in the cloud.
5. Analyze 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.

9 Hours

UNIT III

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.

21CT017 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. Analyze the functions of the data plane and control plane
3. Evaluate and develop network applications using SDN
4. Execute network services using NFV
5. Implement various use cases of SDN and NFV

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

SDN: 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 **6 Hours**

Setup your own virtual SDN lab
i) Virtual box/Mininet Environment for SDN - http://mininet.org
ii) https://www.kathara.org
iii) GNS3

EXPERIMENT 2 **6 Hours**

Create a simple mininet topology with SDN controller and use Wireshark to capture and visualize the OpenFlow messages such as OpenFlow FLOW MOD, PACKET IN, PACKET OUT etc.

EXPERIMENT 3 **6 Hours**

Create a SDN application that uses the Northbound API to program flow table rules on the switch for various use cases like L2 learning switch, Traffic Engineering, Firewall etc.

EXPERIMENT 4 **6 Hours**

Create a simple end-to-end network service with two VNFs using vim-emu https://github.com/containernet/vim-emu

EXPERIMENT 5 **6 Hours**

Install OSM and onboard and orchestrate network service.

Total:30+30= 60 Hours

Reference(s)

1. Fei Hu, Network Innovation through OpenFlow and SDN: Principles and Design, 1st 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, 2nd Edition, O'Reilly Media, 2017.
4. Paul Goransson, Chuck Black Timothy Culver, Software Defined Networks: A Comprehensive Approach, 2nd 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, 1st Edition, 2015.

21CT018 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

Course Outcomes (COs)

1. Understand the cloud security concepts and fundamentals.
2. Explain the security challenges in the cloud.
3. Analyze the cloud policy, identity and Access Management.
4. Delivers various risks, audit and monitoring mechanisms in the cloud.
5. Applying 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.

21CT019 **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.

Course Outcomes (COs)

1. Understand the basics of cyber security, cybercrime and cyber law.
2. Classify various types of attacks and learn the tools to launch the attacks.
3. Apply various tools to perform information gathering for data security and integrity.
4. Apply intrusion techniques to detect intrusion and to observe network traffic for malicious transactions in the network.
5. Apply intrusion prevention techniques to prevent intrusion and to protect against known and unknown threats.

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.

21CT020 **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.

Course Outcomes (COs)

1. Interpret the basic principles of cryptography and general cryptanalysis.
2. Determine the concepts of symmetric encryption and authentication.
3. Identify the use of public key encryption, digital signatures, and key establishment.
4. Apply the cryptographic algorithms to compose, build and analyze simple cryptographic solutions.
5. Demonstrate the use of Message Authentication Code to authenticate information transmitted between the users.

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	1	3	2	1	2								2	
3	1	1	2	3	2								1	
4	3	1	2	1	3								2	
5	2	3	3	3	3								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.

21CT021 **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.

Course Outcomes (COs)

1. To understand the basics of computer forensics, legal and ethical considerations, and the importance of maintaining the integrity of digital evidence.
2. Apply different types of computer forensic tools to preserve the integrity of data in thenetwork.
3. Analyze and validate forensics data from the communicating devices to detect intruders.
4. Apply the various firewall techniques to detect the vulnerabilities in the networks.
5. Implement real-world hacking techniques to test system security and to ensure thesystem's safety from hackers.

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 **8 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 **10 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 & 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.

21CT022 **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

Course Outcomes (COs)

1. Analyze the AWS cloud formation use-case. Enumerate the numerous assaults carried out during ethical hacking and penetrationtesting.
2. Apply the hacking techniques and understand the tools to be used for hacking
3. Understand the various vulnerabilities of Windows and Linux OS
4. Apply the techniques to hack web servers and tools for it
5. Determine the characteristics of the firewall, the intruder detection mechanisms, and themalicious software to protect the system.

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.

21CT023 **CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES** **2 0 2 3**

Course Objectives

- To understand the basics of Blockchain Technology.
- To learn Different protocols and consensus algorithms in Blockchain.
- To learn the Blockchain implementation frameworks.
- To experiment the Hyperledger Fabric, Ethereum networks.
- To understand the Blockchain Applications.

Course Outcomes (COs)

1. Understand emerging abstract models for Blockchain Technology.
2. Identify major research challenges and technical gaps existing between theory and practice in the crypto currency domain.
3. Develop conceptual understanding of the function of Blockchain as a method of securing distributed ledgers, how consensus on their contents is achieved, and the new applicationsthat they enable.
4. Apply Hyperledger Fabric and Ethereum platform to implement the Block chain Application.
5. Analyze the real-life applications of Blockchain Technologies.

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	
2	3	3	3	1	2								2	
3	2	2	1	1									1	
4		2	2		3								2	
5	1	2	3	1	2								2	

UNIT I **7 Hours**

INTRODUCTION TO BLOCKCHAIN

Blockchain- Public Ledgers, Blockchain as Public Ledgers - Block in a Blockchain, Transactions - The Chain and the Longest Chain - Permissioned Model of Blockchain, Cryptographic – Hash Function, Properties of a hash function-Hash pointer and Merkle tree.

UNIT II **6 Hours**

BITCOIN AND CRYPTOCURRENCY

A basic crypto currency - Creation of coins - Payments and double spending - FORTH – precursor for Bitcoin scripting - Bitcoin Scripts - Bitcoin P2P Network - Transaction in Bitcoin Network - Block Mining - Block propagation and block relay.

UNIT III **6 Hours**

BITCOIN CONSENSUS

Bitcoin Consensus - Proof of Work (PoW) - Hashcash PoW - Bitcoin PoW - Attacks on PoW - monopoly problem- Proof of Stake - Proof of Burn - Proof of Elapsed Time - Bitcoin Miner - Mining Difficulty - Mining Pool - Permissioned model and use cases.

UNIT IV **5 Hours**

HYPERLEDGER FABRIC AND ETHEREUM

Architecture of Hyperledger fabric v1.1- chain code- Ethereum: Ethereum network, EVM, Transaction fee, Mist Browser, Ether, Gas, Solidity.

UNIT V **6 Hours**

BLOCKCHAIN APPLICATIONS

Smart contracts - Truffle Design and issue - DApps – NFT - Blockchain Applications in Supply Chain Management, Logistics, Smart Cities, Finance and Banking, Insurance, etc - Case Study.

EXPERIMENT 1 **5 Hours**

Implement a Simple Voting System for an institute Using Ethereum.

EXPERIMENT 2 **5 Hours**

Create a Students health records for an school using hyperledger fabric.

EXPERIMENT 3 **5 Hours**

Implement a Product tracking system in supply chain management using ethereum.

EXPERIMENT 4 **5 Hours**

Design an Accounts management system for Real Estate Using Blockchain.

EXPERIMENT 5 **5 Hours**

Build a Web app for rewards system in Fitness Club using hyperledger fabric

EXPERIMENT 6 **5 Hours**

Design an Online auction management system for Car Second-Hand Car using hyperledger fabric.

Total: 30+30=60 Hours

Reference(s)

1. Bashir and Imran, Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks, 2017.
2. Andreas Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies",O'Reilly, 2014.
3. Daniel Drescher, "Blockchain Basics", First Edition, Apress, 2017.
4. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.
5. Melanie Swan, "Blockchain: Blueprint for a New Economy", O'Reilly, 2015
6. Ritesh Modi, "Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Blockchain", Packt Publishing
7. Handbook of Research on Blockchain Technology, published by Elsevier Inc. ISBN: 9780128198162, 2020.

21CT024 **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.

Course Outcomes (COs)

1. Understand the various concepts of malware analysis and their technologies used.
2. Possess the skills necessary to carry out independent analysis of modern malware samples using both static and dynamic analysis techniques.
3. Understand the methods and techniques used by professional malware analysts.
4. To be able to safely analyze, debug, and disassemble any malicious software by malware analysis.
5. Understand the concept of Android malware analysis their architecture, and App 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.
7. Windows Malware Analysis Essentials by Victor Marak, Packt Publishing, 2015.

21CT025 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.

Course Outcomes (COs)

1. Apply the multimedia elements, image processing and animation.
2. Analyze the encode and decode the multimedia elements
3. Apply the author 2D and 3D creative and interactive presentations for different targetmultimedia applications.
4. Create the 2D animation and develop the storyboards.
5. Create and animate the 3D models using software tools.

Articulation Matrix

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

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**

Perform a Basic operation on a Sample CT Scan Image using Adobe Photoshop, GIMP, Pixlr.

EXPERIMENT 2 **3 Hours**

Apply Audio and Video Editing Techniques to create a Personal Story or Documentary of your own.

EXPERIMENT 3 **3 Hours**

Design Various poses and expressions for Whisker, Luna and Gizmo with simple outdoor settings.

EXPERIMENT 4 **6 Hours**

Create a modern and dynamic logo along with a subtle animated GIF that reflects the company's identity

EXPERIMENT 5 **3 Hours**

Design a 3D room interior that includes furniture and Create a scene with walls, a floor.

EXPERIMENT 6 **3 Hours**

Create a Wooden floor, Glass window and advanced shade for metal furniture with rust and wear effects.

EXPERIMENT 7 **3 Hours**

Generate the Rig with pose mode with one leg forward to manipulate the legs, arms, and body.

EXPERIMENT 8 **3 Hours**

Create a Simple 3D scene with basic objects and place the 3 point light to enhance the visual appeal.

EXPERIMENT 9 **3 Hours**

Apply a material to the emitter cube and adjust transparency and color settings.

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.
7. Mark Gaimbruno, "3D Graphics and Animation", Second Edition, New Riders, 2002.
8. Rogers David, "Animation: Master – A Complete Guide (Graphics Series)", Charles RiverMedia, 2006.
9. Rick parent, "Computer Animation: Algorithms and Techniques", Morgan Kauffman, 3rdEdition, 2012.

21CT008 **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

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 & WIREFRAMING

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.
7. Baecker, Ronald M., Jonathan Grudin, et al. Readings in Human-Computer Interaction: Towardthe Year 2000. 2nd ed. Morgan Kaufmann, 1995. ISBN: 9781558602465.
8. Shneiderman, Ben, and Catherine Plaisant. Designing the User Interface: Strategies for EffectiveHuman-Computer Interaction. 4th ed. Addison Wesley, 2004. ISBN: 9780321197863.
9. Dix, Alan J., Janet E. Finlay, et al. Human-Computer Interaction. 2nd ed. Prentice Hall, 1998.ISBN: 9780132398640.
10. Olsen, Dan R. Developing User Interfaces (Interactive Technologies). Morgan Kaufmann, 1998.ISBN: 9781558604186

21CT026 AUGMENTED REALITY/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.

Course Outcomes (COs)

1. Analyze the tools and technologies related to AR/VR.
2. Design various models using modeling techniques.
3. Apply programming concepts and techniques specific to VR development, including 3D graphics.
4. Develop AR/VR applications in different domains.
5. Apply the technologies related to AR to build AR-enabled 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	2	2		2	2	2
2	2	3	3	3	3			2	2	2		2	3	3
3	2	2	2	2	2			2	2	2		2	3	3
4	3	3	3	3	3			2	2	2		2	3	3
5	3	3	3	3	3			2	2	2		2	3	3

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.

21CT027 **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

Course Outcomes (COs)

1. Understand the foundations of 2D and 3d Graphics
2. Design game design documents
3. Implementation of gaming engines.
4. Survey gaming environments and frameworks.
5. Develop and construct a simple game in Pygame.

Articulation Matrix

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

21CT028 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.

Course Outcomes (COs)

1. Compare the strengths and limitations of Nonlinear editing.
2. Identify the infrastructure and significance of storytelling.
3. Apply suitable methods for recording to CDs and VCDs.
4. Address the core issues of advanced editing and training techniques.
5. Design and develop projects using AVID XPRESS DV 4.

Articulation Matrix

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

21CT029 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

Course Outcomes (COs)

1. Identify some of the latest digital marketing trends and skills sets needed for today's Marketer.
2. Compare the strengths and limitations of search engine optimisation.
3. Apply the suitable techniques for E-Mail Marketing.
4. 1Discover the hottest techniques to help to successfully plan, predict, and manage your digitalMarketing campaigns.
5. Evaluate the importance of your digital marketing assets, which ones actually matter the mostto your business.

Articulation Matrix

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

E- MAIL MARKETING

E- Mail Marketing - Types of E- Mail 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.

21CT030 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 modeling 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.

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.

21CT031 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

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										1
2	3	3	2	2										2
3	3	3	2	3	2	2								1
4		2	2		3									
5		2	3		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 & 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.

21CT032 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.

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								2	
2	2		1	2										2
3		2	2	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/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.

21CT033 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.

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								1
2		2			2	1								
3	3	2	2	3	2	3								3
4	2		3	3		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.

21CT034 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.

Course Outcomes (COs)

1. Understand the significance of Security.
2. Understand the major concepts and techniques related to Cryptography.
3. Show thorough knowledge about the aspects of Embedded System Security.
4. Delivers insight into the role of Security Aspects during Data Transfer and Communication.
5. Applying 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	3	2	2			2								
3	1	3		1										
4	3	1	2		3	1				2				3
5	3	2	3	2	3	3							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.

21CT035 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

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	3		3	3	2									1
3			2	2	3									
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.

21CT036 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.

Course Outcomes (COs)

1. Infer XML technologies including XML Schema, XPath, and XSLT, enabling effective data transformation and manipulation in XML-based systems.
2. Design scalable and secure web service architectures using industry-standard protocols like SOAP and REST, ensuring interoperability and efficient communication between distributed systems.
3. Building web services by creating service interfaces, defining operations, and implementing message exchange patterns, ensuring seamless integration and communication between heterogeneous systems.
4. Design and implement XML-based solutions for electronic data interchange (EDI), data validation, and interoperability, ensuring compliance with industry standards and optimizing e-business processes.
5. Design and implement XML-based content management solutions, including content modeling, metadata management, and content transformation.

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 –SAXpresentation 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 ebusiness 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.

21CT037 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.

Course Outcomes (COs)

1. Understand Project Management principles while developing software.
2. Gain extensive knowledge about the basic project management concepts, framework and the process models.
3. Obtain adequate knowledge about software process models and software effort estimation techniques.
4. Estimate the risks involved in various project activities.
5. Define 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								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**

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

21CT038 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.

Course Outcomes (COs)

1. Collect fundamental design and evaluation methodologies of computer
2. Design effective HCI for individuals and persons with disabilities.
3. Explain the HCI implications for designing multimedia/ ecommerce/ e-learning Websites.
4. Design mobile application framework using HCI tools
5. Develop a web interface using various tools.

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	
2	1	2	2	2	2				2	2			2	
3	1	2	2	3					3	3			2	
4	2	2	3	2	3				2	2			2	
5	2	2	1	2	3				2	2			2	

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 & SOFTWARE PROCESS

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.

21CT039 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

Course Outcomes (COs)

1. To analyze 2D / 3D animation principles and techniques
2. To use CGI, color and light elements in VFX applications
3. To create special effects using any of the state of the art tools
4. To apply popular visual effects techniques using advanced tools
5. To use 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.

21CT040 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.

Course Outcomes (COs)

1. Infer the real-world business problems and model with analytical solutions.
2. Interpret 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 & 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 & 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

21CT041 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

Course Outcomes (COs)

1. Explain 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/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.

21OCE01 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

Course Outcomes (COs)

1. Classify and characterize the various energy utilization techniques.
2. Identify suitable technique to provide an energy efficient system.
3. Identify the need for thermal systems with latest technologies.
4. Choose suitable techniques doe conserving energy with respect to emerging trends.
5. Assess the impact economics on the conservation of energy.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Energy - Power – Past & Present scenario of World; National Energy consumption Data – Environmental aspects associated with energy utilization – Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Instruments for energy auditing.

UNIT II **9 Hours**

ELECTRICAL SYSTEMS

Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.

UNIT III **9 Hours**

THERMAL SYSTEMS

Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and Encon measures. Steam: Distribution &U sage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators & Refractories

UNIT IV **9 Hours**

ENERGY CONSERVATION IN MAJOR UTILITIES

Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets

UNIT V **9 Hours**

ECONIMICS

Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept .

Total: 45 Hours

Reference(s)

1. Energy Manager Training Manual (4 Volumes) available at www.energymanager training.com,a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.
2. Witte. L.C., P.S. Schmidt, D.R. Brown, “Industrial Energy Management and Utilisation” Hemisphere Publ, Washington, 1988.
3. Callaghn, P.W. “Design and Management for Energy Conservation”, Pergamon Press, Oxford, 1981.
4. Dryden. I.G.C., “The Efficient Use of Energy” Butterworths, London, 1982
5. Turner. W.C., “Energy Management Hand book”, Wiley, New York, 1982.
6. Murphy. W.R. and G. Mc KAY, “Energy Management”, Butterworths, London 1987.

21OEC01 BASICS OF ANALOG AND DIGITAL ELECTRONICS 3 0 0 3

Course Objectives

- Understand the working of diodes and transistors in electronic circuits.
- Understand the analog operational amplifier and its applications.
- Understand the implementation of combinational and sequential circuits in digital systems.

Course Outcomes (COs)

1. Apply the diodes and transistors in regulators and amplifiers and analyze their characteristics.
2. Illustrate the working of analog IC with different configurations and its applications.
3. Simplification of Boolean expressions using K-map and implementation of combinational circuits.
4. Analyze the Flip flops and memory configurations in digital circuits.
5. Classify and analyze A/D and D/A converters with its parameters.

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	3											2
3	2	2	3	2										2
4	2	2	3	3										2
5	2	2	3	3										2

UNIT I **9 Hours**

SEMICONDUCTORS DEVICES

Conductor, Semiconductors & Insulators, Semiconductors: intrinsic & extrinsic, energy band diagram - Mobility - Electrons and holes - The P-N junction diode - Zener diode - Avalanche effect- Rectifier Circuits Half wave, Full wave circuits, Efficiency, PIV, Ripple factor and AC and DC current and voltage in rectifier. PNP and NPN Bipolar junction Transistors - H parameters equivalent circuit - Common emitter amplifier - DC behavior: the load slope and the Q point - AC behavior - Emitter follower amplifier - Field effect transistors: JFET and MOSFET.

UNIT II **9 Hours**

OPERATIONAL AMPLIFIERS: DC PERFORMANCE

The operational amplifier - Input resistance, Output resistance, Open loop gain - Bias currents - Offset currents - Offset voltage - Differential mode gain - Common mode gain - Common mode rejection ratio - Negative feedback - Open loop gain and closed loop gain - Inverter amplifier - Non-inverter amplifier - The voltage follower - Transimpedance amplifier (Current to voltage converter) - Differential amplifier. Adders, Subtractors, Comparator, Integrator and Differentiator.

UNIT III **9 Hours**

DIGITAL TECHNIQUES: COMBINATIONAL CIRCUITS

Numbering systems - Binary, octal and hexadecimal numbers - Boole algebra - Conversion and operations - AND gate- OR gate - Inverter - NAND gate - NOR gate - Exclusive OR gate. Morgans laws. Combinational Circuits: Truth tables, logic expressions, Logic simplification using K- map, half and full adder/subtractor, multiplexers, demultiplexers, Logic families :TTL and CMOS.

UNIT IV **9 Hours**

DIGITAL TECHNIQUES: SEQUENTIAL CIRCUITS

Gated Latches & Flip Flops- Level triggered and Edge triggered Flip-Flops, Flop (FF) types: RS type. JK FF. JK FF Master slave. D FF. T FF. Flip Flop Conversion. Shift registers, Counters. Memories Structure: address and data bus. ROM, PROM, EPROM and flash RAM. Volatiles Memories: RAM, SRAM, DRAM. Addressing modes.

UNIT V **9 Hours**

DIGITAL TO ANALOG CONVERTERS AND ANALOG TO DIGITAL CONVERTERS

DIGITAL TO ANALOG CONVERTERS : Input latch. Binary Weighted Resistor Network. R-2R Ladder Resistor Network. Pulse Width Modulation . Resolution. Accuracy. Linearity. Zero Offset. Settling Time. Glitches. ANALOG TO DIGITAL CONVERTERS: Sampling. Real time sampling and equivalent time sampling. Sampling frequency. Sampling theorem (Nyquist). Anti-aliasing filtering. Sampling and holding. Conversion.

Total: 45 Hours

Reference(s)

1. L Robert Boylestead, Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson Education,2012.
2. J Millman, C. Halkias & Satyabrata Jit, Electronic Devices and Circuits, Tata McGraw- Hill,2010.
3. Ramakant A.Gayakwad, OP-AMP and Linear IC"s , Prentice Hall of India, 2002.
4. D.RoyChoudhry, Shail Jain, Linear Integrated Circuits, New Age International Pvt. Ltd., 2000.
5. Thomas L.Floyd, Digital Fundamentals, Prentice Hall, 11th Edition, 2015.
6. M.Morris Mano, Michael D Ciletti Digital Design 4th edition Pearson, 2011.

21OEC02 **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.

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.

FOR FURTHER READING

Introduction- Architecture- Registers- Memory- Instruction set- Addressing Modes- I/O Pins- Timers- Counters- Interrupts.

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.

21OEC03 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

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											2
2	3	2												2
3	3	2												2
4	2	2	2											2
5	3	2												2

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 OPTICALCOMMUNICATION

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.

21OEC04 **PRINCIPLES OF COMPUTER COMMUNICATION AND NETWORKS** **3 0 0 3**

Course Objectives

- To understand the concept of data communication and networking models.
- To study the various networking Components and Networks.
- To explore the routing, addressing and security and management aspects of computer networks.

Course Outcomes (COs)

1. Classify the types of computer networks and analyze the seven layers of OSI model.
2. Analyze the basic operations of Routing Algorithms and Routing devices
3. Analyze the local and wide area networking technologies.
4. Apply the ISDN and ATM interface connections in broadband networks.
5. Analyze the security and management techniques related with networks.

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	1	2	2	3										2
3	1	1	2	3										2
4	1	1	3											2
5	1	2	3	3										2

UNIT I **9 Hours**

NETWORK FUNDAMENTALS

Types of Computer Networks: by Area, by Topology ; Communication Services: Serial and Parallel, Synchronous and Asynchrounous, Simplex and Duplex, Analog and Digital; Speed and Capacity; Multiplexing and Switching; Network Architecture: OSI Seven-Layer Network model.

UNIT II **9 Hours**

INTERNETWORKING AND COMPONENTS

Routing Concepts: Routing Algorithms, RIP, RIP-2, OSPF and other routing Protocols; Switches and Hubs: Store and Forward Switch, Cut-Through Switch,Hybrid Switch, Performance of Switches ; Repeaters; Repeater Vs Hubs; Bridges: Standards, Bridges Vs Repeaters; Routers and Gateways.

UNIT III **9 Hours**

LOCAL AND WIDE AREA NETWORKING TECHNOLOGIES

LAN Components and Topologies; Access Techniques; Transmission Protocols and Media; Ethernet and IEEE 802.3 Networks: History, 10-MBPS Ethernet, Switched Ethernet, 100-MBPS Ethernet, Gigabit Ethernet.

UNIT IV **9 Hours**

BROADBAND NETWORKS

ISDN: Evolution, ISDN Channel and Interface Structures; Broadband ISDN: Basics, Principles and General Architecture; Asynchronous Transfer Mode(ATM): Introduction, Concepts, Components, Connection Supported by ATM network and Concept of Virtual Channel and Virtual Path, Traffic control and Congestion Control, Operation and Maintenance aspects.

UNIT V **9 Hours**

NETWORK SECURITY AND MANAGEMENT

Security: Need of Security, Security Threats, Vulnerabilities, Methods, tools and Techniques for Attacks; Network Security: Levels of Security, Cryptosystems; Data Encryption Standard (DES), Public Key Cryptography, Firewalls; Network Management: Functions and Elements, Distribution of Management; Simple Network Management Protocol (SNMP), Remote Network Management Services.

Total: 45 Hours

Reference(s)

1. Michael A.Gallo, William M. Hancock, Computer Communications and Networking Technologies, 1 Ed, Thomson Learning, 2002.
2. Kenneth C. Mansfield, Jr.James L. Antonakos, An Introduction to Computer Networking, 1Ed, Prentice Hall of India, 2002
3. A Shanmugam, S Rajeev, Computer Communication Networks, 1Ed, ISTE Learning Materials Centre, 2001
4. Discrete-Time Signal Processing by Alan V. Oppenheim and Ronald W. Schafer, 3rd edition, 2010, Prentice Hall
5. Digital Signal Processing by Sanjit Mitra, 4th edition, 2011, McGraw-Hill, New York, NY

21OEI01 PROGRAMMABLE LOGIC CONTROLLERS 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

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
2	2	1		2	2		3							1
3	2	1		2	2		3							1
4	2	1		2	2		3							1
5	2	1		2	2		3							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 FUNCTONS

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.

21OEI02 **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

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.

21OEI03 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.

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.

21OEI04 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

Course Outcomes (COs)

6. Attribute the properties of optical fibers, their light sources and detectors.
7. Implement the fiber-optic sensor for the measurement of various physical quantities.
8. Conclude the fundamentals of laser, types of laser and its working.
9. Outline the applications of laser for industrial applications.
10. 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)

4. John M. Senior, Optical Fiber Communications - Principles and Practice, Prentice Hall of India, 2010.
5. John F. Ready, Industrial Applications of Lasers, Academic Press, 2012.
6. Gerd Keiser, Optical Fiber Communication, Mc Graw Hill, New York, 2013.
7. S.C. Gupta, Textbook on Fiber Optics Communications and its application, Prentice Hall of India, 2012.
8. John Wilson and J.F.B. Hawkes, Introduction to Opto Electronics, Prentice Hall of India, 2011.
9. R. P. Khare, Fiber Optics and Optoelectronics, Oxford University Press, 2011.

21OME01 **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)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature,and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. 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.
m. Design, analyse and evaluate the performance of mechanical systems.
n. Choose the appropriate methodology, materials, tools and machinery to manufacture quality products at economical cost.

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								1	1
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

21OME02 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)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature,and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. 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.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
n. Choose the appropriate methodology, materials, tools and machinery to manufacture quality products at economical cost.

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

21OME03 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)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature,and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. 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.
f. 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.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of,and need for sustainable development.
n. Choose the appropriate methodology, materials, tools and machinery to manufacture quality products at economical cost.

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												
3					2	2	1							
4	1	2	1		2	2	2							
5	2	2	2		1	1	1							

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.

FURTHER READING

Retrofitting, objectives, classification of retrofitting, cost effectiveness through retrofitting (economical aspects), circumstances leading to retrofitting, features and selection for retrofitting.

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.

21OME04 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)

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

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

e. 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.

f. 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.

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. 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.

l. 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.

m. Design, analyse and evaluate the performance of mechanical systems.

n. Choose the appropriate methodology, materials, tools and machinery to manufacture quality products at economical cost.

o. Address all the fluid flow and heat transfer related problems of mechanical systems.

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

FOR FURTHER READING

Case Studies- Major accidents at Flixborough, UK, Seveso, Italy, Victoria Dock, India, Bhopal, India.

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.

21OBT01 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.

Course Outcomes (COs)

1. Apply thee 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		2				3							
2	2						1							
3	1						3							
4	2						3							
5	1						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 and thermal 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, purification of 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

21OFD01 **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.

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.

21OFD02 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

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 21000, ISO 14000, ISO 17025, PAS 21000, FSSC 21000, 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

21OFD03 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

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.

21OFD04 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

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								
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**

OIL SEEDS 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.

21OFT01 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.

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	3	2	3				1		2	3		2		
3	3	2	3				2		2	3		2		
4	3	2	3				2		2	3		2		
5	3	2	3				2		2	3		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

21OFT02 **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

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	3	2	3		2	3		2						
3	3	3	3		2	2		2						
4	3	3	3		2	3		2						
5	3	2			2			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

21OFT03 **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

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					
3	2	3	2		3									
4	2	2	2						2					
5	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

21OPH01 **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

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	1	1												
2	2	2												
3	3	1												
4	1	1												
5	2	3												

9 Hours

UNIT I

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.

9 Hours

UNIT II

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.

9 Hours

UNIT IV

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

9 Hours

UNIT V

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.

21OPH02 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

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	2	1												
2	2	1												
3	2	1												
4	2	1												
5	2	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

9 Hours

UNIT V

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

21OPH03 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

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	2	1												
2	1	2												
3	2	1												
4	2	1												
5	1	2												

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

21OPH04 BIO-PHOTONICS 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.

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	3	2												
2	3	2												
3	3	2							3					
4	3	2							3					
5	3	2												

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**

BIO-NANO-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.

21OPH05 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

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

9 Hours

UNIT II

COLLOIDAL DISPERSIONS & 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

9 Hours

UNIT IV

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

9 Hours

UNIT V

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 Condensd 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.

21OCH01 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

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.
6. http://corrosion-doctors.org/Corrosion-History/Eight.html

21OCH02 **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

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. F. W. Billmeyer,"Text Book of Polymer Science", John Wiley & Sons, New York, 2008
4. Barbara H. Stuart, "Polymer Analysis", John Wiley & Sons, New York, 2008
5. George Odian , "Principles of Polymerization", John Wiley & Sons, New York, 2004
6. R. J. Young and P. A. Lovell, "Introduction to Polymers", CRC Press, New York, 2011
7. Common Biocompatible Polymeric Materials for Tissue Engineering and Regenerative Medicine (2019), Materials Chemistry and Physics https://doi.org/10.1016/j.

21OCH03 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.

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. N. Eliaz, E. Gileadi, Physical Electrochemistry, Fundamentals, Techniques and Applications, Wiley, 2019.
2. J. Garche, K. Brandt, Electrochemical Power sources: Fundamentals Systems and Applications, Elsevier, 2018
3. S.P. Jiang, Q. Li, Introduction to Fuel Cells, Springer, 2021.
4. A. Iulianelli, A. Basile, Advances in Hydrogen Production, Storage and Distribution, Elsevier, 2016.
5. M.M. Eboch, The Future of Energy, From Solar Cells to Flying Wind Farms, Capstone, 2020.

21OMA01 **GRAPH THEORY AND COMBINATORICS** **3 0 0 3**

Course Objectives

- This course comprehends the graphs as a modeling and analysis tool in computer science & Engineering
- It introduces the structures such as graphs & trees and techniques of counting and combinations, which are needed in number theory based computing and network security studies in Computer Science.

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Recognize the basic ideas of Graph and its characteristics.
2. Assess the characteristics of trees and its properties.
3. Predict the coloring of graphs and its applications in the respective areas of engineering.
4. Compute the permutations and combinations in the engineering field.
5. Demonstrate the types of generating functions and their applications in engineering.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Graphs - Introduction - Isomorphism - Sub graphs - Walks, Paths, Circuits - Connectedness - Components - Euler graphs - Hamiltonian paths and circuits - Trees - Properties of trees - Distance and centers in tree - Rooted and binary trees.

UNIT II **9 Hours**

TREES, CONNECTIVITY

Spanning trees - Fundamental circuits - Spanning trees in a weighted graph - cut sets - Properties of cut set - All cut sets - Fundamental circuits and cut sets - Connectivity and separability - Network flows - 1-Isomorphism - 2-Isomorphism - Combinational and geometric graphs - Planer graphs - Different representation of a planer graph.

UNIT III **9 Hours**

MATRICES, COLOURING AND DIRECTED GRAPH

Chromatic number - Chromatic partitioning - Chromatic polynomial - Matching - Covering - Four color problem - Directed graphs - Types of directed graphs - Digraphs and binary relations - Directed paths and connectedness - Euler graphs.

UNIT IV **9 Hours**

PERMUTATIONS

Fundamental principles of counting - Permutations and combinations - Binomial theorem - combinations with repetition - Combinatorial numbers - Principle of inclusion and exclusion - Derangements - Arrangements with forbidden positions.

UNIT V **9 Hours**

GENERATING FUNCTIONS

Generating functions - Partitions of integers - Exponential generating function - Summation operator - Recurrence relations - First order and second order - Non-homogeneous recurrence relations - Method of generating functions.

Total: 45 Hours

Reference(s)

1. Narsingh Deo, Graph Theory: With Application to Engineering and Computer Science, Prentice Hall of India, 2003
2. Grimaldi R.P., Discrete and Combinatorial Mathematics: An Applied Introduction, Addison Wesley, 1994.
3. Rosen K.H., Discrete Mathematics And Its Applications, McGraw Hil, 2007
4. Clark J. & Holton D.A., A First Look at Graph Theory, Allied Publishers, 1995.
5. Mott J.L., Kandel A. & Baker T.P., Discrete Mathematics for Computer Scientists and Mathematicians, Prentice Hall of India, 1996.
6. Liu C.L., Elements of Discrete Mathematics, McGraw Hill, 1985.

21OGE01 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.

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**

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.

FURTHER READING

Retrofitting, objectives, classification of retrofitting, cost effectiveness through retrofitting (economical aspects), circumstances leading to retrofitting, features and selection for retrofitting.

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.

21OGE02 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

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

21OGE03 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

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, Factories Act 1948 (an over view)

UNIT III **9 Hours**

BUSINESS TAXATION

Direct taxation, Income tax, Corporate tax, MAT, Tax holidays, Wealth tax, Professional tax Cases).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

21OGE04 **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

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. Director General NCC Website: https://indiancc.nic.in/ncc-general-elective-subject-course-design/
2. Grooming Tomorrow's Leaders, published by DG, NCC. https://indiancc.nic.in/
3. Youth in Action, published by DG, NCC. https://indiancc.nic.in/
4. The Cadet, Annual Journal of the NCC. https://indiancc.nic.in/
5. Précis Issued by respective Service Headquarters on specialized subject available to PI Staff as reference material. https://indiancc.nic.in/

ONE CREDIT COURSES

19CT0XA GraphQL USING REST API 1 0 0 1

Course Objectives

- Demonstrate the fundamental concepts of GraphQL.
- Understand the concepts and semantics of REST API.
- Learn about API language that executes queries by using a type system based on defined input data.

Course Outcomes (COs)

1. Apply the basic concepts of GraphQL
2. Analyze GraphQL API using Apollo server
3. Create jQuery client applications to consume the API.

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
1	2	2	2										2	
2	2	2	2	2	2								2	
3	2	2	2	2	2								2	

UNIT 1 **20 Hours**

GRAPHQL USING REST API

Introduction to GraphQL - Environment Setup - Characteristics of GraphQL using REST API - Architecture - Application Components - REST API vs GraphQL - GraphQL in Canvas - Type system in GraphQL using REST API – Schema – Resolver – Query – Mutation – Validation - JQuery Integration – React Integration - GraphQL to build client applications: Apollo Client - Setting up Server - Setting up the Client - Authenticating Client-Caching.

Total: 20 Hours

References

1. Robin Wieruch,” The Road to GraphQL”, Nov 05, 2018.
2. Kelly Goetsch, “GraphQL for Modern Commerce”,O’Reilly Media, Inc., 2020.
3. Samer Buna,” GraphQL in Action”, Manning Publications. 2021

19CT0XC GAME PROGRAMMING 1 0 0 1

Course Objectives

- Demonstrate the basic and fundamental concepts in Unity 3D.
- Understand the 3D concepts for game play, modeling, and programming.
- Learn the basics of Modeling like object creation, collision with Unity.

Course Outcomes (COs)

1. Apply the basic concepts of Unity development environment.
2. Apply the scripting programming concepts in real world problems..
3. Analyze the modeling and programming concepts for 2D and 3D objects.

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	2	2	2										2	
2	2	2	2	2	2								2	
3	2	2	2	2	2								2	

UNIT 1 20 Hours

INTRODUCTION TO UNITY DEVELOPMENT ENVIRONMENT

Game Engines: Engine Concepts - Development Tools - Introducing Unity, Unity Development Environment: IDE Basics - Unity Concepts – Sprites, Setup And Unity Features - Introduction to Game Design and Production - Unity Production Basics: Lighting, Materials, Effects, etc. - Setting up Game and Adding Script - Adding Script - Unity Camera- Unity Identifying Collision.

Total 20 Hours

Reference(s)

1. Joe Hocking, Unity in Action. Multiplatform game development in C# with Unity 5.1, 1st Edition, 2015.
2. Ben Tristem and Mike Geig, Unity Game Development in 24 Hours, 2nd Edition, Sams, 2013.
3. Andy Beane, 3D Animation Essentials, John Wiley & Sons, 2012.

19CT0XD LARAVEL 1 0 0 1

Course Objectives

- To Understand the PHP concepts
- To Familiar with Laravel framework
- To Gain knowledge about how to build a website using its features

Course Outcomes (COs)

1. Analyze how to create a database and how to use appropriate SQL statements to create tables and store data using PHP
2. Apply Laravel templates to create an authentication system for your application.
3. Create highly responsive websites with appropriate forms and authentications.

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	2	2	2										2	
2	2	2	2	2	2								2	
3	2	2	2	2	2								2	

UNIT I **20 Hours**

INTRODUCTION TO PHP AND LARAVEL

Introduction to PHP – Basics - Web concepts - String and Form Processing - PHP MySQL Database – Laravel: Introduction, Installation, Application Structure, Routing and Middleware, Working with Database, HTML Template to Laravel Blade Template - Forms – Session – Validation – Error Handling – Exceptions and Event Handling - Encryption/ Decryption - Eloquent ORM - Composer Packages – Security.

Total 20 Hours

Reference(s)

1. Martin Bean, "Laravel 5 Essentials", Packet Publishing, ISBN 978-1-78528-301-7
2. Fernando Monteiro, "Hands-On Full-Stack Web Development with Angular 6 and Laravel 5 ", Packt Publishing, ISBN 9781788833912
3. Web Technologies: HTML, CSS3, JavaScript, jQUERY, AJAX, PHP, XML, MVC and LARAVEL), Black Book, 2018, Dreamtech, ISBN 9789386052490

19CT0XF TRANSFER LEARNING IN DATA SCIENCE 1 0 0 1

Course Objective(s)

- The main objective of the course is to understand the multiclass approaches in Machine Learning and build a transfer learning model to achieve reusability

Course Outcomes (s)

1. Understand the basic concepts of Multiclass approaches
2. Apply various transfer learning techniques such as fine-tuning, feature extraction, domain adaptation, and multi-task learning to different scenarios.

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1		2	2											
2			2	2	2									

Datasets and Pre-Processing on Data - Neural Networks Framework - Transfer Learning Framework -Training a Model - Develop Model Approach - Pre-Trained Model Approach – Introduction - Transfer in Inductive Learning - Inductive Transfer - Bayesian Transfer - Hierarchical Transfer - Transfer with Missing Data or Class Labels - Transfer in Reinforcement Learning - Imitation Methods - Hierarchical Methods - Alteration Methods - Avoiding Negative Transfer - Automatically Mapping Tasks - Transfer Learning with Image Data - Transfer Learning for Image Recognition - Transfer Learning with Language Data - Feature Extraction - Popular Pre-Trained Models - Oxford VGG Model - Google Inception Model - Microsoft ResNet Model

Total: 15 Hours

Reference(s)

1. Transfer Learning Handbook, Lisa Torrey and Jude Shavlik, University of Wisconsin, Madison WI, USA
2. https://towardsdatascience.com/a-comprehensive-hands-on-guide-to-transfer-learning-with-real-world-applications-in-deep-learning-212bf3b2f27a
3. https://machinelearningmastery.com/transfer-learning-for-deep-learning/
4. https://www.kaggle.com/code/nicholasjhana/tensorflow-multi-classification-transfer-learning/input

19CT0XG DATABASE INTEGRATION IN WEB DEVELOPMENT 1 0 0 1

Course Objectives

- To Understand the data integration concepts, including data warehousing, schema matching, data exchange, and provenance.
- To Learn how to identify and align schemas from different data sources to facilitate data integration.

Course Outcomes (s)

1. Understand the principles of designing and implementing data warehouses to support efficient data integration and analysis.
2. Apply schema matching and mapping to resolve structural heterogeneity for successful data integration.

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
1		2	2											
2			2	2										

Introduction to Data Integration - Data Warehousing and Provenance - Resolving Structural Heterogeneity through Schema Matching and Mapping - Techniques for Querying Several Heterogeneous Data Sources at once (Data Integration) - Translating Data between Databases with different Data Representations (Data Exchange) - Data-Warehouse Paradigm including Extract Transform Load (ETL) Process - Data Cube Model and its Relational Representations (Such as Snowflake and Star Schema) - Efficient Processing of Analytical Queries - Big Data Analytics Approaches - Representing and Keeping Track of Origin and Creation Process Of Data (Provenance)

Total: 15 Hours

Reference(s)

1. Lillian Pierson, Data Science for Dummies, John Wiley,2015
2. Garrett Grolemund, Hadley Wickham, R for Data Science, O Reilly in January 2017
3. Andrie de Vries, Joris Meys, R For Dummies, John Wiley and Sons, 2012
4. Jiawei Han, Micheline Kamber, Jian Pei, Data Mining: Concepts and Techniques, Elsevier Inc., 2012
5. David Baldwin, Mastering Tableau, Packt Publishing, 2016
6. Java Development with the Spring Framework, Wiley-India, 2012

19CT0XH VIDEO ANALYTICS USING EDGE COMPUTING 1 0 0 1

Course Objectives

- To develop a custom trained model using Jetson Nano
- To measure and improve video AI application performance

Course Outcomes (s)

1. Apply transfer learning to develop a custom video AI model that is configured for optimal performance
2. Identify, apply and analyze algorithms for developing solutions for real world problems

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
1		2	3											
2			3	2	2									

Set Up Jetson Nano and Camera - Collect Image Data for Classification Models - Annotate Image Data for Regression Models - Train a Neural Network to Create Own Models - Run Inference on the Jetson Nano with the Models - Build End-To-End Deep Stream Pipelines - Configure Multiple Video Streams Simultaneously - Configure Inference Engines (Yolo) - Video Analytics in Healthcare: At Home Patient Monitoring, Mental Health Analysis, Video Analytics in Smart Cities.

Total: 15 Hours

Reference(s)

1. "Deep Learning: Algorithms and Applications", I. Good fellow, Y. Bengio and A. Courvill
2. "Video analytics using Deep Learning", Charan. Puvvala, 2018.
3. "Jetson Nano developer- User guide",Daniel Wilson, 2021.

19CT0XI NLP WITH CHATGPT 1 0 0 1

Course Objectives

- This course will help learners to understand the basics of the GPT architecture and how it can be used for natural language processing tasks
- The course covers various modules that explain the libraries and models used in ChatGPT, text and code completion, image generation, fine-tuning, embedding, moderation and best practices

Course Outcomes (s)

1. Use ChatGPT for various Natural Language Processing tasks
2. Apply ChatGPT in Chatbot development, dialogue systems, or text generation

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
1		2	2										2	
2			2	2	2								2	

Introduction to ChatGPT - Setting Up ChatGPT Environment and Creating a Chatbot Interface - Understanding different Programming Languages used for ChatGPT - Natural Language Processing and Learn how ChatGPT Processes Language - Building a basic Chatbot using ChatGPT - Learn best practices for Writing Prompts and Integrating ChatGPT into Writing Exercises - Building Arduino Projects using ChatGPT - Creating Charts and Graphs using ChatGPT

Total: 15 Hours

Reference(s)

1. ChatGPT content creation: SEO, youtube, book writing and more made easy by CeoWest
2. The Power of ChatGPT: Leveraging the potential of AI in social media by KP Panchal
3. Mastering ChatGPT: by Mostafa Gamil