B.Tech. (Artificial Intelligence and Machine Learning)

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

SATHYAMANGALAM - 638401 ERODE DISTRICT TAMILNADU INDIA

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

CONTENTS

	Page No.
Revised Regulations 2018	1
PEOs	27
POs	29
Mapping of PEOs and POs	30
Connectivity Chart	31
Curriculum Revised 2018	32
Syllabi	40
Electives	136

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- requisitesor 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 anyone 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 sub sequent 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: Full Stack Development

Vertical II: Cloud Computing and data center

Vertical III: Cyber security and data Science.

Vertical IV: AI and Robotics

Vertical V: Mern Stack Development

Vertical VI: Business data analytics

Vertical VII: Diversified courses

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

VISION OF THE DEPARTMENT

To achieve excellence in the field of Artificial Intelligence and Machine Learning by focusing on knowledge-centric education systems, integrative partnerships, innovation and cutting-edge research to meet latest industry standards and service the greater cause of society.

MISSION OF THE DEPARTMENT

- To develop professionals skilled in the field of Artificial Intelligence and Machine Learning.
- To impart quality and value based education and contribute towards the innovation of computing, expert systems, AI, ML to solve complex problems in research and society.

PROGRAMME EDUCATIONAL OBJECTIVIES (PEOs)

PEO 1: To Perform well in their professional career by acquiring enough knowledge in the domain of Artificial Intelligence and Machine Learning.

PEO 2: To improve communication skills, follow professional ethics and involve in team work in their profession.

PEO 3: To Update with evolving technology and use it for career advancement.

PROGRAMME OUTCOMES (POs)

Engineering Graduates will be able to:

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 analyse 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 within 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)

PSO 1: Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

PSO 2: Formulate solutions for interdisciplinary AI problems through acquired programming Knowledge in the respective domains fulfilling with real- time constraints.

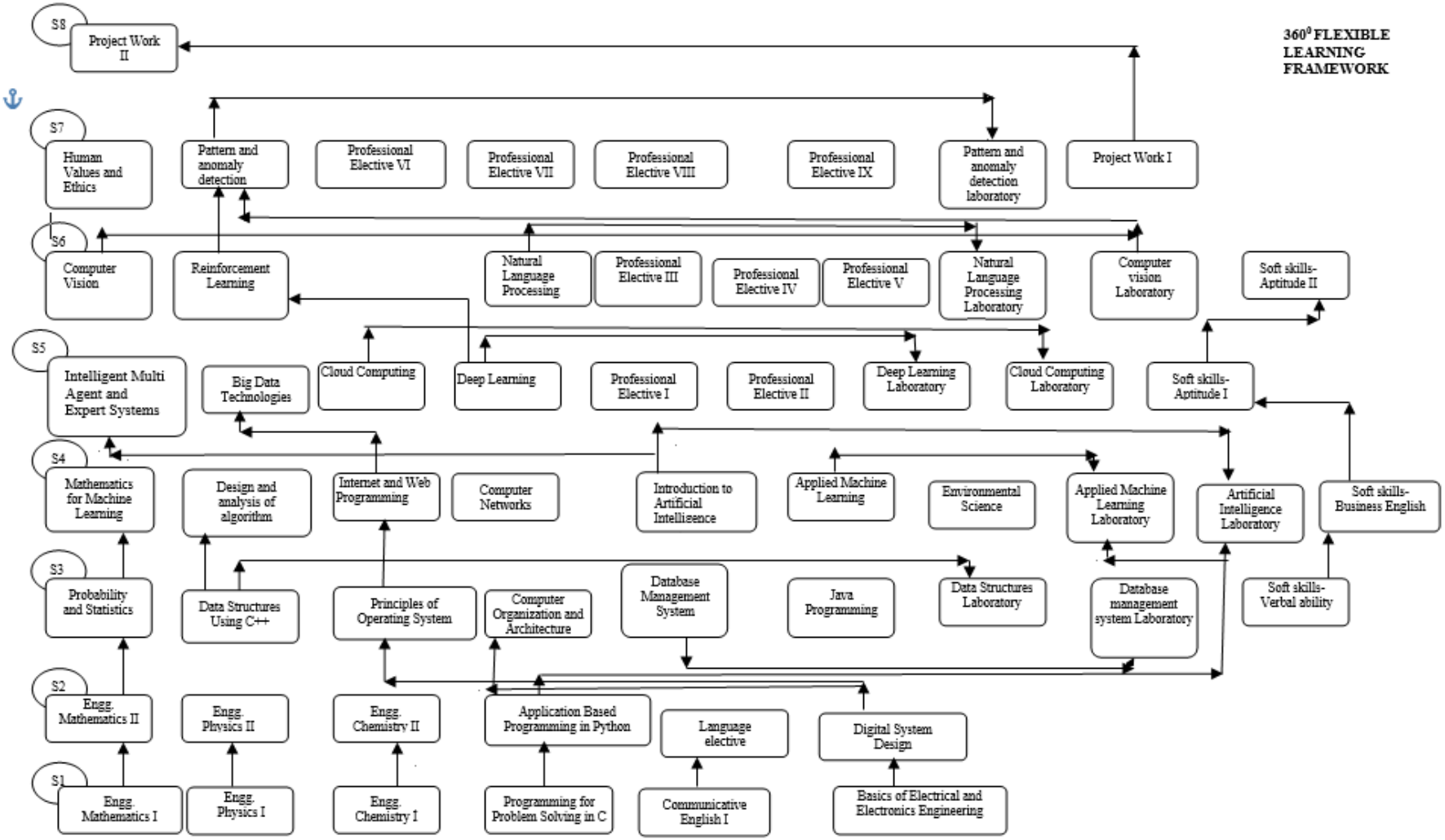
MAPPING OF PEOs AND POs

POs	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
PEO1	X						X					X	X		
PEO2						X	X	X	X	X					X
PEO3	X	X	X	X									X	X	

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

CURRICULUM DESIGN & INTERLINKING OF COURSES

CONNECTIVITY CHART



General Electives (I to IX) are the courses offered by the Department

B. TECH (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING) Revised R2018
Minimum Credits to be Earned: 163

I SEMESTER

Code No.	Course Title	L	T	P	C	Hours/ week	Maximum marks			Category
							CA	ES	Total	
21AM101	Engineering Mathematics I	3	1	0	4	4	40	60	100	BS
21AM102	Engineering Physics I	2	0	2	3	4	50	50	100	BS
21AM103	Engineering Chemistry I	2	0	2	3	4	50	50	100	BS
21AM104	Programming for ProblemSolving in C	2	0	2	3	4	50	50	100	ES
21AM105	Basics of Electrical and Electronics Engineering	2	0	2	3	4	50	50	100	ES
18HS101	Communicative English I	1	0	2	2	3	100	0	100	HSS
Total		**12**	**1**	**10**	**18**	**23**	-	-	-	-

II SEMESTER

Code No.	Course Title	L	T	P	C	Hours/ week	Maximum marks			Category
							CA	ES	Total	
21AM201	Engineering Mathematics II	3	1	0	4	4	40	60	100	BS
21AM202	Engineering Physics II	2	0	2	3	4	50	50	100	BS
21AM203	Engineering Chemistry II	2	0	2	3	4	50	50	100	BS
21AM204	Application Based Programming in Python	2	0	2	3	4	50	50	100	ES
21AM205	Digital System Design	3	0	2	4	4	50	50	100	ES
	Language Elective	1	0	2	2	3	100	0	100	HSS
Total		**13**	**1**	**10**	**19**	**23**	-	-	-	-

III SEMESTER										
Code No.	**Course Title**	**L**	**T**	**P**	**C**	**Hours/ week**	**Maximum marks**			**Category**
							CA	**ES**	**Total**	
21AM301	Probability and Statistics	3	1	0	4	4	40	60	100	BS
21AM302	Data Structures Using C++	3	1	0	4	4	40	60	100	PC
21AM303	Principles of OperatingSystem	3	0	0	3	3	40	60	100	PC
21AM304	Computer Organization and Architecture	3	0	0	3	3	40	60	100	PC
21AM305	Database Management System	3	0	0	3	3	40	60	100	PC
21AM306	Java Programming	3	1	0	4	4	40	60	100	PC
21AM307	Data Structures Laboratory	0	0	4	2	2	100	0	100	PC
21AM308	Database Management System Laboratory	0	0	4	2	2	100	0	100	PC
18GE301	Soft Skills - Verbal Ability	2	0	0	0	2	100	0	100	EEC
Total		**20**	**3**	**8**	**25**	**27**	-	-	-	-

IV SEMESTER										
Code No.	**Course Title**	**L**	**T**	**P**	**C**	**Hours/ week**	**Maximum marks**			**Category**
							CA	**ES**	**Total**	
21AM401	Mathematics for Machine Learning	3	1	0	4	4	40	60	100	BS
21AM402	Design and Analysis of Algorithm	3	1	0	4	4	40	60	100	PC
21AM403	Internet and Web Programming	3	1	0	4	4	40	60	100	PC
21AM404	Computer Networks	3	0	0	3	3	40	60	100	PC
21AM405	Introduction to Artificial Intelligence	3	0	0	3	3	40	60	100	PC
21AM406	Applied Machine Learning	3	0	0	3	3	40	60	100	PC
21AM407	Applied Machine Learning Laboratory	0	0	4	2	4	100	0	100	PC
21AM408	Artificial Intelligence Laboratory	0	0	4	2	4	100	0	100	PC
18HS001	Environmental Science	2	0	0	0	2	100	0	100	HSS
18GE401	Soft Skills - Business English	2	0	0	0	2	100	0	100	EEC
Total		**22**	**3**	**8**	**25**	**33**	-	-	-	-

V SEMESTER										
Code No.	**Course Title**	**L**	**T**	**P**	**C**	**Hours/ week**	**Maximum marks**			**Category**
							CA	**ES**	**Total**	
21AM501	Intelligent Multi Agent and ExpertSystems	3	0	0	3	3	40	60	100	PC
21AM502	Big Data Technologies	3	1	0	4	4	40	60	100	PC
21AM503	Cloud Computing	3	0	0	3	3	40	60	100	PC
21AM504	Deep Learning	3	0	0	3	3	40	60	100	PC
	Professional Elective I	-	-	-	-	-	-	-	-	PE
	Professional Elective II	-	-	-	-	-	-	-	-	PE
21AM507	Deep Learning Laboratory	0	0	4	2	4	100	0	100	PC
21AM508	Cloud Computing Laboratory	0	0	4	2	4	100	0	100	PC
18GE501	Soft Skills - Aptitude I	0	0	2	0	2	100	0	100	EEC
Total		**18**	**1**	**10**	**23**	**29**	-	-	-	-

VI SEMESTER										
Code No.	**Course Title**	**L**	**T**	**P**	**C**	**Hours/ week**	**Maximum marks**			**Category**
							CA	**ES**	**Total**	
21AM601	Computer Vision	3	0	0	3	3	40	60	100	PC
21AM602	Reinforcement Learning	3	0	0	3	3	40	60	100	PC
21AM603	Natural Language Processing	3	0	0	3	3	40	60	100	PC
	Professional Elective III	-	-	-	-	-	-	-	-	PE
	Professional Elective IV	-	-	-	-	-	-	-	-	PE
	Professional Elective V	-	-	-	-	-	-	-	-	PE
21AM607	Natural Language Processing Laboratory	0	0	4	2	4	100	0	100	PC
21AM608	Computer Vision Laboratory	0	0	4	2	4	100	0	100	PC
18GE601	Soft Skills - Aptitude II	0	0	2	0	2	100	0	100	EEC
Total		**18**	**0**	**10**	**22**	**28**	**-**	**-**	**-**	-

VII SEMESTER										
Code No.	**Course Title**	**L**	**T**	**P**	**C**	**Hours/ week**	**Maximum marks**			**Category**
							CA	**ES**	**Total**	
21HS002	Human Values and Ethics	2	0	0	2	2	100	0	100	HSS
21AM702	Pattern and Anomaly Detection	3	0	0	3	3	40	60	100	PC
	Professional Elective VI	-	-	-	-	-	-	-	100	PE
	Professional Elective VII	-	-	-	-	-	-	-	100	PE
	Professional Elective VIII	-	-	-	-	-	-	-	100	PE
	Professional Elective IX	-	-	-	-	-	-	-	100	PE
21AM707	Pattern and AnomalyDetection Laboratory	0	0	4	2	4	100	0	100	PC
21AM708	Project Work I	0	0	6	3	6	50	50	100	EEC
Total		**17**	**0**	**10**	**22**	**27**	-	-	-	-

VIII SEMESTER										
Code No.	**Course Title**	**L**	**T**	**P**	**C**	**Hours/ week**	**Maximum marks**			**Category**
							CA	**ES**	**Total**	
21AM801	Project Work II	0	0	18	9	18	50	50	100	EEC
Total		**9**	**0**	**18**	**9**	**18**	-	-	-	-

LANGUAGE ELECTIVES										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18HS201	Communicative English II	1	0	2	2	3	100	0	100	HSS
18HSH01	Hindi	1	0	2	2	3	100	0	100	HSS
18HSG01	German	1	0	2	2	3	100	0	100	HSS
18HSJ01	Japanese	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

PROFESSIONAL ELECTIVES

Code No.	Course	L	T	P	C	Hour/ Week	Maximum Marks			Category
							CA	ES	Total	
VERTICAL I FULL STACK DEVELOPMENT										
21AM001	Agile Software Development	3	0	0	3	3	40	60	100	PE
21AM002	UI and UX Design	3	0	0	3	3	40	60	100	PE
21AM003	Web Frameworks	3	0	0	3	3	40	60	100	PE
21AM004	App Development	2	0	2	3	3	40	60	100	PE
21AM005	Software Testing and Automation	3	0	0	3	3	40	60	100	PE
21AM006	DevOps	3	0	0	3	3	40	60	100	PE
VERTICAL II CLOUD COMPUTING AND DATA CENTER TECHNOLOGIES										
21AM007	Virtualization in Cloud Computing	3	0	0	3	3	40	60	100	PE
21AM008	Cloud Services and Data Management	3	0	0	3	3	40	60	100	PE
21AM009	Cloud Storage Technologies	3	0	0	3	3	40	60	100	PE
21AM010	Cloud Automation Tools and Applications	3	0	0	3	3	40	60	100	PE
21AM011	Software Defined Networks	2	0	2	3	3	40	60	100	PE
21AM012	Security and Privacy in Cloud	3	0	0	3	3	40	60	100	PE
VERTICAL III CYBER SECURITY AND DATA SCIENCE										
21AM013	Cyber Security	3	0	0	3	3	40	60	100	PE
21AM014	Modern Cryptography	3	0	0	3	3	40	60	100	PE
21AM015	Cyber Forensics	3	0	0	3	3	40	60	100	PE
21AM016	Ethical Hacking	3	0	0	3	3	40	60	100	PE
21AM017	Cryptocurrency and Blockchain Technologies	2	0	2	3	3	40	60	100	PE
21AM018	Malware Analysis	3	0	0	3	3	40	60	100	PE
VERTICAL IV AI AND ROBOTICS										
21AM019	Robotic Process Automation	3	0	0	3	3	40	60	100	PE
21AM020	Text and Speech Analysis	2	0	2	3	3	50	50	100	PE
21AM021	Edge Computing	3	0	0	3	3	40	60	100	PE
21AM022	Intelligent Robots and Drone Technology	3	0	0	3	3	40	60	100	PE
21AM023	Intelligent Transportation Systems	3	0	0	3	3	40	60	100	PE
21AM024	Expert Systems	3	0	0	3	3	40	60	100	PE
VERTICAL V MERN STACK DEVELOPMENT										
21AM001	Agile Software Development	3	0	0	3	3	40	60	100	PE
21AM026	Web Frameworks and Applications	3	0	0	3	3	40	60	100	PE
21AM027	Ecommerce and Web Development	3	0	0	3	3	40	60	100	PE
21AM028	Mobile and Web Application	3	0	0	3	3	40	60	100	PE

21AM029	NOSQL Database	2	0	2	3	3	50	50	100	PE
21AM030	Smart Product Development	3	0	0	3	3	40	60	100	PE
VERTICAL VI DATA ANALYTICS										
21AM031	Bio Medical Image Analysis	2	0	2	3	3	50	50	100	PE
21AM032	Data Analytics and Data Science	3	0	0	3	3	40	60	100	PE
21AM033	Video Analytics	3	0	0	3	3	40	60	100	PE
21AM034	Cyber Threat Analytics	3	0	0	3	3	40	60	100	PE
21AM035	Business Intelligence	3	0	0	3	3	40	60	100	PE
21AM036	Digital Marketing and Techniques	3	0	0	3	3	40	60	100	PE
VERTICAL VII DIVERSIFIED COURSES										
21AM037	Internet of Things and its Applications	3	0	0	3	3	40	60	100	PE
21AM038	Bioinformatics	3	0	0	3	3	40	60	100	PE
21AM039	Social and Information Networks	3	0	0	3	3	40	60	100	PE
21AM040	Information Storage Management	3	0	0	3	3	40	60	100	PE
21AM041	Software Project Management	3	0	0	3	3	40	60	100	PE
21AM042	Intellectual Property Rights	3	0	0	3	3	40	60	100	PE

ONE CREDIT COURSES										
21AM0XA	Machine Learning with Tensorflow	1	0	0	1	-	100	0	100	EEC
21AM0XB	Introduction to Tableau	1	0	0	1	-	100	0	100	EEC
21AM0XC	Kubernetes:Developers Perspective	1	0	0	1	-	100	0	100	EEC
21AM0XD	Natural Language Processing with Attention Models	1	0	0	1	-	100	0	100	EEC
21AM0XE	Unifying DevOps and SRE	1	0	0	1	-	100	0	100	EEC
21AM0XF	Data Management and Analytics in Healthcare	1	0	0	1	-	100	0	100	EEC

SUMMARY OF CREDIT DISTRIBUTION

S.No	CATEGORY	CREDITS PER SEMESTER								TOTAL CREDIT	CREDITS in %	Range of Total Credits	
		I	II	III	IV	V	VI	VII	VIII			Min	Max
1	BS	10	10	4	4	0	0	0	0	28	17.1	15%	20%
2	ES	6	7	0	0	0	0	0	0	13	8.0	15%	20%
3	HSS	2	2	0	0	0	0	0	0	4	2.4	5%	10%
4	PC	0	0	23	21	17	13	5	0	79	48.7	30%	40%
5	PE	0	0	0	0	6	9	12	0	27	16.5	15%	20%
6	EEC	0	0	0	0	0	0	3	9	12	7.3	5%	10%
Total		**18**	**19**	**27**	**25**	**23**	**22**	**20**	**9**	**163**	**100**	**-**	**-**

BS - Basic Sciences
ES - Engineering Sciences
HSS

-
Humaniti
es and
Social
Sciences
PC

-
Professio
nal Core
PE - Professional Elective
EEC -
Employabilit
y
Enhancement
CourseCA
-
Continuous
Assessment
ES - End Semester Examination

21AM101 Engineering Mathematics I **3 1 0 4**

Course Objectives

- Understand the concepts of vectors and Eigenvectors for different matrices to describe the stability of the linear systems in engineering fields.
- Exemplify the concepts of differentiation and integration to identify the area of 2D and 3D surfaces in engineering problems.
- Explain the concepts of analytic functions in complex domain to predict the nature of different engineering systems.

Course Outcomes (COs)

1. Represent the different forms of coordinate system in complex plane and characteristics of linear systems by Eigenvalues and Eigenvectors.
2. Analyze various types of functions and their differentiation techniques involved in engineering fields.
3. Implement different methods of integration used in engineering problems.
4. Execute the suitable integration technique to calculate the area and volume of different surfaces.
5. Apply the concept of analytic function to estimate the integral in complex plane.

Articulation matrix:

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

UNIT I **9 Hours**

COMPLEX NUMBERS, VECTORS AND MATRICES

Complex plane, polar coordinates and polar form of complex numbers, powers and roots, fundamental theorem of algebra. Vector algebra in 2-D and 3-D space, dot product and cross product. Matrices: Eigen values and Eigen vectors, Properties of Eigen values and Eigen vectors.

UNIT II **9 Hours**

CALCULUS

Limits and Continuity of Functions: Limits of functions, types of limits, evaluation of limits, continuity of functions, properties of continuous functions. Derivatives: Derivatives, differentiability, rules and properties, differentiation of transcendental functions, higher order derivatives, implicit differentiation, and differentiation of hyperbolic functions. Integration: Anti-derivatives, Riemann Sum, indefinite and definite integration, Mean Value Theorem for definite integral, Fundamental Theorem of Calculus.

UNIT III **9 Hours**

INTEGRATION METHODS

Basic integration formulae for algebraic and transcendental functions. Integration by special devices: integration by parts, rationalizing substitution or trigonometric substitution, partial fractions, reduction formulas, improper integrals, convergence tests.

UNIT IV **9 Hours**

APPLICATIONS OF DERIVATIVES AND INTEGRATIONS

Extreme values, points of inflection and curve sketching, Rolles Theorem, Mean Value Theorem, optimization, indeterminate forms, L Hopitals Rule. Area between curves, volume of a general solid by slicing and cylindrical shell methods, volume of a solid of revolution, length of plane curves, area of a surface of revolution.

UNIT V **9 Hours**

COMPLEX ANALYSIS

Analytic Functions- Properties of Analytic function - Determination of Analytic Function using Milne Thompson method. Cauchys Integral Formula - Classification of Singularities - Cauchys Residue Theorem.

FOR FURTHER READING

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

Total: 45 Hours

Reference(s)

1. S.C. Gupta, Fundamentals of Statistics, 7th Edition, Himalaya Publishing House Pvt. Ltd. 2018.
2. Smith RT and Minton RB, Calculus, 2nd Edition, McGraw Hill, 2002.
3. Finney RL, Weir MDand Giordano FR, Thomas Calculus, 10th edition, Addison-Wesley, 2001.
4. Kreysgiz E, Advanced Engineering Mathematics, 8th edition, John Wiley & Sons, 1999.
5. Anton H, Calculus with Analytic Geometry, 5th edition, John Wiley & Sons, 1995.
6. Ayres F Jr and Mendelson E, Schaum s Outline of Theory and Problems of Calculus, 4th edition, McGraw Hill, 1999.

21AM102 Engineering Physics I **2 0 2 3**

Course Objectives

- Illustrate the Newtons laws of motion and wave motion with applications
- Understand the basic properties of electricity, magnetism and optics
- Differentiate the special theory of relativity and quantum physics from classical physics

Course Outcomes (COs)

1. Illustrate the Newtons three laws of motion and apply the same to solve the real-world problems involving elevator, at wood machine and acceleration of objects
2. Exemplify the physical characteristics of simple harmonic motion, wave motion and find the solutions for wave equations
3. Infer the fundamental laws, properties of electricity and magnetism and apply the same to electric and magnetic elements
4. Apply the principles of physical and geometrical optics in the mirrors, lenses, microscopes and diffraction gratings
5. Outline the importance of special theory of relativity, quantum physics and analyze the wave and particle nature of matter

Articulation matrix:

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

UNIT I **6 Hours**

MECHANICS

Newton's laws of motion: Concept of force and its nature-Newtons first law and inertial frames- definition of mass -Newton's second law-gravitational force and weight -Newton's third law. Applications of Newtons laws: particle in equilibrium, particle under net force-weighing a mass in an elevator, the at wood machine and acceleration of two objects connected by a cord.

UNIT II **6 Hours**

OSCILLATIONS AND WAVES

Fundamentals of simple harmonic motion -energy of simple harmonic oscillator -spring mass system -time period of simple pendulum, compound pendulum and torsional pendulum - Damped oscillations. Travelling wave motion -sinusoidal waves on strings -speed of a wave -reflection and transmission -rate of energy transfer in wave motion.

UNIT III **6 Hours**

ELECTRICITY AND MAGNETISM

Point charges-electric fields -Gauss law and its applications -electric potential -capacitance -energy stored in a capacitor. Concept and source of magnetic fields -Amperes theorem -determination of magnetic field due to different current distributions -Faradays law -self-induction and mutual induction -energy stored in an inductor.

UNIT IV **6 Hours**

LIGHT AND OPTICS

Nature of light -laws of reflection and refraction -refractive index and Snells law -dispersion of light -total internal reflection -image formation: concave mirrors -convex mirrors -thin lenses -compound microscope - human eye. Conditions of interference -Youngs double slit experiment - intensity distribution of interference - phase change duet reflection -diffraction-narrow slit diffraction -single slit and two slit -intensity distribution-diffraction grating –applications.

UNIT V **6 Hours**

MODERN PHYSICS

Special theory of relativity -simultaneity and time dilation -twin paradox -length contraction -relativistic mass variation - space time graph. Black body radiation and Planck hypothesis -allowed energy levels -thermal radiation from different objects -photoelectric and Compton effect. Matter waves -de-Broglie hypothesis -wave nature of particles -Davission-Germer experiment

EXPERIMENT 1 **5 Hours**

Determination of resultant of system of concurrent coplanar Forces-Parallelogram law of forces

EXPERIMENT 2 **5 Hours**

Determination of moment of Inertia-Torsional pendulum

EXPERIMENT 3 **5 Hours**

Determination of wavelength of mercury spectral lines-spectrometer

EXPERIMENT 4 **4 Hours**

Determination of refractive index of solid and liquid-travelling microscope

EXPERIMENT 5 **3 Hours**

Determination of wavelength of laser-diffraction grating

EXPERIMENT 6 **4 Hours**

Determination of frequency of a tuning fork-Meldes apparatus

EXPERIMENT 7 **4 Hours**

Thickness of a thin wire using interference of Light-Air wedge method

Total: 60 Hours

Reference(s)

1. H C Verma, Concepts of Physics (Vol I& II), Bharathi Bhawan Publishers & Distributors, New Delhi, 2017
2. H D Youngand R AFreedman, Sears and Zemanskys University Physics with Modern Physics, Pearson education, 2016
3. R K Gaur and S L Gupta, Engineering Physics, DhanpatRai Publications, 2012
4. R ASerway and J W Jewitt, Physics for Scientists and Engineers, Thomson Brooks/Cole, 2011
5. Hallidayand Resnick, Fundamentals of Physics, John Wiley and Sons, Inc, 2011

21AM103 Engineering Chemistry I **2 0 2 3**

Course Objectives

- Identify the properties and applications of optical materials for smart screen
- Summarize the conducting materials and explain its applications to smart screens
- 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	1												
2	2	1												
3	2	1												
4	2	1												
5	2	1												

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 [polythiophene].

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 **5 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 aluminium chloride, aluminium 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 **6 Hours**

Electroless plating of nickel on polymeric material used in IC fabrication

Total: 60 Hours

Reference(s)

1. 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
2. Advanced Magnetic and Optical Materials, edited by Ashutosh Tiwari, Parameswar K. Iyer, Vijay Kumar, Hendrik Swart, wiley publication, 2016
3. Smart Materials Taxonomy, Victor Goldade, Serge Shil"ko, Aleksander Neverov, CRC publication, 2015
4. G.M. Crean, R. Stuck, J.A. Woollam. Semiconductor Materials Analysis and Fabrication Process Control Elsevier publication, 2012
5. Padma L Nayak, Polymer Science, 1st Edition, Kalyani Publishers, New Delhi, 2005
6. https://www.dmccoltd.com/english/museum/touchscreens/technologies/projected.asp

21AM104 Programming for Problem Solving in C **2 0 2 3**

Course Objectives

- Understand the basics of C primitives, operators and expressions.
- Gain knowledge about the different primitive and user defined data types.
- Impart knowledge about the structural programming concepts.

Course Outcomes (COs)

1. Demonstrate the basic C programming concepts
2. Implement C programs using control statements
3. Implement the concepts of Arrays and strings in C
4. Implement the concepts of functions and pointers in C
5. Analyze the concepts of structures, unions and files in C

Articulation matrix:

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

UNIT I **6 Hours**

INTRODUCTORY CONCEPTS

C Primitives: Introduction to C- planning and writing a C program- Character Set - Keywords and Identifiers - Data Types - Variables and Constants - Compiling and executing the C program Operators and Expressions: Arithmetic - Relational - Logical - Increment and decrement - Conditional - Bitwise- Comma - Size of() - Assignment - Shift operator - Precedence and order of evaluation Type Conversion-Input and Output Operations: Formatted I/O functions - getchar and putchar function - gets and puts functions.

UNIT II **6 Hours**

CONTROL STATEMENTS

Decision Making and Branching: simple if statement - if else statement - nesting of if else Statement - Switch Statement. Decision Making and Looping: while statement - do while statement - for statement - Nested for statement Jump Statements: goto - break - continue - return statement.

UNIT III **6 Hours**

ARRAYS AND STRINGS

Arrays: Introduction, one dimensional array, declaration - Initialization of one dimensional array, two-dimensional arrays, initializing two dimensional arrays, multi-dimensional arrays. Strings: Declaring and initializing string variables- Reading strings from terminal - writing string to screen - String handling functions.

UNIT IV **6 Hours**

FUNCTIONS AND POINTERS

User Defined Functions: Elements of user defined functions - Definition of functions - return values and their types -function calls - function declaration -categories of function - call by value and call by reference recursion - Pre-processor directives and macros. Pointers: Understanding Pointers - accessing the address of the variable - Declaring pointer variables - Initialization of pointer variables – Accessing a variable through its pointer.

6 Hours

UNIT V

STRUCTURES AND FILES

Storage Class Specifiers: Auto - registers - static - extern – typedef Structures and Unions Introduction- defining a structure - declaring structure variables - accessing structure members –structure initialization- Unions -Enumerated data type File Management in C: Defining and opening a file - closing a file – Input/ output operations on files – Command line arguments.

EXPERIMENT 1 **4 Hours**

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

EXPERIMENT 2 **4 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 checkif 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**

Writea 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 **4 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**

Writea c program to remove the occurrence of "the" word from entered string.

EXPERIMENT 8 **2 Hours**

Writea C program to find the factorial of given number.

EXPERIMENT 9 **4 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: roll no, name, branch, year, section, cgpa.

****

NAME:

ROLL:

BRANCH:

YEAR:

SECTION:

CGPA:

EXPERIMENT 10 **4 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

Total: 60 Hours

Reference(s)

1. Herbert Schildt, C -The complete Reference, Tata McGraw-Hill, 2013
2. Ashok.N.Kamthane,Programming in C,Pearson education,2013
3. Byron Gottfried, Programming with C, Schaum"s Outlines, Tata Mcgraw-Hill, 2013
4. E.Balagurusamy, Programming in ANSI C, Tata McGraw-Hill, 2012
5. Kernighan BW and Ritchie O M, The C Programming Language. Prentice-Hall of India, 2009
6. Kelley A and I. Pohl, A Book on C: Programming in C, Pearson Education, 1998

21AM105 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. Demonstrate the basic concepts of electric and magnetic circuits.
2. Compare 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	2	2									2	
2	3	2	3										2	
3	2	3	3										2	
4	2	3	3	3									2	
5	1	2	3	2									2	

UNIT I **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- Construction - Working Principle- Applications.

UNIT III **6 Hours**

AC MACHINES

Single Phase Transformer - Alternator - Three phase induction motor - Single phase induction motor - Construction - 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.

EXPERIMENT 1 **4 Hours**

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

EXPERIMENT 2 **4 Hours**

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

EXPERIMENT 3 **4 Hours**

Understand the concept of electromagnetic induction using copper coil.

EXPERIMENT 4 **4 Hours**

Understand the construction and working principle of DC machines.

EXPERIMENT 5 **6 Hours**

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

EXPERIMENT 6 **4 Hours**

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

EXPERIMENT 7 **4 Hours**

Lighting applications using logic gates principle.

Total: 60 Hours

Reference(s)

1. R. S. Sedha, ATextbook of Applied Electronics, S.Chand& Company Ltd, 2013
2. T. K. Nagsarkar and M. S. Sukhija, Basic of Electrical Engineering, Oxford University Press, 2011.
3. Smarjith Ghosh, Fundamentals of Electrical and Electronics Engineering, Prentice Hall (India) Pvt. Ltd., 2010.
4. A. Sudhakar, Shyammohan S Palli, Circuits and Networks Analysis and Synthesis, Tata McGraw Hill, 2010

18HS101 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. Demonstrate 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									1					
2									2					
3									3					
4										1				
5										2				

UNIT I

GRAMMAR **9 Hours**

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 - What-questions in the past – Question tags – Will and going to, for prediction – Gender Sensitive Vocabulary.

UNIT II

READING **9 Hours**

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

WRITING **9 Hours**

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

UNIT IV

LISTENING **9 Hours**

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

SPEAKING **9 Hours**

Exchanging personal and factual information – expressing and finding out about attitudes and opinions – organize 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: 45 Hours

Reference(s)

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

21AM201 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. Analyze 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	1	3												
2	2	3												
3	2	3												
4	3	3												
5	1	3												

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 Hours

Reference(s)

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

21AM202 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. Analyze the characteristics of semiconducting materials in terms 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	1							2					
3	2	1							2					
4	2	1												
5	2	1							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- fiber optic sensors- intensity modulated sensor-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.

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**

MAGNETICMATERIALS

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: 60 Hours

Reference(s)

1. Kasap, S.O. Principles of Electronic Materials and Devices McGraw-Hill Education,2017
2. Wahab, M.A. Solid State Physics: Structure and Properties of Materials Alpha Science International Ltd., 2017
3. K. Thiyagarajanand A. K. Ghatak, LASERS: Fundamentals and Applications, Springer, USA, 2015
4. Bala subramaniam, R. Callisters Materials Science and EngineeringWiley India Pvt.Ltd, 2014
5. Donald A. Neamen. Semiconductor Physics and Devices, McGraw-Hill, 2011
6. B.D. Cullity, Introduction to Magnetic Materials, Addison-Wesley ,2001

21AM203 Engineering Chemistry II **2 0 2 3**

Course Objectives

- Classify the traditional and advanced materials used to manage heat developed in electronic devices
- Summarize the terminologies of electrochemistry and explain the applications of energy storagedevices for computers
- Indicate the types, properties and applications of Nano chips 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 devicesin 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	1												
2	2	1												
3	2	1												
4	2	1												
5	2	1												

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 [Al2O3, BeO, AlN, SiC and Kovar alloy]

UNIT II **7 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 **7 Hours**

ENERGYSTORAGE 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 **5 Hours**

NANOMATERIALS

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

UNIT V **5 Hours**

E- WASTE MANAGEMENTS

Sources -toxicityduehazardous substances -impact to environment. E-waste Management-Hazardous materials recycling (Gallium and Arsenic)

EXPERIMENT 1 **8 Hours**

General introduction and Determination of thermal stability of aluminium oxide using thermo gravimetric analysis

EXPERIMENT 2 **4 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

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: 60 Hours

Reference(s)

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

21AM204 Application Based Programming in Python 2 0 2 3

Course Objectives

- Develop a basic understanding Python programming language
- Solve problems requiring the writing of well-documented programs in the Python language, including use of the logical constructs of that language
- Demonstrate significant experience in data structures with the Python program

Course Outcomes (COs)

1. Demonstrate the basic concepts of Python programming
2. Implement Python programs using control statement and functions
3. Develop Python programs for the data structures String, List and Set
4. Implement Python programs for tuples and dictionaries data structures
5. Develop Python programs for files, modules and packages.

Articulation Matrix

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

UNIT I **6 Hours**

BASICS OF PYTHON PROGRAMMING AND CONTROL STATEMENTS

Introduction-Python – Object Oriented Programming –Classes, Object and Instances- Constructor, 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 II **6 Hours**

DATASTRUCTURES: STRINGS, LISTS, SET, TUPLES, DICTIONARIES

Strings: string slices, immutability, string methods and operations; Lists: creating lists, list operations, Sets: creating sets, set operations, Tuples: Tuple assignment, Operations on Tuples, lists and tuples, Tuple as return value; Dictionaries: operations and methods, Nested Dictionaries, Arrays: operations and methods

UNIT III **6 Hours**

PYTHON AND ITS LIBRARIES

Pandas: Data frame, Operations, Index, Time series, plot; NumPy: Array Creation Routines, Mathematical, Statistical Functions, Arithmetic Operations- Matplotlib- pyplot, Markers, Line, Labels, Grid, Pie Charts; Scikit-learn: Modelling Process, Data Representation, Linear Modelling.

UNIT IV **6 Hours**

DATA PREPROCESSING

Scaling: Standard Scalar, Minimax Scalar, Feature Scaling; Normalization: L1, L2 Normalization; Binarization: Image binarization with OpenCV-NumPy, Image binarization without OpenCV, Automatic image thresholding.

6 Hours

UNIT V

FILES, MODULES, PACKAGES

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

EXPERIMENT 1 **2 Hours**

Programs using expressions and input and output statements.

EXPERIMENT 2 **2 Hours**

Programs using operators and built-in functions.

EXPERIMENT 3 **2 Hours**

Programs using conditional statements.

EXPERIMENT 4 **2 Hours**

Programs performing all string operations.

EXPERIMENT 5 **2 Hours**

Programs using Data Frames

EXPERIMENT 6 **2 Hours**

Programs to process data using Data Pre-processing methods

EXPERIMENT 7 **2 Hours**

Programs to perform Data Visualization

EXPERIMENT 8 **2 Hours**

Programs to perform Image binarization

EXPERIMENT 9 **2 Hours**

Programs using dictionary and set

EXPERIMENT 10 **2 Hours**

Programs to work with Tuples.

EXPERIMENT 11 **2 Hours**

Programs to perform Scaling

EXPERIMENT 12 **2 Hours**

Program to perform Normalization.

EXPERIMENT 13 **2 Hours**

Program to perform file operations

EXPERIMENT 14 **2 Hours**

Program to perform Linear Modelling

EXPERIMENT 15 **2 Hours**

Programs using modules and packages

Total: 60 Hours

Reference(s)

1. Ashok Namdev Kamthane, 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 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. John V Guttag, Introduction to Computation and Programming Using Python, Revised and expanded Edition, MIT Press, 2013.
6. Kenneth A. Lambert, Fundamentals of Python: First Programs, CENGAGE Learning, 2012.

21AM205 Digital System Design **3 0 2 4**

Course Objectives

- Understand the fundamentals of digital logic
- Understand the implementation of logic circuits.
- Analyze 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	2	1											
2	1	2	2											
3	2	2	2											
4	2	2	2											
5	1	2	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 Paritygenerator and paritychecker

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: 75 Hours

Reference(s)

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

21AM301 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	3	3	1											
2	2	3												
3	3	2		1										
4	2	1	1	3										
5	2	2	1	1										

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, Chi-square And F Distributions For Mean, Variance And Proportion - Contingency Table (Test For Independent) - Goodness Of Fit.

9 Hours

UNIT IV

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**

STATISTICALQUALITYCONTROL

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

Total: 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., Ã¢??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.

21AM302 Data Structures Using C++ **3 1 0 4**

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. Classify 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												
2	2	2	3										2	
3	2	3	2	2	2								2	
4			2	2										
5			2	2										

UNIT I **9 Hours**

OBJECTS AND CLASSES IN C++

Objects and Classes Simple Class - C++ Objects as Physical Objects - C++ Object as Data types- Constructors and Destructors- Polymorphism -Class Hierarchies-Public and Private Inheritance-Levels of Inheritance-Multiple Inheritance.

UNIT II **9 Hours**

LINEAR DATA STRUCTURES - STACKS, QUEUES

Arrays -Abstract Data Types -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 DATASTRUCTURES - 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. Data Structures Through C++ (4th Edition): Experience Data Structures C++ through animations ,2022
2. Michael T. Goodrich, Roberto Tamassia, David M. Mount, Data Structures and Algorithms in C++, ISBN 978-0-470-38327-8, February 2011. Paperback, 736 pages
3. Richard F. Gilberg, and Behrouz A. Forouzan, Data Structures - A Pseudocode Approach with C, Thomson 2011
4. Data Structures Using C++, Second Edition D.S. Malik,2010
5. Aho, J.E.Hopcroft and J.D.Ullman, Data Structures and Algorithms, Pearson education, Asia,2010
6. Reema Thareja, Data Structures Using C, Second Edition , Oxford University Press, 2011

21AM303 Principles of Operating System **3 0 0 3**

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 inter process 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	2	1	1		1				2		1	
2	2	3	3	2	2		2				2		2	
3	2	2	3	2	2		2				2		3	
4	2	2	3	2	2		2				2		4	
5	2	2	3	2	2		2				2		5	

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. Interposes 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**

STORAGEMANAGEMENT

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 Hours

Reference(s)

1. Abraham Silberschatz, Greg Gagne and Peter B. Galvin. "Operating System Concepts", 10th Edition, Wiley, 2018.
2. D. M. Dhamdhere. "Operating Systems: A Concept-Based Approach", 3rd. Edition, Tata McGrawHill, 2017.
3. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, 9th Edition, John Wiley & Sons Pvt. Ltd, 2015
4. Andrew S. Tanenbaum, Modern Operating Systems, Fourth Edition, Prentice Hall of India Pvt. td, 2014
5. William Stallings. "Operating Systems: Internals and Design Principles", 7th Edition, Prentice Hall, 2013. 85
6. WilliamStallings, Operating System, Seventh Edition Prentice Hall of India, 2012
7. Harvey M. DeitelM ,Operating Systems, Pearson Education Pvt. Ltd, 2007
8. Russ Cox, Frans Kaashoek and Robert Morris. "xv6: A Simple, Unix-like Teaching Operating System", Revision 8. (Free and can be downloaded)

21AM304 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. Interpret 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											
2	3	3	2											
3	2	3	3											
4	2	2	2											
5	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-Memory Access-Buses-Interface circuits- Standard I/O Interfaces- 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. Carl Hamacher, Zvonko Vranesicand Safwat Zaky, Computer Organization, McGraw- Hill, Third Reprint 2015
2. William Stallings, Computer Organization and Architecture Designing for Performance, Pearson Education, 2003
3. DavidA, Patterson and John L, Hennessy, Computer Organization and Design: Thehardware/ software interface, Morgan Kaufmann, 4th edition, 2014.
4. John P.Hayes, Computer Architecture and Organization, McGraw Hill, 3rd edition, 2002

21AM305 Database Management System 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 systemand design an 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 organizations, 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	1	2	3		2							3	2	
3	2	3										2		
4	2	3												
5	1	3	2									1		

UNIIT 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 - Algorithms for relational database schema design 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-Multiple Granularity Time stamp based protocols-Recovery system: Failure classification -Storage-Recovery and atomicity Recovery Algorithms.

Total: 45 Hours

Reference(s)

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Seventh Edition, Tata McGraw Hill, 2019.
2. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson/Addison - Wesley, 2016.
3. Ramez Elmasri and Shamkant B. Navathe, Fundamental Database Systems, Pearson Education, 2008
4. Raghu Ramakrishnan, Database Management System, Tata McGraw-Hill Publishing Company, 2003C.J.Date,An Introduction to Database system, Pearson Education, 2006
5. Peter Rob and Corlos Coronel, Database System, Design, Implementation and Management,ThompsonLearning Course Technology, 2003

21AM306 Java Programming **3 1 0 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 database connectivity
5. Design desktop-based java applications using JSP and Spring Framework

Articulation Matrix

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

UNIT I **9 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. File - The Byte Streams - The Character Streams - Using Stream I/ O - Serialization. String Handling: SpecialString operations and Methods - String Buffer - Exploring java. lang: Simple type Wrappers - System - Math - Utility Classes: StringTokenizer - Date and Time

UNIT II **9 Hours**

INHERITANCE INTERFACES AND COLLECTION CLASSES

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

UNIT III **9 Hours**

ROBUSTNESS AND CONCURRENCY

Interfaces Definitions and Implementations - Exception Handling: Types - Try and Catch - Throw -Multi-Threaded Programming: Exception Handling - Exceptions Errors - Types of Exception - Control Flow in Exceptions - Use of try, catch, finally, throw, throws in Exception Handling. Creating Threads - Inter Thread Communication - Multithreading Thread creation sharing the workload among threads synchronization inter thread communication deadlock.

UNIT IV **9 Hours**

DATABASE CONNECTIVITY AND SERVLET

Accessing databases-JDBC connectivity- Introduction to servlet - Servlet life cycle – Developing and Deploying Servlets - Exploring Deployment Descriptor (web.xml) - Handling Request and Response - Session Tracking Management.

UNIT V **9 Hours**

JAVA SERVER PAGES AND SPRING

JSP Tags and Expressions - JSP Expression Language (EL) - JSP with Java Bean. Spring framework- Container concepts - Building a Sample Application.

FOR FURTHER READING

JAVA Networking -Client and Server Programming

TUTORIAL 1 **1 Hour**

Program on Classes and Method

TUTORIAL 2 **1 Hour**

Implementation of Inheritance

TUTORIAL 3 **1 Hour**

Implementation of Interfaces and Packages

TUTORIAL 4 **1 Hour**

Implementation of Multithreaded Programming

TUTORIAL 5 **1 Hour**

Develop a program to implement String Handling Methods

TUTORIAL 6 **1 Hour**

Implementation of Exception handling mechanisms

TUTORIAL 7 **2 Hours**

Implementation of Collections Interfaces and Classes

TUTORIAL 8 **2 Hours**

Implementation of Servlet

TUTORIAL 9 **2 Hours**

Write a program to implement Java Database Connectivity

TUTORIAL 10 **2 Hours**

Implementation of MVC Architecture

Total: 60 Hours

Reference(s)

1. Y. Daniel Liang, "Introduction to Java Programming and Data Structures, Comprehensive Version", 11th Edition, Pearson Education, 2018
2. Herbert Schildt, "Java: The Complete Reference", 11th Edition, McGraw-Hill Education, 2018
3. Deitel & Deitel, Java Howto Program, Prentice Hall of India, 2010
4. Gary Cornell and Cay S.Horstmann, Core Java Vol.1 and Vol.2, Sun Microsystems Press, 2008
5. Nicholas S. Williams, Professional Java for Web Applications, Wrox Press, 2014
6. Rod Johnson, Juergen Hoeller, Alef Arendsen, Thomas Risberg, Colin Sampaleanu, Java Development with the Spring Framework, Wiley-India, 2012

21AM307 Data Structures Laboratory **0 0 4 2**

Course Objectives

- Understand the principles of linear and nonlinear 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										2	
2	2	3	3										2	
3	2	3	3										3	

EXPERIMENT 1 **4 Hours**

Program to Solve Tower-of-Hanoi Problem using Recursion

EXPERIMENT 2 **4Hours**

a) Write a C 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) Write a C 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 **6 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 orderdisplay the elements of the list
v. Display the Elements of the list.
vi. 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 lists
vi. 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 quicksort.

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 **4 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
vi. write a main method to execute the above functionalities

EXPERIMENT 13 **6 Hours**

Implementation of hashing technique

Total: 60 Hours

21AM308 Database Management System 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	3	2	1		3							2	3	
2	3	2	2		3							2	2	
3	3	2	2		3							2	3	
4	3	2	2		3							2	3	
5	3	2	2		3							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. AbrahamSilberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts, McGraw -Hill, 2015
2. C.J.Date, An Introduction to Database system, Pearson Education, 2006.

18GE301 Soft Skills – Verbal Ability **2 0 0 0**

Course Objectives

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

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										1				

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- Mispronounced/ Misspelt Words.

Total: 30 Hours

Reference(s)

1. Baron's The Official Guide for New GMAT Review, New Jersey: John Wiley & Sons, Inc. 2015.
2. 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.
3. Lewis, Norman. Word Power Made Easy. New York: Pocket Books. 1991.

21AM401 Mathematics for Machine Learning 3 1 0 4

Course Objectives

- Enhancing the basic understanding of Application of Mathematics in Computer Science.
- Imparting design thinking capability to build ML systems
- Developing design skills of models for machine learning problems

Course Outcomes (COs)

1. Represent the different forms of coordinate system in complex plane and characteristics of linear systems.
2. Analyze various types of functions and their differentiation techniques involved in Machine Learning
3. Implement different types of correlation.
4. Analyze the suitable classical optimization techniques for solving real world problems.
5. Apply the concept of LPP models for optimizing the real scenario.

Articulation Matrix

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

UNIT I **9 Hours**

VECTOR SPACES

Vector spaces – Subspaces – Linear combinations and linear system of equations – Linear independence and linear dependence – Bases and dimensions.

UNIT II **9 Hours**

LINEAR TRANSFORMATION AND DIAGONALIZATION

Linear transformation – Null spaces and ranges – Dimension theorem – Matrix representation of a linear transformations – Eigenvalues and eigenvectors – Diagonalizability.

UNIT III **9 Hours**

REGRESSION

Correlation and Regression, types of correlation – Pearson's, Spearman's correlations –Ordinary Least Squares, Fitting a regression line, logistic regression, Rank Correlation- Partial and Multiple correlation- Multiple regression, multi-collinearity.

UNIT IV

CLASSICAL OPTIMIZATION USING DIFFERENTIAL CALCULUS **9 Hours**

Single variable and multivariable optimization with & without Constraints, Langrangian theory, Kuhn Tucker conditions.

UNIT V

OPTIMIZATION USING LINEAR PROGRAMMING **9 Hours**

Simplex method, two phase method and duality in linear programming. Application of linear programming: Transportation and Assignment problems.

Total: 45 Hours

Reference(s)

1. Gilbert Strang, Introduction to linear algebra, Fifth Edition, ANE Books, 2016.
2. Kuldeep Singh -Engineering Mathematics Through Applications 2nd ed. Edition, Palgrave macmillan, 2011
3. Ross Baldick -Applied Optimization: Formulation and Algorithms for Engineering Systems 1st Edition, Cambridge University Press,2013
4. Hamdy A. Taha, Operations Research, Eighth Edition, Pearson, Prentice hall of India, 2007
5. Ross, S.M., Introduction to Probability and Statistics for Engineers and Scientists, 3rd Edition, Elsevier, 2004.

21AM402 Design and Analysis of Algorithm **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	3													
2	2	3	2										1	
3		3	2											
4		3	2											
5		2	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 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 Hours

Reference(s)

1. S. Sridhar, “Design and Analysis of Algorithms”, Oxford University Press, 2015
2. Steven S. Skiena, “The Algorithm Design Manual”, Second Edition, Springer, 2010
3. Robert Sedgewick, Kevin Wayne, “Algorithms”, Fourth Edition, Pearson Education, 2011
4. AnanyLevitin, Introduction to the Designand Analysis of Algorithms, Third Edition, Pearson EducationAsia, 2011
5. T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, Introduction to Algorithms, PHIPvt. Ltd.,2009
6. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, “Introduction to Algorithms”,
7. Third Edition, McGraw Hill, 2009

21AM403 Internet and Web Programming 3 1 0 4

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. Demonstrate web services and its technologies

Articulation Matrix

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

UNIT I **10 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 **10 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 **8 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 **8 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

Total: 45 Hours

FOR FURTHER READING

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

Reference(s)

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

21AM404 Computer Networks **3 0 0 3**

Course Objectives

- Understand the concepts of computer networks and to study the functions of different layers.
- Familiarized with different protocols and network components.
- Understand the implementation of network management protocol.

Course Outcomes (COs)

1. Demonstrate the fundamentals of networking.
2. Explore the Data Link Layer and Network layer.
3. Elucidate the High Performance Networks.
4. Classify the SNMP and Network Management.
5. Illustrate the RMON and Telecommunication Network Management.

Articulation Matrix

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

UNIT I **9 Hours**

FOUNDATIONS OF NETWORKING

Data communication networks - Protocols and standards -OSI model - Layers in OSI -TCP/IP protocol suite Addressing. Physical layer and Media-analog and digital-transmission impairment-data rate limits-performance

UNIT II **9 Hours**

DATA LINK LAYER AND NETWORK LAYER

Wireless LANs-IEEE 802.11- Bluetooth-Connecting Devices-Backbone Networks-Virtual LANs - IPv4 - IPv6- Transition from IPv4 to IPv6 -Address mapping - ICMP-ICMPv6 -Congestion control: open-loop and Closed-loop Congestion control.

UNIT III **9 Hours**

HIGH PERFORMANCE NETWORKS

Optical Networks: Optical links-WDM System-Optical Cross Connects-Optical LANs-Optical paths and networks -Switching: Switching performance Measures-Modular switch design-packet Switching.

UNIT IV **9 Hours**

SNMP AND NETWORK MANAGEMENT

Network Monitoring-Architecture-Performance-Fault-Accounting - Network Control- Network Management concepts- Network Management Information - Standard MIBs - Simple Network Management Protocol

UNIT V **9 Hours**

RMON AND TELECOMMUNICATION NETWORK MANAGEMENT

Remote monitoring - RMON SMI and MIB - RMON1 - RMON2-ATM Remote monitoring- TMN -TMN conceptual model-TMN architecture - TMN management service architecture- TMN integrated view

Total: 45 Hours

Reference(s)

1. James F. Kurose, Keith W. Ross, “Computer Networking: A Top-Down Approach”, Seventh Edition, Pearson Education, 2017
2. William Stallings, “Data and Computer Communications”, Tenth Edition, Pearson Education, 2014.
3. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, “Computer Networks: An Open Source Approach”, McGraw Hill, 2012.
4. Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, Fifth Edition, Morgan Kaufmann Publishers Inc., 2011
5. Behrouz A. Forouzan, "Data Communication and Networking", Fourth Edition, Tata McGraw Hill,2007
6. Mani Subramanium, "Network Management Principles and practices",Pearson Education,2010.

21AM405 Introduction to Artificial Intelligence 3 0 0 3

Course Objectives

- To impart artificial intelligence principles, techniques and its history
- To assess the applicability, strengths, and weaknesses of the basic knowledge representation, problem solving, and learning methods in solving engineering problems
- To develop intelligent systems by assembling solutions to concrete computational problems

Course Outcomes (COs)

1. Evaluate Artificial Intelligence (AI) methods and describe their foundations.
2. Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation and learning.
3. Demonstrate knowledge of reasoning and knowledge representation for solving real world problems
4. Analyze and illustrate how search algorithms play vital role in problem solving
5. Illustrate the construction of learning and expert system

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

UNIT I **9 Hours**

INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Definitions of AI - Intelligent Agents. Problem solving by searching: Problem-solving agents- Example problems -Search for solutions Uninformed search strategies- Informed search strategies- Heuristic functions.

UNIT II

OVERVIEW TO PROBLEM SOLVING **9 Hours**

Problem solving by Search, Problem space – State space , Blind Search – Types , Performance measurement Heuristic Search Types, Game playing mini-max algorithm, Alpha-Beta Pruning

UNIT III

KNOWLEDGE REPRESENTATION AND REASONNG **9 Hours**

Logical systems Knowledge Based systems, Propositional Logic Constraints, Predicate Logic First Order Logic, Inference in First Order Logic, Ontological Representations and applications

UNIT IV **9 Hours**

UNCERTAINITY AND KNOWLEDGE REASONING

Overview of uncertainty, Bayes Rule Inference, Belief Network, Utility Based System, DecisionNetwork.

UNIT V **9 Hours**

EXPERT SYSTEMS

Expert Systems - Stages in the development of an Expert System - Probability based Expert Systems - Expert System Tools - Difficulties in Developing Expert Systems - Applications of Expert Systems.

Total: 45 Hours

FOR FURTHER READING

Reinforcement Learning

Reference(s)

1. Stuart J. Russell, Peter Norvig, "Artificial Intelligence - A Modern Approach", Third Edition, Pearson Publishers, 2015.
2. Dheepak Khemani, "A first course in Artificial Intelligence", McGraw Hill Education Pvt Ltd., NewDelhi, 2013
3. Ric, E., Knight, K and Shankar, B. 2009. Artificial Intelligence, 3rd edition, Tata McGraw.
4. Hill. 2. Luger, G.F. 2008. Artificial Intelligence -Structures and Strategies for Complex Problem.
5. Solving, 6th edition, Pearson. 3. Brachman, R. and Levesque, H. 2004. Knowledge Representationand Reasoning, Morgan Kaufmann.
6. Alpaydin, E. 2010. Introduction to Machine Learning. 2nd edition, MIT Press.
7. Sutton R.S. and Barto, A.G. 1998. Reinforcement Learning: An Introduction, MIT Press.

21AM406 Applied Machine Learning **3 0 0 3**

Course Objectives

- To introduce students to the basic concepts and techniques of Machine Learning.
- To have a thorough understanding of the Supervised and Unsupervised Learning Techniques.
- To study the various probability-based learning techniques
- To understand graphical models of machine learning algorithms

Course Outcomes (COs)

1. Recognize the characteristics of machine learning that makes it useful to solve real-world problems.
2. Provide solution for classification and regression approaches in real-world applications.
3. Gain knowledge to combine machine learning models to achieve better results.
4. Choose an appropriate clustering technique to solve real world problems.
5. Realize methods to reduce the dimension of the dataset used in machine learning algorithms.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Learning – Types of Machine Learning – Supervised -Unsupervised Learning – Regression basics- Relationship between attributes using Covariance and Correlation-Relationship between multiple variables- Regression - Linear-Multivariate in prediction-Residual Analysis-Identifying significant features-feature reduction using AIC- multi-collinearity- Non-normality and Heteroscedasticity-Hypothesis testing of Regression Model-Confidence intervals of Slope,R-square and goodness of fit, Influential Observations – Leverage

UNIT II **9 Hours**

CLASSIFICATION

Naive Bayes Classifier -Model Assumptions, Probability Estimation-Required data processing- M-estimates, Feature selection- -K-Nearest Neighbor algorithm- Aspects to consider while designing K-Nearest Neighbor-Support Vector Machines-Linear learning machines and Kernel space, Making Kernels and working in feature Space-Decision Trees- ID4, C4.5, CART

UNIT III **9 Hours**

CLUSTERING

Distance Measures-Different clustering methods -Distance-Density-Hierarchical-Iterative distance-based Clustering-Dealing with continuous, categorical values in K-Means-Constructing a hierarchical cluster-K-Medoids, k-Mode and density-based clustering-Measures of quality of clustering.

UNIT IV **9 Hours**

ASSOCIATION RULE MINING

The applications of Association Rule Mining- Market Basket, Recommendation Engines-A mathematical model for association analysis for large item set- Association Rules-Apriori- Constructs large item sets with mini sup by Iterations-Interestingness of discovered association-Rules-Application examples- Association analysis vs. classification-FP-trees

.

UNIT V **9 Hours**

GRAPHICAL MODELS

Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo – Graphical Models – Bayesian Networks – Markov Random Fields – Hidden Markov Models – Tracking Methods

Total: 45 Hours

Reference(s)

1. Peter Flach, ―Machine Learning: The Art and Science of Algorithms that Make Sense of Data‖, First Edition, Cambridge University Press, 2012.
2. Jason Bell,―Machine learning– Hands on for Developers and Technical Professionals‖, FirstEdition, Wiley, 2014
3. Ethem Alpaydin, ―Introduction to Machine Learning 3e (Adaptive Computation and MachineLearning Series)‖, Third Edition, MIT Press, 2014

21AM407 Applied Machine Learning Laboratory **0 0 4 2**

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 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	3	3	2	2	3	1					2	3	2	3
2	3	3	2	2	3	1					2	2	2	3

EXPERIMENT 1 **6 Hours**

Implement and demonstrate the Liner Regression algorithm for finding the most specific hypothesis basedon a given set of training data samples. Read the training data froma.CSV file.

EXPERIMENT 2 **6 Hours**

For a given set of training data examples stored in a .CSV file, implement and demonstrate the Multivariate Regression algorithm to output a description of the set of all hypotheses consistent with the training examples

EXPERIMENT 3 **6 Hours**

Write a program to demonstrate the working of the Naive Bayes Classification algorithm. Use an appropriatedata set for building the decision tree and apply this knowledge to classify a new sample.

EXPERIMENT 4 **6 Hours**

Write a program to demonstrate the working of the K Nearest Neighbor algorithm. Use an appropriate dataset to apply classification technique.

EXPERIMENT 5 **6 Hours**

Write a program to demonstrate the working of the Support Vector Machines algorithm. Use an appropriatedata set to apply classification technique.

EXPERIMENT 6 **6 Hours**

Write a program to demonstrate the working of the K-Means algorithm. Use an appropriate data set to apply clustering technique.

EXPERIMENT 7 **6 Hours**

Write a program to demonstrate the working of the K - Medoids algorithm. Use an appropriate data set to apply clustering technique.

EXPERIMENT 8 **6 Hours**

Write a program to demonstrate the working of the FP Tree algorithm. Use an appropriate data set to determineassociation rules.

EXPERIMENT 9 **6 Hours**

Write a program to demonstrate the working of the Bayesian Network model. Use an appropriate data set for building the graph model.

EXPERIMENT 10 **6 Hours**

Write a program to demonstrate the working of the Markov Model for encoding Joint Probability Distribution. Use an appropriate data set for building the graph model.

Total: 60 Hours

21AM408 Artificial Intelligence Laboratory **0 0 4 2**

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 the algorithms using C /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	3	3	2		3					2		3	3	3
2	3	3	2		3					2		3	3	3

EXPERIMENT 1 **6 Hours**

Implement the Logic Programming for solving N-Queen problem

EXPERIMENT 2 **6 Hours**

Implement the Logic Programming for solving Zebra puzzle

EXPERIMENT 3 **6 Hours**

A magic square is an arrangement of distinct numbers, generally integers, in a square grid, where the numbers in each row, and in each column, and the numbers in the diagonal, all add up to the same number called the "magic constant". Implement Heuristic Search to generate Magic squares

EXPERIMENT 4 **6 Hours**

Build a Bot to Play Tic Tac Toe gaming problem.

EXPERIMENT 5 **6 Hours**

Implement Bayes Inference Rule to a problem of drug screening (mandatory testing for federal or many other jobs which promise a drug-free work environment). Suppose that a test for using a particular drug is 97% sensitive and 95% specific. That is, the test will produce 97% true positive results for drug users and 95% true negative results for non-drug users. These are the pieces of data that any screening test will have from their history of tests. Bayes' rule allows us to use this kind of data-driven knowledge to calculate the final probability.

EXPERIMENT 6 **6 Hours**

Harry installed a new burglar alarm at his home to detect burglary. The alarm reliably responds at detecting a burglary but also responds for minor earthquakes. Harry has two neighbors David and Sophia, who have taken a responsibility to inform Harry at work when they hear the alarm. David always calls Harry when he hears the alarm, but sometimes he got confused with the phone ringing and calls at that time too. On the other hand, Sophia likes to listen to high music, so sometimes she misses to hear the alarm. Here we would like to compute the probability of Burglary Alarm.

Calculate the probability that alarm has sounded, but there is neither a burglary, nor an earthquake occurred, and David and Sophia both called the Harry using Bayes Belief Networks.

EXPERIMENT 7 **6 Hours**

Text is the most unstructured form of all the available data, various types of noise are present in it and the data is not readily analyzable without any pre-processing. The entire process of cleaning and standardization of text, making it noise-free and ready for analysis is known as text preprocessing.

Implement Noise Removal, Lexicon Normalization and Object Standardization.

EXPERIMENT 8 **6 Hours**

Count or Density based features can also be used in models and analysis. These features might seem trivial but shows a great impact in learning models. Some of the features are: Word Count, Sentence Count, Punctuation Counts and Industry specific word counts. Other types of measures include readability measures such as syllable counts, smog index and flesch reading ease. Refer to Text stat library to create such features.
A. Term Frequency – Inverse Document Frequency.

Implement the concept of determining Term Frequency for a sample data set.

EXPERIMENT 9 **6 Hours**

Text classification is one of the classical problem of NLP. Notorious examples include – Email Spam Identification, topic classification of news, sentiment classification and organization of web pages by search engines.
Text classification, in common words is defined as a technique to systematically classify a text object (document or sentence) in one of the fixed category. It is really helpful when the amount of data is too large, especially for organizing, information filtering, and storage purposes.

Implement the concept of Text classification for a sample data set.

EXPERIMENT 10 **6 Hours**

Markov models are a useful class of models for sequential-type of data. Before recurrent neural networks (which can be thought of as an upgraded Markov model) came along, Markov Models and their variants were *the in thing* for processing time series and biological data. Implement Markov models for a sample dataset.

Total: 60 Hours

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. Demonstrate 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. Identify 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
6.

Articulation Matrix

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

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, bio magnification). 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 - 5RPrinciples (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 Edition, New Age International Publishers, New Delhi, 2014
2. T. G. Jr. Miller, S. Spoolman, New Environmental Science, 14th Edition, Wadsworth Publishing Co, New Delhi, 2014
3. A. K. De, Environmental Chemistry, 7th Edition , New age international publishers, New Delhi, 2014
4. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. AcademicPress
5. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. Environment. 8th edition. John Wiley & Sons

18GE401 Soft Skills-Business English 2 0 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

Programme Outcomes(POs)

- Function effectively as an individual, and as a member or leader in diverse teams, and in multi- disciplinary settings.
- Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Listen, 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				2			2		2		2		
2	1				1					2		2		

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 analyzing 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 – apologizing - reassuring – complaining - describing - summarizing - recommending – persuading turn- taking - sustaining interaction - initiating - responding - giving personal information - talking about present circumstances, past experiences and future plans - expressing opinion - speculating - organizing 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.

21AM501 Intelligent Multi Agent and Expert Systems **3 0 0 3**

Course Objectives

- To explain and describe the concepts central to the creation of knowledge based and expert systems.
- To know methods used to evaluate the performance of an expert system.
- To conduct an in-depth examination of an existing expert system with an emphasis on basic methods of creating a knowledge base.
- To examine properties of existing systems in a case-study manner, comparing differing approaches.

Course Outcomes (COs)

1. Demonstrate the modern view of AI as the study of agents that receive precepts from the Environment and perform actions.
2. Demonstrate awareness of informed search and exploration methods.
3. Analyze about AI techniques for knowledge representation, planning and uncertainty Management.
4. Develop knowledge of decision making and learning methods.
5. Describe the use of AI to solve English Communication 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	3	2							2	
3	2	3	3	3	3	2							3	
4	2	3	3	3	3	2							3	
5	2	3	3	3	3	2							3	

UNIT I **9 Hours**

INTRODUCTION TO EXPERT SYSTEMS

Introduction to AI: Intelligent agents – Perception – Natural language processing – Problem – Solving agents – Searching for solutions: Uniformed search strategies – Informed search strategies. Multi-Agent Learning, Meta-learning.

UNIT II **9 Hours**

KNOWLEDGE AND REASONING

Adversarial search – Optimal and imperfect decisions – Alpha, Beta pruning – Logical agents: Propositional logic – First order logic – Syntax and semantics – Using first order logic – Inference in first order logic.

UNIT III **9 Hours**

LOGIC SYSTEMS

Trees, lattices, and graphs, state and problem spaces, AND-OR trees and goals, methods of inference, rules of inference, limitations of propositional logic, logic systems, resolution rule of inference, resolution systems, and deduction, shallow and causal reasoning, applying resolution to first-order predicate logic, forward and backward chaining, additional methods of reference, Meta knowledge, the Markov decision process.

UNIT IV **9 Hours**

PLANNING AND LEARNING

Planning: Planning problem – Partial order planning – Planning and acting in non-deterministic domains – Learning: Learning decision trees – Knowledge in learning – Neural networks – Reinforcement learning – Passive and active.

UNIT V **9 Hours**

EXPERT SYSTEMS

Definition – Features of an expert system – Organization – Characteristics – Prospector – Knowledge Representation in expert systems – Expert system tools – MYCIN – EMYCIN.

Total: 45 Hours

Reference(s)

1. J.Giarratano and G. Riley, "Expert Systems -- Principles and Programming". 4th Edition, PWS Publishing Company, 2004.
2. Durkin, J., Expert systems Design and Development, Macmillan, 1994 2. Elias M. Awad, Building Expert Systems, West Publishing Company 1996
3. Peter Jackson, Introduction to Expert Systems, Addison Wesley Longman, 1999.ISBN 0- 20187686-8.
4. Gonzalez and D. Dankel, "The Engineering of Knowledge-Based Systems", Prentice Hall, 1994.
5. Nikolopoulos, "Expert Systems", Marcel Dekker Inc. 1997. ISBN 0 8247 9927 5.

21AM502 Big Data Technologies **3 1 0 4**

Course Objectives

- Understand the basic ideas of Big Data
- Analyze the data analytics life cycle and methodology.
- Design unstructured data analytics

Course Outcomes (COs)

1. Demonstrate the concepts and applications of big data
2. Create and Manage data using NoSQL databases.
3. Implement the basic idea of the Hadoop and HDFS
4. Implement programs using Map reduce concepts
5. Design machine learning techniques to resolve the issue by Hadoop related tools.

Articulation Matrix

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

UNIT I **10 Hours**

UNDERSTANDING BIG DATA

Data Storage and Analysis, Comparison with Other Systems, Rational Database Management System, Grid Computing, Volunteer Computing- unstructured data - industry examples of big data- web analytics- big data and marketing -fraud and big data -risk and big data -credit risk management-big data and algorithmic trading- big data and healthcare - big data in medicine- advertising and big data - big data technologies – introduction to Hadoop - open source technologies.

UNIT II **7 Hours**

NOSQL DATA MANAGEMENT

Introduction to NoSQL- aggregate data models- aggregates -key-value and document data models relationships- graph databases-schema less databases-materialized views-distribution models -sharding - version - Map reduce- partitioning and combining -composing map-reduce calculations.

UNIT III **8 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.

UNIT IV **10 Hours**

MAP REDUCE APPLICATIONS

Map Reduce workflows - unit tests with MR Unit -test data and local tests -anatomy of Map Reduce job run - classic Map-reduce - YARN- failures in classic Map -reduce and YARN - job scheduling -shuffle and sort - task execution – Map Reduce types -input formats -output formats

UNIT V **10 Hours**

HADOOP RELATED TOOLS

Hbase- data model and implementations- Hbase clients - Hbase examples -praxis. Cassandra-cassandra data model- Cassandra examples- Cassandra clients -Hadoop integration. Pig - Grunt - pigdata 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

Cloud and big data - mobile business intelligence - Crowd sourcing analytics - inter and Trans firewall analytics

Total: 45 Hours

Reference(s)

1. TomWhite, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.
2. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
3. Vignesh Prajapati, Big data analytics with R and Hadoop, SPD 2013

21AM503 Cloud Computing **3 0 0 3**

Course Objectives

- Familiarize students with the practical aspects of IaaS (Infrastructure as a Service) cloud computing model
- Familiarize students with the installation and configuration procedure of compute, storage and networking components of open stack platform for establishing enterprise private cloud
- Familiarize students with python programming environment enable them to analyze open stack source code from github

Course Outcomes (COs)

1. Design the basic environment required for open stack implementation and configure keystone service for authentication and glance service for managing cloud VM images authentication and glance service for managing cloud VM images.
2. Implement and configure compute service and neutron service for creating IaaS cloud platform.
3. Organize cloud resources and deliver virtual machines to end users through dashboard and CLI commands.
4. Implement block storage service, object storage service for data storage requirements.
5. Constrate metering service for managing private cloud environment metering service for managing private cloud environment.

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

UNIT I **9 Hours**

BASIC ENVIRONMENT

Introduction to Cloud Computing - Open Stack Architecture - Basic Requirements – Configuring Identity service - Configuring keystone and its dataset - Image service - Managing Glance

UNIT II **9 Hours**

COMPUTE AND NETWORK MANAGEMENT

Compute service – Installing Nova with its API - Managing security groups – Networking service – Managing neutron services – VLAN Manager networking

UNIT III

DASHBOARD MANAEMENT **9 Hours**

Dashboard Service – Horizon Installation – GUI Management and Maintenance – creating network – flavor Creation – Resource monitoring

UNIT IV **9 Hours**

STORAGEMANAGEMENT

Block Storage vs Object Storage - Installation and configuration of cinder -attach volume to VM instances - Configure booting from volume - Installation and configuration of swift -java API integration.

UNIT V **9 Hours**

VM MANAGEMENT

Orchestration service - Telemetry service- Launch VM instances

FURTHER READING

Google File System(GFS) - Hadoop Distributed File System(HDFS)

Total: 45 Hours

Reference(s)

1. Dan Radez, "OpenStack Essentials", PackT publishing, 2015
2. Omar Khedhar, "MasteringOpenstack", PackT Publishing, 2015
3. docs.openstack.org
4. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
5. Alan Gates, "Programming Pig", O'Reilley, 2011.

21AM504 Deep Learning **3 0 0 3**

Course Objectives

- To understand the theoretical foundations, algorithms and methodologies of Machine Learning Algorithms
- To design and develop an application using specific deep learning models
- To provide the practical knowledge in handling and analyzing real world applications.

Course Outcomes (COs)

1. Apply the Basic fundamentals of Machine Learning Algorithms to solve real world problems
2. Apply the Deep Learning Architectures to classify the unstructured data.
3. Analyze the Convolutional Neural Networks and transfer learning models to obtain an optimal solution
4. Constrict Recurrent Neural Networks, Recursive Nets models and classify the given inputs with reduced cost and time
5. Design a model using Auto encoders and Generative models for image generation

Articulation Matrix

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

UNIT I **10 Hours**

MACHINE LEARNING BASICS

Learning algorithms, Maximum likelihood estimation, Building machine learning algorithm, Basic Machine Learning Algorithms: Naïve Bayes, Support Vector Machine, Decision Tree, Random Forest, Neural Networks Multilayer Perceptron, Back-propagation algorithm and its variants stochastic gradient decent, Curse of Dimensionality.

UNIT II **9 Hours**

DEEP LEARNING ARCHITECTURES

Machine Learning and Deep Learning, Representation Learning, Width and Depth of Neural Networks, Activation Functions: RELU, LRELU, ERELU, Unsupervised Training of Neural Networks, Restricted Boltzmann Machines, Auto Encoders, Deep Learning Applications.

UNIT III **9 Hours**

CONVOLUTIONAL NEURALNETWORKS AND TRANSFER LEARNING

Architectural Overview, Motivation, Layers, Filters, Parameter sharing, Regularization, Popular CNN Architectures: ResNet, AlexNet – Applications-Transfer Learning Techniques, Variants of CNN: Dense Net, PixelNet.

UNIT IV **8 Hours**

SEQUENCE MODELLING – RECURRENT AND RECURSIVE NETS

Recurrent Neural Networks, Bidirectional RNNs, Encoder-decoder sequence to sequence architectures - BPTT for training RNN, Long Short-Term Memory Networks, Neural style transfer in Keras.

UNIT V **9 Hours**

AUTOENCODERS AND DEEP GENERATIVE MODELS

Under complete Auto encoder, Regularized Auto encoder, stochastic Encoders and Decoders, Contractive Encoders - Deep Belief networks, Boltzmann Machines, Deep Boltzmann Machine, Generative Adversial Networks.

FOR FURTHER READING

Sentiment Analysis using RNN, Image Generation, Digital Twins, Recommendation Systems

Total: 45 Hours

Reference(s)

1. Ian Good fellow, YoshuaBengio and Aaron Courville, “Deep Learning”, MIT Press, 2017.
2. Josh Patterson, AdamGibson "Deep Learning: A Practitioner's Approach", O'ReillyMedia, 2017
3. Umberto Michelucci “Applied Deep Learning. ACase-based Approach to Understanding Deep Neural Networks” Apress, 2018.
4. Kevin P. Murphy"Machine Learning: A Probabilistic Perspective", The MIT Press, 2012.
5. EthemAlpaydin,"Introduction to Machine Learning”, MIT Press, Prentice Hall of India, Third Edition2014.
6. Giancarlo Zaccone, Md. RezaulKarim, Ahmed Menshawy"Deep Learning with Tensor Flow”.
7. Explore neural networks with Python", Packt Publisher, 2017. Antonio Gulli, Sujit Pal "Deep Learning with Keras", Packt Publishers, 2017

21AM507 Deep Learning Laboratory **0 0 4 2**

Course objectives

- Understand complexity of Deep Learning algorithms and their limitations
- Understand modern notions in data analysis oriented computing;
- Be capable of confidently applying common Deep Learning algorithms in practice and implementing their own;
- Be capable of performing distributed computations;
- Be capable of performing experiments in Deep Learning using real-world data

Course Outcomes (COs)

1. Implement the concepts of Tensor Flow, its main functions, operations and the execution pipeline
2. Implement deep learning algorithms, understand neural networks and traverse the layers of data abstraction which will empower the student to understand data more precisely.
3. Integrate topics such as convolutional neural networks, recurrent neural networks, training deep networks and high-level interfaces
4. Execute deep learning models in Tensor Flow and interpret the results
5. Integrate the language and fundamental concepts of artificial neural networks

Articulation Matrix

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

EXPERIMENT 1 **4 Hours**

Experiment with Random Forest, Neural Networks Multilayer Perceptron, Back propagation algorithm.

EXPERIMENT 2 **8 Hours**

Experiment with Neural Networks, Activation Functions: RELU, LRELU, ERELU.

EXPERIMENT 3 **4 Hours**

Experiment with CNN Architectures: ResNet, AlexNet

EXPERIMENT 4 **8 Hours**

Experiment with Recurrent Neural Networks

EXPERIMENT 5 **4 Hours**

Experiment with Recurrent Neural Networks

EXPERIMENT 6 **8 Hours**
Experiment with Long Short-Term Memory Networks.

EXPERIMENT 7 **8 Hours**
Experiment with Neural style transfer in Keras.

EXPERIMENT 8 **8 Hours**
Experiment with Auto encoder, stochastic Encoders and Decoders, Contractive Encoders

EXPERIMENT 9 **8 Hours**
Experiment with Deep Belief networks

Total: 60 Hours

Reference(s)

1. Ian Good fellow, YoshuaBengio and Aaron Courville, "Deep Learning", MIT Press, 2017.
2. Josh Patterson, AdamGibson "Deep Learning: APractitioner's Approach", O'Reilly Media, 2017
3. Umberto Michelucci "Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks" Apress, 2018.
4. Kevin P. Murphy"Machine Learning: A Probabilistic Perspective", the MIT Press, 2012.
5. EthemAlpaydin,"Introduction to Machine Learning", MIT Press, Prentice Hall of India, Third Edition 2014.

21AM508 Cloud Computing Laboratory **0 0 4 2**

Course Objectives

- To develop web applications in cloud
- To learn the design and development process involved in creating a cloud based application
- To learn to implement and use parallel programming using Hadoop

Course Outcomes (COs)

1. Configure various virtualization tools such as Virtual Box, VMware workstation.
2. Design and deploy a web application in a PaaS environment.
3. Learn how to simulate a cloud environment to implement new schedulers.
4. Install and use a generic cloud environment that can be used as a private cloud.
5. Manipulate large data sets in a parallel environment.

Articulation Matrix

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

EXPERIMENT 1 **8 Hours**

Install Virtual box/VMware Workstation with different flavors of Linux or windows OS on top of windows 7or 8.

EXPERIMENT 2 **8 Hours**

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

EXPERIMENT 3 **8 Hours**

Install Google App Engine. Create hello world app and other simple web applications using python/java.

EXPERIMENT 4 **8 Hours**

Use GAE launcher to launch the web applications.

EXPERIMENT 5 **7 Hours**

Simulate a cloud scenario using Cloud Sim and run a scheduling algorithm that is not present in Cloud Sim.

EXPERIMENT 6

Find a procedure to transfer the files from one virtual machine to another virtual machine. **7 Hours**

EXPERIMENT 7

Find a procedure to launch virtual machine using try stack (Online Openstack Demo Version) **7 Hours**

EXPERIMENT 8 **8 Hours**

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

Total: 60 Hours

Reference(s)

1. Barrie Sosinsky, Cloud Computing Bible, Wiley-India, 2014.
2. Anthony T Velte, Cloud Computing: Apractical Approach, Tata McGraw Hill, 2009.
3. Halper Fern, Kaufman Marcia, Bloor Robin, Hurwit Judith, Cloud Computing for Dummies, Wiley India, 2009.

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.

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Execute various concepts of number systems and their techniques in solving the percentage, average and age problems.
2. Analyze 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. Execute 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												
2	2	2												
3	2	2												
4	2	2												
5	2	2												

UNIT I

NUMBER SYSTEMS **2 Hours**

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.

UNIT II **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.

UNIT III **2Hours**

AVERAGES AND AGES

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

UNIT IV **2 Hours**

RATIO, PROPOSITIONS 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.

UNIT V **2Hours**

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.

UNIT VI **2Hours**

TIME AND WORK

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

UNIT VII **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.

UNIT VIII **2 Hours**

CODING AND DECODING

Introduction-Description of coding Method-Coding patterns - Concepts of Coding and Decoding-Problems involving coding and decoding methods.

UNIT IX **4 Hours**

SEQUENCES AND SERIES

Introduction-Sequences of real numbers - Number and Alphabet Series-Description of Number and Alphabet Series-Analogy-Odd Man Out-Power series.

UNIT X **4 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.

UNIT XI

DIRECTION **4 Hours**

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

UNIT XII **2 Hours**

CRITICIAL REASONING

Introduction-Basic concept of critical reasoning- Weaken the Argument-Strengthen the argument-Flawin the Argument-Evaluate the conclusion.

Total: 30 Hours

Reference(s)

1. Dinesh Khattar, The Pearson Guide to Quantitative Aptitude for Competitive Examinations, Third Edition, Pearson Education Pvt Ltd, India, 2016.
2. Abhijit Guha, Quantitative Aptitudefor Competitive Examinations, Fourth Edition, Mc GrawHill Publications.
3. U. Mohan Rao, Quantitative Aptitude for Competitive Examinations, Scitech Publications Pvt Ltd,India.
4. Dr. RS Aggarwal, AModern ApproachtoVerbaland 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. Jaikishanand Premkishan, How to Crack Test of Reasoning in all Competitive Examinations, Revised Edition, Arihant Publications.

21AM601 Computer Vision **3 0 0 3**

Course Objectives

- To review image processing techniques for computer vision.
- To understand shape and region analysis.
- To understand Hough Transform and its applications to detect lines, circles, ellipses.
- To understand three-dimensional image analysis techniques.
- To understand motion analysis.
- To study some applications of computer vision algorithms.

Course Outcomes (COs)

1. Implement fundamental image processing techniques required for computer vision.
2. Perform Shape Analysis.
3. Apply Hough Transform for line, circle, and ellipse detections.
4. Apply 3D vision techniques.
5. Execute the applications using computer vision techniques.

Articulation Matrix

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

UNIT I **9 Hours**

IMAGE PROCESSING FOUNDATIONS

Review of image processing techniques – classical filtering operations – thresholding techniques – edge detection techniques – corner and interest point detection – mathematical morphology – texture.

UNIT II **9 Hours**

SHAPES AND REGIONS

Binary shape analysis – connectedness – object labeling and counting – size filtering – distance functions – skeletons and thinning – deformable shape analysis – boundary tracking procedures – active contours – shape models and shape recognition – centroidal profiles – handling occlusion – boundary length measures – boundary descriptors – chain codes – Fourier descriptors –region descriptors – moments

UNIT III **9 Hours**

HOUGH TRANSFORM

Line detection – Hough Transform (HT) for line detection – foot-of-normal method – line localization – line fitting – RANSAC for straight line detection – HT based circular object detection – accurate center location – speed problem– ellipse detection – Case study: Human Iris location – hole detection – generalized Hough

Transform (GHT) – spatial matched filtering – GHT for ellipse detection – object location – GHT for feature collation.

UNIT IV **9 Hours**

3D VISION AND MOTION

Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations – point-based representation – volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion – spline-based motion – optical flow – layered motion.

UNIT V **9 Hours**

APPLICATIONS

Application: Photo album– Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces Application: Surveillance – foreground-background separation – particle filters – Chamfer matching, tracking, and occlusion – combining views from multiple cameras – human gait analysis Application: In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians.

Total: 45 Hours

Reference(s)

1. Computer Vision: Models, Learning, and Inference 1st Editionby Simon J. D. Prince,2012
2. K. Mikolajczyk and C. Schmid, A performance evaluation of local descriptors. In IEEE Conference on Computer Vision and Pattern Recognition, pp. 257-263, 2003
3. D. G. Lowe, Distinctive Image Features from Scale-Invariant Key points. In International Journal of Computer Vision, 2004
4. D. Comaniciu and P.Meer, Robust analysis of feature spaces: Color image segmentation. IEEE Conference on Computer Vision and Pattern Recognition, June 1997, 750-755
5. J. Shi and C. Tomasi, Good Features to Track. In IEEE Conference on Computer Vision and Pattern Recognition, 1994
6. E. H. Adelson, E. P. Simoncelli, and W. T. Freeman, Pyramids and Multiscale Representations. In Representations of Vision, pp. 3-16, 1991

21AM602 Reinforcement Learning **3 0 0 3**

Course Objectives

- To acquire knowledge of basic and advanced reinforcement learning techniques.
- To Identify suitable reinforcement learning tasks
- To evaluate the current limitations of reinforcement learning techniques.
- To formulate decision problems, set up and run computational experiments, evaluation of results from experiments.

Course Outcomes (COs)

1. Implemental Reinforcement Learning system for sequential decision making.
2. Represent the space of RL algorithms
3. Demonstrate how to formalize your task as a Reinforcement Learning problem, and how to begin implementing a solution.
4. Demonstrate how RL fits under the broader umbrella of machine learning, and how it complements deep learning, supervised and unsupervised learning.
5. Demonstrate how to formalize your task as a RL problem, and how to begin implementing a solution.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION AND PROBABILITY PRIMER

Course logistics and overview. Origin and history of Reinforcement Learning research. Its connections with other related fields and with different branches of machine learning. Brush up of Probability concepts - Axioms of probability, concepts of random variables, PMF, PDFs, CDFs, Expectation. Concepts of joint and multiple random variables, joint, conditional and marginal distributions. Correlation and independence.

UNIT II **9 Hours**

MARKOV DECISION PROCESS

Introduction to RL terminology, Markov property, Markov chains, Markov reward process (MRP). Introduction to and proof of Bellman equations for MRPs along with proof of existence of solution to Bellman equations in MRP. Introduction to Markov decision process (MDP), state and action value functions, Bellman expectation equations, optimality of value functions and policies, Bellman optimality equations.

UNIT III **9 Hours**

PREDICTION AND CONTROL BY DYNAMIC PROGRAMING

Overview of dynamic programing for MDP, definition and formulation of planning in MDPs, principle of optimality, iterative policy evaluation, policy iteration, value iteration, Banach fixed point theorem, proof of contraction mapping property of Bellman expectation and optimality operators, proof of convergence of policy

evaluation and value iteration algorithms, DP extensions.

UNIT IV **9 Hours**

MONTE CARLO METHODS FOR MODEL FREEPREDICTION AND CONTROL

Overview of Monte Carlo methods for model free RL, First visit and every visit Monte Carlo, Monte Carlo control, On policy and off policy learning, Importance sampling.

UNIT V **9 Hours**

FUNCTION APPROXIMATION METHODS AND POLICY GRADIENTS

Getting started with the function approximation methods, Revisiting risk minimization, gradient descent from Machine Learning, Gradient MC and Semi-gradient TD(0) algorithms, Eligibility trace for function approximation, After states, Control with function approximation, Least squares, Experience replay in deep Q-Networks. Policy Gradients-Getting started with policy gradient methods, Log-derivative trick, Naive REINFORCE algorithm, bias and variance in Reinforcement Learning, Reducing variance in policy gradient estimates, baselines, advantage function, actor-critic methods.

Total: 45 Hours

Reference(s)

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement learning: An introduction", Second Edition, MIT Press, 2019
2. Li, Yuxi. "Deep reinforcement learning." arXivpreprint arXiv: 1810.06339 (2018)
3. Russell, Stuart J., and Peter Norvig. "Artificial intelligence: a modern approach. "Pearson Education Limited, 2016.
4. Wiering, Marco, and Martijn Van Otterlo. "Reinforcement learning." Adaptation, learning, and optimization 12 (2012)

21AM603 Natural Language Processing **3 0 0 3**

Course Objectives

- Understand the representation and processing of Morphology and Part-of Speech Taggers
- Express different aspects of natural language syntax and the various methods used for processing syntax
- To know about various applications of natural language processing

Course Outcomes (COs)

1. Implement the different linguistic components of given sentences.
2. Design a morphological analyzer for a language using finite state automata concepts
3. Implement a parser by providing suitable grammar and words
4. Analyze the semantic role of the sentence and implement the semantic parsing
5. Apply the machine translation and statistical translation to extract the information from the sentence

Articulation Matrix

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

UNIT I **8 Hours**

INTRODUCTION

Natural Language Processing tasks in syntax, semantics, and pragmatics -Issues - Applications - The role of machine learning - Probability Basics -Information theory - Collocations -N-gram Language Models - Estimating parameters and smoothing - Evaluating language models.

UNIT II **9 Hours**

MORPHOLOGY AND PART OF SPEECH TAGGING

Linguistic essentials - Lexical syntax- Morphology and Finite State Transducers - Part of speech Tagging - Rule-Based Part of Speech Tagging - Markov Models - Hidden Markov Models - Transformation based Models - Maximum Entropy Models. Conditional Random Fields.

UNIT III **10 Hours**

SYNTAX PARSING

Syntax Parsing - Grammar formalisms and treebanks - Parsing with Context Free Grammars - Features and Unification -Statistical parsing and probabilistic CFGs (PCFGs)-Lexicalized PCFGs.

UNIT IV **10 Hours**

SEMANTIC ANALYSIS

Representing Meaning - Semantic Analysis - Lexical semantics - Word-sense disambiguation - Supervised - Dictionary based and Unsupervised Approaches - Compositional semantics- Semantic Role Labeling and Semantic Parsing - Discourse Analysis.

UNIT V **8 Hours**

APPLICATIONS

Named entity recognition and relation extraction- Information Extraction (IE) using sequence labeling- Machine Translation (MT) - Basic issues in MT-Statistical translation-word alignment- phrase-based translation - Question Answering- VXML Applications

FOR FURTHER READING

Wordsense disambiguation-discourse analysis and lexical resources

Total: 45 Hours

Reference(s)

1. Daniel Jurafsky and James H. Martin "Speech and Language Processing", Second Edition, Prentice Hall, 2014
2. Christopher D. Manning and Hinrich Schuetze, "Foundations of Statistical Natural Language Processing", MIT Press, 2014.
3. Roland R. Hausser, "Foundations of Computational Linguistics Human- Computer Communication in Natural Language", Springer, 2014.

21AM607 Natural Language Processing Laboratory **0 0 4 2**

Course Objectives

- To develop Natural Language Processing tasks
- To learn the Estimating parameters and smoothing - Evaluating language models
- To learn to implement Lexical semantics, Word-sense disambiguation, Supervised, Dictionary based and Unsupervised Approaches

Course Outcomes (COs)

1. Implement the different linguistic components of given sentences.
2. Design a morphological analyzer for a language using finite state automata concepts
3. Implement a parser by providing suitable grammar and words
4. Analyze the semantic role of the sentence and implement the semantic parsing
5. Apply the machine translation and statistical translation to extract the information from the sentence

Articulation Matrix

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

EXPERIMENT 1 **8 Hours**

Experiment in semantics, and pragmatics -Issues - Applications - The role of machine learning - Probability Basics -Information theory using NLTK library

EXPERIMENT 2 **8 Hours**

Experiment in Linguistic essentials - Lexical Syntax-Morphology and Finite State Transducers

EXPERIMENT 3 **8 Hours**

Experiment in Rule-Based Part of Speech Tagging

EXPERIMENT 4 **7 Hours**

Experiment in Syntax Parsing -Grammar formalisms and treebanks

EXPERIMENT 5 **7 Hours**
Experiment in Representing Meaning - Semantic Analysis

EXPERIMENT 6 **7 Hours**
Experiment in Dictionary based and Unsupervised Approaches

EXPERIMENT 7 **7 Hours**
Experiment in Named entity recognition and relation extraction

EXPERIMENT 8 **8 Hours**
Experiment in VXML Applications

Total: 60 Hours

Reference(s)

1. Daniel Jurafsky and James H. Martin "Speech and Language Processing", Second Edition, Prentice Hall, 2014
2. Christopher D. Manning and Hinrich Schuetze, "Foundations of Statistical Natural Language Processing", MIT Press, 2014.
3. Roland R. Hausser, "Foundations of Computational Linguistics Human - Computer Communication in Natural Language", Springer, 2014.

21AM608 Computer Vision Laboratory **0 0 4 2**

Course Objectives

- To review image processing techniques for computer vision.
- To understand shape and region analysis.
- To understand Hough Transform and its applications to detect lines, circles, ellipses.
- To understand three-dimensional image analysis techniques.
- To understand motion analysis.

Course Outcomes (COs)

1. Implement fundamental image processing techniques required for computer vision.
2. Apply chain codes and other region descriptors.
3. Apply Hough Transform for line, circle, and ellipse detections.
4. Apply 3D vision techniques.
5. Develop applications using computer vision techniques

Articulation Matrix

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

EXPERIMENT 1 **8 Hours**
Experiment in image processing techniques – classical filtering operations

EXPERIMENT 2 **8 Hours**
Experiment in thresholding techniques

EXPERIMENT 3 **8 Hours**
Experiment in edge detection techniques

EXPERIMENT 4 **7 Hours**
Experiment in mathematical morphology

EXPERIMENT 5 **7 Hours**
Experiment in shape models and shape recognition

EXPERIMENT 6 **7 Hours**
Experiment in Line detection

EXPERIMENT 7 **7 Hours**

Experiment in GHT for feature collation

EXPERIMENT 8 **8 Hours**

Experiment in 3D vision – projection schemes

Total: 60 Hours

Reference(s)

1. K. Mikolajczyk and C. Schmid, A performance evaluation of local descriptors. In IEEE Conference on Computer Vision and Pattern Recognition, pp. 257-263, 2003.
2. J. Shi and C. Tomasi, Good Features to Track. In IEEE Conference on Computer Vision and Pattern Recognition, 1994.
3. E. H. Adelson, E. P. Simoncelli, and W. T. Freeman, Pyramids and Multiscale Representations. In Representations of Vision, pp. 3-16, 1991.

0 0 2 0

18GE601 Soft Skills-Aptitude II

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 forreal time problems.
2. Implement the concept of logarithms, progressions and Simple and Compound interest to solve various practical problems.
3. Analyze objects involving cubes and cuboids in determining the number of sides colored.
4. Integrate 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												
2	2	2												
3	2	2												
4	2	2												
5	2	2												

UNIT I **2 Hours**

PERMUTATION AND COMBINATION

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

UNIT II **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.

UNIT III **2 Hours**

SYLLOGISM AND VENN DIAGRAM

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

UNIT IV **2 Hours**

SIMPLEINTEREST 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 Interest-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.

UNIT V **2 Hours**
MIXTURES AND ALLIGATION

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

UNIT VI **2 Hours**
CUBE AND ALLIGATION

Introduction-Basic Concepts of Cube and Cuboid-Problems involving cubes and cuboids of various dimensions-Problems involving colored 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.

UNIT VII **2Hours**
DATA INTERPRETATION

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

UNIT VIII **2Hours**
PROGRESSION AND LOGICAL REASONING

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

UNIT IX **2Hours**
PROBLEM ON AGES

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

UNIT X **4 Hours**
ANALYTICAL REASONING

Introduction-Basic Concept-Non-Verbal Analytical Reasoning–Arrangements.

UNIT XI **4 Hours**
BLOODY RELATION

Introduction-Basic Concept-Kinds of Relation-Tree Diagram-Relations

UNIT XII **2 Hours**
VISUAL REASONING

Introduction-Basic Concepts-Odd Man Out-Next Series-Mirror image and water image

UNIT XIII **2 Hours**
SIMPLIFICATIONS

Introduction-Basic Concepts-Arithmetic Operations-Equation solving Methods-Puzzles.

Total: 30 Hours

Reference(s)

1. Dinesh Khattar, The Pearson Guide to Quantitative Aptitude for Competitive Examinations, Third Edition, Pearson Education Pvt Ltd, India, 2016.
2. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Mc GrawHill Publications.
3. U. Mohan Rao, Quantitative Aptitude for Competitive Examinations, Scitech Publications Pvt Ltd,India.
4. Dr. R S Aggarwal, AModern 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 Pub

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. Demonstrate 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				
2								3	2	2				
3								3	2	2				
4								3	2	2				
5								3	2	2				

UNIT I **6 Hours**

COURSE INTRODUCTION - NEED, BASIC GUIDELINES AND ANALYSIS

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

UNIT II **6 Hours**

EMBRACING THE COMMON ETIQUETTE

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

6 Hours

UNIT III

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

6 Hours

UNIT IV

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

21AM702 Pattern and Anomaly Detection **3 0 0 3**

Course Objectives

- To know the fundamental algorithms for pattern recognition
- To instigate the various classification techniques
- To originate the various structural pattern recognition and feature extraction techniques

Course Outcomes (COs)

1. Apply various algorithms for pattern classifier and recognition
2. Implement the concepts of Unsupervised classification in pattern recognition
3. Analyze the structural pattern recognition and feature extraction techniques
4. Apply the feature selection and extraction in pattern recognition
5. Create the recent advances of neural network in pattern recognition

Articulation Matrix

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

UNIT I **9 Hours**

PATTERN CLASSIFIER

Overview of pattern recognition - Discriminant functions - Supervised learning - Parametric estimation - Maximum likelihood estimation - Bayesian parameter estimation - Perception algorithm - LMSE algorithm - Problems with Bayes approach - Pattern classification by distance functions - Minimum distance pattern classifier.

UNIT II **9 Hours**

UNSUPERVISED CLASSIFICATION

Discrete and Binary classification -Techniques to directly obtain linear classifiers - Clustering for unsupervised learning and classification - Clustering concept - C-means algorithm -Hierarchical clustering procedures - Graph theoretic approach to pattern clustering - Validity of clustering solutions.

UNIT III **9 Hours**

STRUCTURAL PATTERN RECOGNITION

Elements of formal grammars -String generation as pattern description - Recognition of syntactic description - Parsing - Stochastic grammars and applications - Graph based structural representation.

UNIT IV **9 Hours**

FEATURE EXTRACTION AND SELECTION

Entropy minimization - Karhunen - Loeve transformation - Feature selection through functions approximation Binary feature selection.

UNIT V **9 Hours**

RECENT ADVANCES

Neural network structures for pattern recognition - Neural network based pattern associators -Unsupervised learning in neural pattern recognition - Self organizing networks - Fuzzy logic - Fuzzy pattern classifiers - Pattern classification using Genetic Algorithms.

FOR FURTHER READING

Multilayer, Feed forward Network Structure -Delta Rule -Generalized data rule.

Total: 45 Hours

Reference(s)

1. Robert J.Schalkoff, Pattern Recognition: Statistical, Structural and Neural Approaches, John Wiley & Sons Inc., New York, 2007.
2. Tou and Gonzales, Pattern Recognition Principles, Wesley Publication Company, London, 1974.
3. Duda R.O. and Hart.P.E., Pattern Classification and Scene Analysis, Wiley, New York, 1973.
4. Morton Nadier and Eric Smith P., Pattern Recognition Engineering, John Wiley & Sons, New York, 1993.

21AM707 Pattern and Anomaly Detection Laboratory **0 0 4 2**

Course Objectives

- To know the fundamental algorithms for pattern recognition
- To instigate the various classification techniques
- To originate the various structural pattern recognition and feature extraction techniques

Course Outcomes (COs)

1. Apply various algorithms for pattern classifier and recognition
2. Implement the concepts of Unsupervised classification in pattern recognition
3. Analyze the structural pattern recognition and feature extraction techniques
4. Apply the feature selection and extraction in pattern recognition
5. Create the recent advances of neural network in pattern recognition

Articulation Matrix

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

EXPERIMENT 1 **8 Hours**

Experiment in pattern recognition - Discriminant functions

EXPERIMENT 2 **8 Hours**

Experiment in Bayesian parameter estimation

EXPERIMENT 3 **7 Hours**

Experiment in Discrete and Binary classification

EXPERIMENT 4 **7 Hours**

Experiment in C-means algorithm

EXPERIMENT 5 **7 Hours**

Experiment in String generation as pattern description

EXPERIMENT 6 **7 Hours**

Experiment in Entropy minimization - Karhunen - Loeve transformation

EXPERIMENT 7 **8 Hours**

Experiment in Feature selection through functions approximation - Binary feature selection.

EXPERIMENT 8 **8 Hours**

Experiment in Neural network structures for pattern recognition.

Total: 60 Hours

Reference(s)

1. Robert J.Schalkoff, Pattern Recognition: Statistical, Structural and Neural Approaches, John Wiley & Sons Inc., New York, 2007.
2. Tou and Gonzales, Pattern Recognition Principles, Wesley Publication Company, London, 1974.
3. Duda R.O. and Hart.P.E., Pattern Classification and Scene Analysis, Wiley, New York, 1973.
4. Morton Nadier and Eric Smith P., Pattern Recognition Engineering, John Wiley & Sons, New York, 1993.

Language Electives

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

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

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

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

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.

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

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

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

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.

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

Course Outcomes (COs)

1. Recognize and write Japanese alphabet
2. Speak using basic sounds of the Japanese language
3. Apply appropriate vocabulary needed for simple conversation in Japanese language
4. Apply appropriate grammar to write and speak in Japanese language
5. Comprehend the conversation and give correct meaning

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

Reference(s)

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

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

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

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.Tones

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

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

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 - letemps libre et les loisirs, les saisons, les activites quotidiennes, le temps (le matin, le soir, la nuit)

UNIT IV **9 Hours**

COMPRENDRE 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 accessories

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 | LexiqueLes services et les commerces, les aliments, les ustensiles, argent

Total: 45 Hours

Reference(s)

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

Professional Electives

3 0 0 3

21AM001 Agile Software Development

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 quality assurance.

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 analyse 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.
e. Modern Tool Usage: 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.
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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

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	
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 projectmanagement 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 Software Development, Kanban model.

UNIT III **9 Hours**

AGILITY AND KNOWLEDGE MANAGEMENT

Agile information systems - agile decision making - Earl 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 - agile requirements modelling 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 in Computer Science, Springer, VIII edition, 2009
4. Craig Larman, Agile and Iterative Development: A managers Guide, Addison Wesley, 2004
5. Kevin C. Desouza, Agile information systems: conceptualization, construction, and management, Butterworth-Heinemann, 2007.

3 0 0 3

21AM002 UI and UX Design

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 design process and methodology.
- Learning the Importance and scope of Interaction design, User cantered design

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 analyse 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 modelling to complex engineering activities with an understanding of the limitations.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.
n. Formulate solutions for interdisciplinary AI problems through acquired programming knowledge in the respective domains fulfilling with real-time constraints.

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 - Master the Brand Platforms & Style Guides - comments and current UI patterns - Understand problems and design solutions for e-commerce, social media, message, data, and dashboard design.

UNIT III **9 Hours**

ELEMENTARY SKETCHING

Principles of Sketching - Core Responsive Design - Wireframing vs Wireflows - Click through Wireframing Prototyping - Wireflow Creation - Work with different tools – Figma – Low - High Fidelity Design: Inclusive Design and Designing for Accessibility - Building High -Fidelity Mockups - Designing Efficiently with Tools - Interaction Patterns - Designing animations and interactions.

UNIT IV **9 Hours**

UNDERSTAND STYLE GUIDES, ELEMENTS, PROTOTYPING

Building a Design System - Style guides, color palette, fonts, grid, iconography, UI elements, photography or imagery, and illustration - Use of grids in UI design - Design animations andinteraction 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.

21AM003 Web Frameworks **3 0 0 3**

Course Objectives

- Understand the architecture behind an Angular application and how to use it
- To understand the significance of using MongoDB as a database system
- To understand the role of React in designing front-end components
- Build a Web Server in Node and understand how it really works
- Develop a web application and API using web frameworks

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
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.
e. Modern Tool Usage: 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. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

Course Outcomes (COs)

1. Apply modules and components and Animations for creating Forms and developing web pages
2. Create web applications by performing CRUD operations in database using web frameworks
3. Design Progressive Web Application with dynamic HTML web pages using Angular.
4. Designing single page applications with reusable UI components using React CSS and SaaS
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 - Ng Modules - 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 EventEmitter - 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, and Node, Vasan Subramanian, A Press Publisher, 2019.
2. Caleb Dayley Brad Dayley,Brendan Dayley ,Node.js, MongoDB and Angular Web Development, 2nd Edition,Pearson, 2018.
3. Shyam Seshadri, Angular: Up and Running- Learning Angular, Step by Step , O"Reilly; First edition, 2018.
4. Christoffer Noring, Pablo Deeleman,Learning Angular, Packt Publishing Limited, 2nd Revised edition edition, 2017.

21AM004 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

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

Course Outcomes (COs)

1. Identify fundamental concepts of mobile programming that make it unique from programming for other platforms
2. Analyse the essential of Android Application with their anatomy and terminologies
3. Apply rapid prototyping techniques to design, develop and deploy the Android Applications
4. Analyse the essentials of User Interface Design in IOS with SQLite Database
5. Design the flutter applications on the Android marketplace for distribution.

Articulation Matrix

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

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, iPhone marketplace.

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 **2 Hours**

Develop a simple application with one EditText so that the user can write some text in it. Create a button called "Convert Text to Speech" that converts the user input text into voice.

EXPERIMENT 2 **4 Hours**

Create an application to design a Visiting Card. The Visiting card should have a company logo at the top right corner. The company name should be displayed in Capital letters, aligned to the center. Information like the name of the employee, job title, phone number, address, email, fax and the website address is to be displayed. Insert a horizontal line between the job title and the phone number.

EXPERIMENT 3 **4 Hours**

Create a SIGNUp activity with Username and Password. Validation of password should happen based on the following rules:

- Password should contain uppercase and lowercase letters.
- Password should contain letters and numbers.
- Password should contain special characters.
- Minimum length of the password (the default value is 8).
- On successful SIGN UP proceed to the next Login activity. Here the user should SIGN IN using the Username and Password created during signup activity. If the Username and Password are matched, then navigate to the next activity which displays a message saying "Successful Login" or else display a toast message saying "Login Failed". The user is given only two attempts and after that displays a toast message saying "Failed Login Attempts" and disable the SIGN IN button. Use Bundle to transfer information from one activity to another.

EXPERIMENT 4 **4 Hours**

Write a program to enter Medicine Name, Date and Time of the Day as input from the user and store it in the SQLite database. Input for Time of the Day should be either Morning or Afternoon or Evening or Night. Trigger an alarm based on the Date and Time of the Day and display the Medicine Name.

EXPERIMENT 5 **4 Hours**

Develop an application to set an image as wallpaper. On click of a button, the wallpaper image should start to change randomly every 30 seconds.

EXPERIMENT 6 **4 Hours**

Create an activity like a phone dialer with CALL and SAVE buttons. On pressing the CALL button, it must call the phone number and on pressing the SAVE button it must save the number to the phone contacts.

EXPERIMENT 7 **4 Hours**

Implement UI elements like TextFields, Label, Toolbar, Statusbar, Tabbar.

EXPERIMENT 8 **4 Hours**

Implement any type of App using Flutter.

Total: 30 +30 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 for any device" ISBN-13 9780141044804.
5. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, "Beginning iOS 6Development: Exploring the iOS SDK", Apress, 2013.55.

21AM005 Software Testing And Automation **3 0 0 3**

Course Objectives

- Understand the importance of software testing in the software development process
- Analyze different testing methodologies and techniques to create test plans, test cases, and test scripts
- Apply automation testing tools and frameworks to design and implement automated test suites

Programme Outcomes (POs)

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 analyse 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.
e. Modern Tool Usage: 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. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

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

UNIT I **9 Hours**

INTRODUCTION

Basic definitions - Software Testing Principles - the Testers Role in a Software Development Organization - Origins of Defects - Cost of Defects - Defect Classes - the Defect Repository and Test Design - Defect Examples - Developer/Tester Support of Developing a Defect Repository.

9 Hours

UNIT II

INTRODUCTION

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 Code Logic - 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 -Skills needed bya 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. Ilene Burnstein, “Practical Software Testing”, Springer International Edition, 2003.
2. Edward Kit, “Software Testing in the Real World Improving the Process”, Pearson Education, 1995.
3. Boris Beizer, “Software Testing Techniques “2nd Edition, Van Nostrand Reinhold, New York, 1990.
4. Aditya P. Mathur, “Foundations of Software Testing Fundamental Algorithms and Techniques”, Dorling Kindersley (India) Pvt. Ltd., Pearson Education, 2008.

21AM006 Devops **3 0 0 3**

Course Objectives

- To introduce DevOps terminology, definition & concepts
- To understand the different Version control tools like Git, Mercurial
- To understand the concepts of Continuous Integration/ Continuous Testing/ Continuous Deployment)
- To understand Configuration management using Ansible
- Illustrate the benefits and drive the adoption of cloud-based DevOps tools to solve real-world problems

Programme Outcomes (POs)

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 analyse 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 modelling to complex engineering activities with an understanding of the limitations.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

Course Outcomes (COs)

1. 1. Understand different actions performed through Version control tools like Git.
2. 2. Perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven & Gradle.
3. 3. Ability to Perform Automated Continuous Deployment.
4. 4. Ability to do configuration management using Ansible.
5. 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								3	
2	3	3	3	3	2								2	
3	2	2	2	3	2								2	
4	2	2	2	2	2								2	
5	2	2	2	2	2								3	

UNIT I **7 Hours**

INTRODUCTION TO DEVOPS

Devops Essentials - Introduction to AWS, GCP, Azure - Version control systems: Git and GitHub.

UNIT II **10 Hours**

COMPILE AND BUILD USING MAVEN

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 aJenkins 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. 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.
2. David Johnson, “Ansible for DevOps”: Everything You Need to Know to Use Ansible for DevOps, Second Edition, 2016.
3. 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. https://www.jenkins.io/user-handbook.pdf
6. https://maven.apache.org/guides/getting-started/

21AM007 Virtualization in Cloud Computing 3 0 0 3

Course Objectives

- Analyze the basic concepts of virtualization technology to derive the best practice model for deploying cloud based applications
- Create an application by utilizing cloud platforms such as Amazon Web Services and Windows Azure
- Identify major security and privacy problems in cloud computing environment
- Apply the ability to use the architecture of cloud, service and delivery models
- Implement the key enabling technologies that help in the development of cloud.

Programme Outcomes (POs)

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 analyse 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 modelling to complex engineering activities with an understanding of the limitations.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.
n. Formulate solutions for interdisciplinary AI problems through acquired programming knowledge in the respective domains fulfilling with real-time constraints.

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

Understanding Configuration Options - Installing Windows on a Virtual Machine - Installing Linux on a Virtual Machine Installing Virtual Box 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

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.

21AM008 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 the basic concepts of Cloud and capabilities across the various Cloud service models
- Identify strategies to reduce risk and eliminate issues associated with adoption of cloud services
- Select appropriate structures for designing, deploying and running cloud-based services in a business environment

Programme Outcomes (POs)

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 analyse 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 modelling to complex engineering activities with an understanding of the limitations.
n. Formulate solutions for interdisciplinary AI problems through acquired programming knowledge in the respective domains fulfilling with real-time constraints.

Course Outcomes (COs)

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

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. Bernard Golden, Amazon Web Services for Dummies, John Wiley & Sons, First Edition, 2013
2. (IBM ICE), Cloud Computing Architecture, IBM Global Technology Services Thought Leadership White Paper, April 2011
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, Oreilly, SPD, 2011.

21AM009 Cloud Storage Technologies **3 0 0 3**

Course Objectives

- Characterize the functionalities of logical and physical components of storage
- Describe various storage networking technologies
- Identify different storage virtualization technologies
- Discuss the different backup and recovery strategies
- Understand common storage management activities and solutions

Programme Outcomes (POs)

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 analyse 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.
n. Formulate solutions for interdisciplinary AI problems through acquired programming knowledge in the respective domains fulfilling with real-time constraints.

Course Outcomes (COs)

1. Analyse 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

Cloud Backup: Strategies and Architecture, Data Deduplication and Compression, Security - Cloud Archive: Strategies and Architecture, Replication for Data Redundancy: Synchronous and asynchronous replication methods - Disaster Recovery in the Cloud - Hybrid Backup and Archiving in Cloud Environments Backup and Archive Management in Cloud Environments

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. Ritting house , John W , and James F Ransome , Cloud Computing: Implementation, Management and Security, CRC Press , 2017.
2. Rajkumar Buyya , Christian Vecchiola S. ThamaraiSelvi Mastering Cloud Computing , Tata Mcgraw Hill , 2013.
3. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, “Distributed and Cloud Computing, From Parallel Processing to the Internet of Things”, Morgan Kaufmann Publishers, 2012.
4. George Reese, “Cloud Application Architectures: Building Applications and Infrastructure in the Cloud:” Transactional Systems for EC2 and Beyond (Theory in Practice), OReilly, 2009.
5. Toby Velte , Anthony Velte , Robert Elsenpeter, “Cloud Computing A Practical Approach “, Tata Mcgraw Hill , 2009.

21AM010 Cloud Automation Tools and Applications 3 0 0 3

Course Objectives

- To learn the options for running automation tools, and load balancers in the cloud-native applications.
- To learn the configuration management in the cloud.
- To know why cloud automation is important.
- To learn what types of cloud automation tools can be used.
- To learn load balancing and auto scaling in the cloud.

Programme Outcomes (POs)

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 analyse 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 modelling to complex engineering activities with an understanding of the limitations.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.
n. Formulate solutions for interdisciplinary AI problems through acquired programming knowledge in the respective domains fulfilling with real-time constraints.

Course Outcomes (COs)

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

UNIT I **7 Hours**

UNDERSTANDING THE CLOUD AUTOMATION

Introduction to Automation & Configuration Tools. Introduction to Terraform. Understanding Terraform Vs Cloud Formation. Deploying & Destroying AWS environment with Terraform. Introduction to Packer.

UNIT II **9 Hours**

ABSTRACTION AND VIRTUALIZATION

Introduction to Virtualization Technologies, Load Balancing and Virtualization, understanding hypervisors Porting Applications, Virtual Machines Provisioning and Manageability, Virtual Machine Migration Services, Virtual Machine Provisioning and Migration in Action, Provisioning in the Cloud Context, Virtualization of CPU, Memory, I/O Devices, Virtual Clusters and Resource management, Virtualization for Data Centre Automation.

UNIT III **9 Hours**

AUTOMATION AND CONFIGURATION MANAGEMENT IN THE CLOUD

Cloud automation at scale Cloud Configuration Management unmanaged and managed configuration management Modification of the capacity of the service horizontal and vertical scaling and automatic versus manual scaling. Migrating the business to Cloud. Automating cloud deployments Balancers.

UNIT IV **9 Hours**

LOAD BALANCING AND AUTO SCALING IN CLOUD

Managed instance groups, Auto scaling and health check Overview of HTTP(S) load balancing. Example: HTTP load balancer, HTTP(S) load balancing, Configuring an HTTP Load Balancer with Auto scaling, SSL proxy load balancing, TCP proxy load balancing, Network load balancing, Internal load balancing , Configuring an Internal Load - Balancer , Choosing a load balancer.

UNIT V **11 Hours**

AWS CLOUDFORMATION USE-CASE

Introduction to AWS CloudFormation , AWS CloudFormation Features and Components , Working of AWS CloudFormation setting up AWS CloudFormation , building a Pipeline for Test and Production Stacks , AWS CloudFormation Artifacts Parameter Override Functions with Code Pipeline , Using AWS CLI. AWS CloudFormation , Terraform, VMware vs Center Configuration Manager (VCM) , and Puppet.

Total: 45 Hours

Reference(s)

1. Bernd Ruecker, Practical Process Automation: Orchestration and Integration in Micro services and Cloud Native Architectures,O"Reilly Media, First Edition, 2021.
2. Douglas Comer, The Cloud Computing Book: The Future of Computing Explained, Chapman and Hall/CRC, First Edition, 2021.
3. Karen Tovmasyan, Mastering AWS CloudFormation: Plan, develop, and deploy your cloud infrastructure effectively using AWS CloudFormation, Packt Publishing Limited, First Edition, 2020.
4. Mikael Krief, Mitchell Hashimoto, Terraform Cookbook: Efficiently define, launch, and manage Infrastructure as Code across various cloud platforms, Packet Publishing Limited, 2020.
5. Yogesh Raheja, Dennis McCarthy, Automation with Puppet 5.0, Wiley, First Edition, 2018.

21AM011 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

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 analyse 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.
m. Demonstrate the knowledge and technical skills in software development.

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	1	3									
2	2	1	2	2	3								1	
3	2	2	2	3	3									
4	2	2	2	3	1									
5	3	3	1	1	3								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, OpenDaylight, ONOS - Distributed Controllers.

UNIT III

SDN APPLICATIONS **6 Hours**

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) Virtualbox/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 Open Flow 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. Oswald Coker, Siamak Azodolmolky, Software-Defined Networking with OpenFlow, 2nd Edition, O'Reilly Media, 2017.
2. Ken Gray, Thomas D. Nadeau, Network Function Virtualization, Morgan Kauffman, 2016.
3. Paul Goransson, Chuck Black Timothy Culver, Software Defined Networks: A Comprehensive Approach, 2nd Edition, Morgan Kaufmann Press, 2016.
4. William Stallings, Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud, Pearson Education, 1st Edition, 2015.

5. Fei Hu, Network Innovation through OpenFlow and SDN: Principles and Design, 1st Edition, CRC Press, 2014.
6. Thomas D Nadeau, Ken Gray, SDN: Software Defined Networks, O'Reilly Media, 2013.

21AM012 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 be able to monitor and audit cloud applications for security

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 analyse 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 modelling to complex engineering activities with an understanding of the limitations.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.
n. Formulate solutions for interdisciplinary AI problems through acquired programming knowledge in the respective domains fulfilling with real-time constraints.

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

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 - Internment 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. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, Mastering Cloud Computing Foundations and Applications Programming, 2013.
3. Raj Kumar Buyya, James Broberg, Andrzej Goscinski, Cloud Computing, Wiley 2013.
4. Mark C. Chu-Carroll, Code in the Cloud, CRC Press, 2011.
5. Mather, Kumaraswamy and Latif, Cloud Security and Privacy, Oreilly, 2011.

21AM013 Cyber Security 3 0 0 3

Course Objectives

- To learn cybercrime and cyber law.
- To understand the cyber-attacks and tools for mitigating them.
- To understand information gathering.
- To learn how to detect a cyber-attack.
- To learn how to prevent a cyber-attack.

Programme Outcomes (POs)

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 analyse 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 modelling to complex engineering activities with an understanding of the limitations.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

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 Engineering Attack - Wireless Network Attack - Web Application - Attack Tools - Countermeasures.

UNIT III **9 Hours**

RECONNAISSANCE

Harvester - Who is - Netcraft - Host - Extracting Information from DNS - Extracting Information from Email 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. William Stallings, Lawrie Brown, “Computer Security Principles and Practice”, Third Edition, Pearson Education, 2015.
2. Georgia Weidman, Penetration Testing: “A Hands-On Introduction to Hacking”, No Starch Press, 2014.
3. David Kim, Michael G. Solomon, “Fundamentals of Information Systems Security”, Jones & Bartlett Learning Publishers, 2013.
4. Patrick Engebretson, “The Basics of Hacking and Penetration Testing”: Ethical Hacking and Penetration Testing Made easy, Elsevier, 2011.
5. Kimberly Graves, CEH Official Certified Ethical hacker Review Guide, Wiley Publishers, 2007.

21AM014 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 Pseudorandom 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 messageauthentication codes.

Program Outcomes (POs)

- Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation for the solution of complex engineering problems.
- Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.
- 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.
- 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.
- l. Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
- PSO1: Design and develop cost effective, secure, reliable IT, network and web based solutions with professional expertise in the domains including banking and healthcare and communications.

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 cryptographicsolutions.
5. Demonstrate the use of Message Authentication Codes to authenticate informationtransmitted 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	
2	1	3	2	1	2							2	2	
3	1	1	2	3	2							3	1	
4	3	1	2	1	3							2	3	
5	2	3	3	3	3							1	2	

UNIT I **9 Hours**

INTRODUCTION

Basics of Symmetric Key Cryptography, Basics of Asymmetric Key Cryptography, Hardness of Functions. Notions of Semantic Security (SS) and Message Indistinguishability (MI): Proof of Equivalence of SS and MI, Hard Core Predicate, Trap-door permutation, Goldwasser-Micali Encryption. Goldreich-Levin Theorem: Relation between Hardcore Predicates and Trap-door permutations.

UNIT II **9 Hours**

FORMAL NOTIONS OF ATTACKS

Attacks under Message Indistinguishability: Chosen Plaintext Attack (IND-CPA), Chosen Ciphertext Attacks (IND-CCA1 and IND-CCA2), Attacks under Message Non-malleability: NM-CPA and NMCCA2, Inter-relations among the attack model

UNIT III **9 Hours**

RANDOM ORACLES

Provable Security and asymmetric cryptography, hash functions. One-way functions: Weak and Strong one-way functions. Pseudo-random Generators (PRG): Blum-Micali-Yao Construction, Construction of more powerful PRG, Relation between One-way functions and PRG, Pseudorandom Functions (PRF).

UNIT IV **9 Hours**

BUILDING A PSEUDORANDOM PERMUTATION

The LubyRackoff Construction: Formal Definition, Application of the LubyRackoff Construction to the construction of Block Ciphers, The DES in the light of LubyRackoff Construction.

UNIT V **9 Hours**

MESSAGE AUTHENTICATION CODES

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. Formally 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. OdedGoldreich, 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.

21AM015 Cyber Forensics 3 0 0 3

Course Objectives

- To understand the principles and concepts of computer forensics.
- To learn to utilize forensic tools for network-based attacks.
- To identify and apply appropriate methodologies for forensics data.
- To identify and analyze the vulnerabilities in the network.
- To analyze the various hacking techniques and their impacts.

Programme Outcomes (POs)

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 analyse 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 modelling to complex engineering activities with an understanding of the limitations.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

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 the network.
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 the system 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 **9 Hours**

INTRODUCTION TO COMPUTER FORENSICS

Introduction to Traditional Computer Crime, Traditional problems associated with Computer Crime. Introduction to Identity Theft & Identity Fraud. Types of CF techniques - Incident and incident response methodology - Forensic duplication and investigation. Preparation for IR Creating response tool kit and IR team. - Forensics Technology and Systems - Understanding Computer Investigation - Data Acquisition.

UNIT II **9 Hours**

EVIDENCE COLLECTION AND FORENSICS TOOLS

Processing Crime and Incident Scenes - Working with Windows and DOS Systems. Current Computer Forensics Tools Software /Hardware Tools.

UNIT III **9 Hours**

ANALYSIS AND VALIDATION

Validating Forensics Data - Data Hiding Techniques - Performing Remote Acquisition - Network Forensics - Email Investigations - Cell Phone and Mobile Devices Forensics.

UNIT IV **9 Hours**

E-MAIL SECURITY

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 Forensics and 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, Cengage Learning, 2nd Edition, 2005.
5. Man Young Rhee, Internet Security: Cryptographic Principles, Algorithms and Protocols, Wiley Publications, 2003.

21AM016 Ethical Hacking **3 0 0 3**

Course Objectives

- To learn about the importance of information security.
- To learn different scanning and enumeration methodologies and tools.
- To understand various hacking techniques and attacks.
- To be exposed to programming languages for security professionals.
- To understand the different phases in penetration testing

Programme Outcomes (POs)

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 analyse 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 modelling to complex engineering activities with an understanding of the limitations.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

Course Outcomes (COs)

1. Enumerate the numerous assaults carried out during ethical hacking and penetration testing.
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 the malicious 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-Testing Methodologies- Laws of the Land Overview of TCP/IP - The Application Layer - The Transport Layer - 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. RafayBoloch," Ethical Hacking and Penetration Testing Guide", CRC Press, 2014.
2. Michael T. Simpson, Kent Backman, James E. Corley, "Hands-On Ethical Hacking andNetwork Defense", Cengage Learning, 2013.
3. Patrick Engebretson, "The Basics of Hacking and Penetration Testing Ethical Hacking andPenetration Testing Made Easy", Second Edition, Elsevier, 2013.
4. EC-Council, "Ethical Hacking and Countermeasures": Attack Phases, Cengage Learning,2010.
5. Jon Erickson, "Hacking, 2nd Edition: The Art of Exploitation", No Starch Press Inc. 2008.

21AM017 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.

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 analyze 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.

d. 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. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understandingof the limitations.

PSO1: Design and develop cost effective, secure, reliable IT, network and web based solutions with professional expertise in the domains including banking and healthcare and communications.

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

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 – the 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 & 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**

Install and understand Docker container, Node.js, Java and Hyperledger Fabric, Ethereum and perform necessary software installation on local machine/create instance on cloud to run.

EXPERIMENT 2 **5 Hours**

Create and deploy a blockchain network using Hyperledger Fabric SDK for Java Set up and initialize the channel, install and instantiate chain code, and perform invoke and query on your blockchain network.

EXPERIMENT 3 **5 Hours**

Interact with a blockchain network. Execute transactions and requests against a blockchain network by creating an app to test the network and its rules.

EXPERIMENT 4 **5 Hours**

Deploy an asset-transfer app using blockchain. Learn app development within a Hyperledger Fabric network.

EXPERIMENT 5 **5 Hours**

Use blockchain to track fitness club rewards. Build a web app that uses Hyperledger Fabric to track and trace member rewards.

EXPERIMENT 6 **5 Hours**

Car auction network: A Hello World example with Hyperledger Fabric Node SDK and IBM Blockchain Starter Plan. Use Hyperledger Fabric to invoke chain code while storing results and data in the starter plan.

Total: 60 Hours

Reference(s)

1. Daniel Drescher, "Blockchain Basics", First Edition, Apress, 2017.
2. Bashir and Imran, Mastering Blockchain: Deeper insights into decentralization,cryptography, Bitcoin, and popular Blockchain frameworks, 2017.
3. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.
4. Melanie Swan, "Blockchain: Blueprint for a New Economy", O'Reilly, 2015
5. Andreas Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies",O'Reilly, 2014.
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.

21AM018 Malware Analysis **3 0 0 3**

Course Objectives

- Understand the fundamentals of malware, types and its effects.
- Identify and analyze various malware types by static and dynamic analysis.
- To deal with detection, analysis, understanding, controlling, and eradication of malware.

Programme Outcomes (POs)

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 analyse 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 modelling to complex engineering activities with an understanding of the limitations.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

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 **9 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 - Analysing Windows programs - Anti-static analysis techniques -obfuscation - packing - metamorphism - polymorphism.

UNIT III **9 Hours**

ADVANCED DYNAMIC ANALYSIS

Live malware analysis - dead malware analysis - analysing 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 **9 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 **9 Hours**

ANDROID MALWARE ANALYSIS

Android Malware Analysis: Android architecture - App development cycle - APKTool -APK Inspector-Dex2Jar JD-GUI Static and Dynamic Analysis - Case Study Smartphone (Apps) Security.

Total: 45 Hours

Reference(s)

1. Victor Marak, “Windows Malware Analysis Essentials” Packt Publishing, OReilly, 2015.
2. Ken Dunham, Shane Hartman, Manu Quintans, Jose Andre Morales, Tim Strazzere, “Android Malware and Analysis”, CRC Press, Taylor & Francis Group, 2015.
3. Windows Malware Analysis Essentials by Victor Marak, Packt Publishing, 2015.
4. Bruce Dang, Alexandre Gazet, Elias Bachaalany, SÃƒÂ©bastienJosse, "Practical Reverse Engineering: x86, x64, ARM, Windows Kernel, Reversing Tools, and Obfuscation, 2014.
5. Jamie Butler and Greg Hoglund, Rootkits: Subverting the Windows Kernel by 2005, Addison-WesleyProfessional.

21AM019 Robotic Process Automation **3 0 0 3**

Course Objectives

- Understand the basic concepts, methodologies and tools in RPA.
- Implement the exception handling and automation techniques using RPA.

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 analyse 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.
e. Modern Tool Usage: 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. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

Course Outcomes (COs)

1. Interpret the basic concepts and methodologies in RPA.
2. Infer the UiPath building blocks in the RPA.
3. Apply the RPA techniques to automate the application.
4. Implement the exception handling and BOT in RPA.
5. Implement the RPA to solve real time 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	2	3		3								2	
3	2	2	3		3								3	
4	2	2	3		3								3	
5	2	2	3		3								3	

UNIT I **9 Hours**

RPA AND PROCESS METHODOLOGIES

Introduction to RPA: Definition importance and benefits of RPA - Comparison of RPA with BPO, BPM, and BPA - Understanding RPA Skills: On-Premise Vs the Cloud - Lean and Six Sigma Methodologies for Process Improvement - Overview of Agile Methodologies and its importance in RPA.

UNIT II **9 Hours**

UIPATH ESSENTIALS

Introduction to UiPath: Installation and activation - UiPath Activities: Flowcharts, Sequences, and Data Manipulation - UiPath Variables and Data Types-Debugging techniques in UiPath - Overview ofUiPath Orchestrator: BOT Development and Management- UiPath Automation Best Practices.

UNIT III **9 Hours**

ADVANCED RPA TECHNIQUES

Data Manipulation Collections and Data Table Usage - File Operations CSV/Excel to data table and vice versa - Working with UiExplorer and Desktop Automation - Web Automation: Basic and Desktop Recording-Advanced Screen Scraping Techniques - Data Scraping and Extraction from Websites.

UNIT IV **9 Hours**

HANDLING EXCEPTIONS AND USER EVENTS

Exception Handling Techniques: Try-Catch,Re-throwing Exceptions, and Custom Exception Handling-Logging, Debugging, and Error Reporting Techniques- Handling User Events: Assistantbots, System Event Triggers, and Image and Element Triggers-Monitoring Techniques in RPA-Launching an Assistant bot on a Keyboard Event.

UNIT V **9 Hours**

DEPLOYMENT AND MAINTENANCE OF BOT

Overview of Orchestration Server and its functionalities - Orchestrator to Control Bots and Deploy Bots-Uploading Packages, Managing Packages, and Deleting Packages-Publishing and Managing Updates-Continuous Integration and Continuous Deployment (CI/CD) in RPA.

Total: 45 Hours

Reference(s)

1. Tom Taulli, "The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems", Monrovia, CA, USA, APress, 2020.
2. Alok Mani Tripathi, "Learning Robotic Process Automation", Packt Publishing, 2018.
3. Richard Murdoch, Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks & Become an RPA Consultant.
4. Srikanth Miranda, Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation.
5. Christian Czarnecki, Peter Fettke, "Robotic Process Automation: Management, Technology, Applications", 2021.
6. Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston, "Introduction to Robotic Process Automation: a Primer", Institute of Robotic Process Automation, 1st Edition 2015.

21AM020 Text and Speech Analysis 2 0 2 3

Course Objectives

- Understand natural language processing basics
- Apply classification algorithms to text documents
- Build question-answering and dialogue systems
- Develop a speech recognition system
- Develop a speech synthesizer

Course Outcomes (COs)

1. Understand the foundations of natural language processing and speech analysis
2. Apply classification algorithms to text documents
3. Build question-answering and dialogue systems
4. Apply deep learning models for building speech recognition and text-to-speech systems
5. Infer co-reference and coherence for text processing

Articulation Matrix

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

UNIT I **6 Hours**

NATURAL LANGUAGE BASICS

Foundations of natural language processing – Language Syntax and Structure- Text Preprocessing and Wrangling – Text tokenization – Stemming – Lemmatization – Removing stopwords – Feature Engineering for Text representation – Bag of Words model- Bag of N-Grams model – TF-IDF model

UNIT II **6 Hours**

TEXT CLASSIFICATION

Vector Semantics and Embeddings -Word Embeddings - Word2Vec model – Glove model – FastText model – Deep Learning models for text classification– Recurrent Neural Networks (RNN) – Transformers –Text summarization and Topic Models

UNIT III **6 Hours**

QUESTION ANSWERING AND DIALOGUE SYSTEMS

Information retrieval – IR-based question answering – knowledge-based question answering – language models for QA – classic QA models – chatbots – Design of dialogue systems -– evaluating dialogue systems

UNIT IV **6 Hours**

TEXT-TO-SPEECH SYNTHESIS

Text normalization - Letter-to-sound conversion -Prosody – Evaluation -Signal processing - Concatenative and parametric approaches - WaveNet and other deep learning-based TTS systems

UNIT V **6 Hours**

AUTOMATIC SPEECH RECOGNITION

Named Entity Recognition (NER)-Coreference resolution-Text coherence and cohesion-Advanced sentiment analysis-Speech recognition: Acoustic modelling – Feature Extraction - HMM, HMM-DNN systems

EXPERIMENT 1 **3 Hours**
Create Regular expressions in Python for detecting word patterns and tokenizing text

EXPERIMENT 2 **3 Hours**
Getting started with Python and NLTK - Searching Text, Counting Vocabulary, Frequency Distribution, Collocations, Bigrams

EXPERIMENT 3 **3 Hours**
Accessing Text Corpora using NLTK in Python

EXPERIMENT 4 **3 Hours**
Write a function that finds the 50 most frequently occurring words of a text that are not stop words

EXPERIMENT 5 **3 Hours**
Implement the Word2Vec model

EXPERIMENT 6 **3 Hours**
Use a transformer for implementing classification

EXPERIMENT 7 **5 Hours**
Design a Chabot with a simple dialog system

EXPERIMENT 8 **3 Hours**
Convert text to speech and find accuracy

EXPERIMENT 9 **4 Hours**
Design a speech recognition system and find the error rate

Total: 30+30 = 60 Hours

21AM021 Edge Computing **3 0 0 3**

Course Objectives

- To outline an overview of Edge Computing.
- To implement data analytics techniques over edge.
- To apply various security schemes for manipulation and storage service.
- To perform optimization problem using modelling framework.
- To use RaspberryPi for implement edge computing for industry and commercial purpose.

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 analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
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 modelling to complex engineering activities with an understanding of the limitations.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

Course Outcomes (COs)

1. Understand the fundamentals of Edge Computing
2. Implement the data analytics techniques over edge.
3. Apply security schemes for manipulation and storage service.
4. Perform optimization problem using modelling framework.
5. Use RaspberryPI for implement edge computing for industry and commercial purpose.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Introduction to Edge Computing Scenarios and Use cases -Edge computing purpose and definition, Edge computing use cases Edge computing hardware architectures, Edge platforms, Edge vs Fog Computing, Communication Models-Edge, Fog and M2M.

UNIT II **9 Hours**

EDGE ANALYTICS

Data types Data Analytics - Goals, Real - Time Applications - Phases of Data Analytics - Types of Data Analytics - Edge Data Analytics, Potential & Architecture of Edge Analytics, Case study, Machine learning for Edge Devices.

UNIT III **9 Hours**

EDGE DATA SECURITY

Security Data Confidentiality - Identity & Attribute based encryption, Honey & search Encryption, Homomorphic Encryption – Authentication - Single, Cross & Handover - Privacy Preserving Schemes - Secure search and Storage service in Edge.

9 Hours

UNIT IV

OPTIMIZATION PROBLEMS

Case for optimization Formal modelling framework for Fog & Edge computing Metrics & Performance measures for Edge optimization, Optimization opportunities for service life cycle.

UNIT V **9 Hours**

APPLICATIONS

Edge computing with RaspberryPi, Industrial and Commercial IoT and Edge Edge, computing and solutions.

Total: 45 Hours

Reference(s)

1. Edge Computing Fundamentals, Advances and Applications By K. Anitha Kumari, G. Sudha Sadasivam, D. Dharani, M. Niranjanamurthy Ã‚Â· 2021, ISBN:9781000483598, 1000483592.
2. Fog/Edge Computing For Security, Privacy, and Applications by Jie Wu, Wei Chang, and Springer International Publishing, 2021, ISBN: 9783030573287, 3030573281.
3. IoT and Edge Computing for Architects - Second Edition, by Perry Lea, Publisher: Packt Publishing, 2020, ISBN: 9781839214806.
4. Fog and Edge Computing: Principles and Paradigms by Rajkumar Buyya, Satish Narayana Srirama, wiley publication, 2019, ISBN: 9781119524984.
5. David Jensen, Beginning Azure IoT Edge Computing: Extending the Cloud to the Intelligent Edge, MICROSOFT AZURE

21AM022 Intelligent Robots and Drone Technology **3 0 0 3**

Course Objectives

- To understand the Robot types and its sensors, actuators end effectors.
- To understand the basics of Unmanned Arial Vehicles (Drones) and its various applications.
- To impart the knowledge of how to fly a drone by considering the rules and regulations to the specific country.
- To understand the safety measures to be taken during flight.

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 analyse 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 modelling to complex engineering activities with an understanding of the limitations.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

Course Outcomes (COs)

1. Select the robot and its grippers based on application.
2. Select sensors and actuators for any robotic system.
3. Implement the various types of frame design for the UAV/Drones
4. Understand the basic working principal behind the electronic components used and its specification to build a drone from scratch.
5. To identify and understand various functional modules of the controller using a preprogramed controller used in the UAV/Drones.

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

UNIT I **9 Hours**

ROBOTS INTRODUCTION

Introduction - History growth – Applications - Laws of Robotics – Classifications - Work envelope - Selection and Design Considerations - robot teaching - specification.

UNIT II **9 Hours**

ACTUATORS AND SENSORS

Actuators and types DC motors, BLDC servo motors. Introduction to sensors characteristics sensor types - Touch Potentiometer Encoder Force Range and proximity. Economic Analysis of Robots.

UNIT III **9 Hours**

DRONES FUNDAMENTALS

Introduction to UAVs/Drones – Drones - Working Principle and Design - Types of Drones - Motors – Battery - connectors - Assembling the Drones - Frame – aerodynamics - needed for flying Drone.

UNIT IV **9 Hours**

DRONE AND CONTROLLERS

How to Build a Drone - Preparing - APM planner - Building Fellow me drone - Arduino based drones - GPS tracker using ESP8266.

UNIT V **9 Hours**

MAINTENANCE & APPLICATIONS

Building Prototype Drones - Gilding Drones - Racing Drones - Maintaining and troubleshooting Artificial Intelligence techniques in Drones - Case study INS Vikrant Flying Projects.

Total: 45 Hours

Reference(s)

1. Pratihar.D.K, Fundamentals of Robotics, Narosa Publishing House, India, 2019.
2. Syed Omar Faruk Towaha, Building Smart Drones with ESP8266 and Arduino: Build exciting drones by leveraging the capabilities of Arduino and ESP8266, Packt Publishing, 2018.
3. Fu. K.S, Gonzalez. R.C, Lee. C.S.G Robotics Control, Sensing, Vision, and Intelligence, McGraw Hill, 2015.
4. Theory, Design, and Applications of Unmanned Aerial Vehicles- by A. R. Jha 2016.
5. Handbook of Unmanned Aerial Vehicles Editors: Valavanis, K., Vachtsevanos, George J. (Eds.), 2014

21AM023 Intelligent Transportation Systems 3 0 0 3

Course Objective

- To learn the fundamentals of ITS.
- To study the ITS functional areas.
- To have an overview of ITS implementation in developing countries.

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 analyse 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 modelling to complex engineering activities with an understanding of the limitations.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

Course Outcomes (COs)

1. Demonstrate the functionality of the transport system and security issues.
2. Classify the building blocks of intelligent transport system.
3. Construct the various data collection methodologies for ITS.
4. Summarize various communication protocols that can be used in transportation system.
5. Interpret the significance of ITS under Indian conditions.

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

UNIT I **9 Hours**

INTRODUCTION TO INTELLIGENT TRANSPORT SYSTEM

Introduction to Intelligent Transportation Systems (ITS) - Functions of ITS Components - Challenges and Opportunities in ITS – Architecture - ITS Architecture Framework - Logical Architecture - Physical Architecture - Organizational Architecture.

UNIT II **9 Hours**

TECHNOLOGY BUILDING BLOCKS OF ITS

Data Acquisition - Data Analysis - wireless adhoc networks - Tele communication technologies - Cellular wires - Wireless application protocols - Data and Information processing technologies - Data warehousing - Online Analytical Processing -Voice Processing and Internet.

UNIT III **9 Hours**

DATA COLLECTION METHODS FOR ITS

Detection and Sensing Technologies - Road way sensors - Environmental Sensors - probe based sensors - Bluetooth - RFID - Passive - Active and BAP RFID systems - Real time traffic monitoring using GPS probe - Emergency management - Incident management.

9 Hours

UNIT IV

TRANSPORT MANAGEMENT SYSTEM

Vehicle to infrastructure communication - Mobility management - Integrated Traffic Management - Junction Management Strategies - ATMS - Route Guidance - Predictive Guidance - Dynamic Traffic Assignment (DTA).

UNIT V **9 Hours**

TRAVELLER AND INFORMATION SYSTEM

Basic TIS Concepts - Pre Trip and Enroute Methods - Smart Route System - Dissemination to Travelers - Evaluation of Information - Value of Information - Business Opportunities. Case Study: Kavach system Automatic train track switching system.

Total: 45 Hours

Reference(s)

1. R.P Roess, E.S. Prassas, W.R. McShane. Traffic Engineering, Pearson Educational International, Fifth Edition, 2019.
2. Sarkar, Pradip Kumar, Amit Kumar Jain, Intelligent Transport Systems, PHI Learning, 2018.
3. Rodolfo I. Meneguette, Robson E. De Grande, Intelligent Transport System in Smart Cities: Aspects and Challenges of vehicular networks and cloud, Springer, 2018.
4. Sussman, J.M. Perspectives on Intelligent Transportation Systems, Springer, Berlin, 2010.
5. Intelligent Transport Systems, Intelligent Transportation Primer, Washington, US, 2001.

21AM024 Expert Systems **3 0 0 3**

Course Objectives

- Understand the concepts of intelligent agents, searching, knowledge and reasoning, planning and learning in expert systems.
- Illustrate the knowledge representation and acquisition in expert systems.
- Analyze the features, tools, limitations and applications of expert systems.

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 analyse 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 modelling to complex engineering activities with an understanding of the limitations.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

Course Outcomes (COs)

1. Interpret the features, tools, limitations and applications of expert systems.
2. Infer the procedure to build an expert system.
3. Analyze the requirement of knowledge acquisition in expert systems.
4. Represent the knowledge representation using rules, semantic nets, and frame in expert systems.
5. Interpret the concept of fuzzy expert systems.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO EXPERT SYSTEMS

Definition - Features of an expert system - Architecture and Components of Expert System - Roles in Expert Systems - Stages in the Expert System development life cycle - Sources of Error in Expert System Development - Limitations and Applications of Expert Systems.

UNIT II **9 Hours**

BUILDING AN EXPERT SYSTEMS

Expert system tools - Selecting a tool - Evaluating the System Building tool - Knowledge acquisition process - Resources Inherent Limitations - Common pitfalls in planning development - Pitfalls in dealing with Domain Expert.

UNIT III **9 Hours**

9 HOURS KNOWLEDGE ACQUISITION IN EXPERT SYSTEMS

Knowledge Basics - Knowledge Engineering - Views of Knowledge Engineering - Knowledge Acquisition Techniques - Natural Techniques - Contrived Techniques - Modelling Techniques.

UNIT IV **9 Hours**

KNOWLEDGE REPRESENTATION IN EXPERT SYSTEMS

Definition- Characteristics - Properties of the symbolic representation of knowledge - Categories of Knowledge Representation Schemes - Types of Knowledge Representational Schemes - Formal Logic -Semantic Net - Frames - Scripts - Conceptual Dependency.

UNIT V **9 Hours**

FUZZY EXPERT SYSTEMS

Fuzzy Systems: Fuzzy Rule - Fuzzy Reasoning. Fuzzy Expert Systems - Need for Fuzzy Expert Systems Operations - Fuzzy Inference Systems - The Fuzzy Inference Process in a Fuzzy Expert System - Types of Fuzzy Expert Systems - Fuzzy Controller.

Total: 45 Hours

Reference(s)

1. Gupta, G. Nagpal, “Artificial Intelligence and Expert Systems”, Mercury Learning & Information, 2020.
2. Patterson, “Introduction to Artificial Intelligence and Expert Systems”, Pearson Education India, 2015.
3. Donald. A. Waterman, “A Guide to Expert Systems”, 3rd Edition, Pearson Education, 2009.
4. Giarratano and G. Riley, “Expert Systems Principles and Programming”, 4th Edition, PWS Publishing Company, 2004.
5. Peter Jackson, “Introduction to Expert Systems”, Addison Wesley Longman, 1999.

21AM001 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 quality assurance.

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 analyse 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.
e. Modern Tool Usage: 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.
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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.

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	
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 Software Development, Kanban model.

UNIT III **9 Hours**

AGILITY AND KNOWLEDGE MANAGEMENT

Agile information systems - agile decision making - Earl 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 - agile requirements modelling 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. Hazza & Dubinsky, Agile Software Engineering, Series: Undergraduate Topics in Computer Science, Springer, VIII edition, 2009
3. Craig Larman, Agile and Iterative Development: A managers Guide, Addison Wesley, 2004
4. Kevin C. Desouza, Agile information systems: conceptualization, construction, and management, Butterworth-Heinemann, 2007.
5. David J. Anderson; Eli Schragenheim, Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results, Prentice Hall, 2003

21AM026 Web Frameworks and Applications 3 0 0 3

Course Objectives

- To introduce the fundamentals of Internet, and the principles of web design.
- To construct basic websites using HTML and Cascading Style Sheets.
- To build dynamic web pages with validation using Java Script objects and by applying different event handling mechanisms.
- To develop modern interactive web applications using WordPress, Django

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

Course Outcomes

1. Describe the concepts of World Wide Web, and the requirements of effective web design.
2. Develop web pages using the HTML and CSS features with different layouts as per need of applications.
3. Use the JavaScript to develop the dynamic web pages
4. Create and manage Blogs, Websites using WordPress.
5. Django is a high-level open-source Python web development framework for building websites. It's used in many large applications like YouTube and Spotify.

Articulation Matrix

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

UNIT I 9 Hours

INTRODUCTION TO WEB DESIGN

Concept of WWW, Internet and WWW, HTTP Protocol: Request and Response, Web browser and Web servers, features of latest version of Web. Concepts of effective web design, Web design issues including Browser, Bandwidth and Cache, display resolution, Look and Feel of the Website, Page Layout and linking, User centric design, Sitemap, Planning and publishing website, Designing effectivenavigation.

UNIT II 10 Hours

HTML & STYLE SHEETS

Basics of HTML, formatting and fonts, commenting code, color, hyperlink, lists, tables, images, forms, XHTML, Meta tags, Character entities, frames and frame sets, Browser architecture and Web site structure. Overview and features of latest version of HTML.Need for CSS, introduction to CSS, basic syntax and structure, using CSS, background images, colors and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS, CSS2, Overview and features of latest version of CSS.

UNIT III **9 hours**

JAVASCRIPT

Client side scripting with JavaScript, variables, functions, conditions, loops and repetition, Pop up boxes, Advance JavaScript: JavaScript and objects, JavaScript own objects, the DOM and web browserenvironments, Manipulation using DOM, forms and validations, DHTML: Combining HTML, CSS and JavaScript, Events and buttons.

UNIT IV **9 hours**

INTRODUCTION TO WORDPRESS

How WordPress Works- Introduction to Blogging- Creating Blogs- Using Images-Wrapping Text Around Images-Comments-Post Formats- Linking to Posts- Pages and Categories- Using Smiles, - Links Manager-WordPress Feeds- Customizing Feeds- Use Gravatars in WordPress- Writing Code in Your Posts, -Using Password Protection, -Developing a Color Scheme- Designing Headers- CSS Horizontal Menus-Dynamic Menu Highlighting, Navigation Links-Next and Previous Links-Styling for Print

UNIT V **8 hours**

INTRODUCTION TO DJANGO

Introduction to Back-End Web Development using Django-HTTP protocol MVC Model-Virtual Environment-Django Structure-Generic Views-HTML templates-URL dispatcher.

Total: 45 Hours

REFERENCES

1. Joel Sklar, Principles of Web Design, Cengage Learning, 6th Edition, 2015.
2. Internet and World Wide Web How to program, Paul J. Deitel, Harvey M. Deitel, andAbbey Deitel, 5th Edition, Pearson Education, 2011.
3. Kogent Learning Solutions Inc., Web Technologies Black Book, Dreamtech Press, 2009.
4. http://www.wpbeginner.com/beginners-guide/how-to-learn-wordpress-for-free-in-aweek-or-less/

21AM027 Ecommerce and Web Development **3 0 0 3**

Course Objectives

- Understand the fundamentals of web development
- Gain knowledge about the technologies used in ecommerce app development.
- Explore security considerations in ecommerce.
- Understand user experience (UX) principles in web development.
- Develop skills in data analysis and analytics for ecommerce.

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 analyse 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.

Course Outcomes (COs)

1. Demonstrate the terms and trade cycle of E Commerce.
2. Design dynamic and interactive web pages by embedding Java Script in XHTML.
3. Develop an interactive Ecommerce Web App.
4. Apply UX principles to enhance the user experience.
5. Analyze ecommerce performance and user behavior through analytical tools.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO ECOMMERCE

Introduction - Scope of ecommerce - Traditional Commerce Vs E-Commerce - Evolution of ecommerce - Ecommerce business models - Benefits and challenges of ecommerce - Ecommerce trends and emerging technologies - Electronic Commerce and the Trade Cycle - Electronic Data Interchange (EDI) - Legal and ethical aspects of ecommerce.

UNIT II **9 Hours**

WEB DEVELOPMENT FUNDAMENTALS

Introduction to XHTML and Editing XHTML Headings – Linking - Images- Special characters and Horizon rules - Lists – Tables – Forms - Internal Linking - Meta Elements - Cascading Style Sheets. Introduction to Java script - Control statements I, II Functions: Definition - Recursion - Arrays: Declaring and allocating arrays Multidimensional Arrays - Window Object - Events.

UNIT III **9 Hours**

WEB APPLICATIONTECHNOLOGIES

Web server (IIS and Apache): Multitier Architecture - Client /Server side scripting - Server Side Scripting Fundamentals - Implementation of Array Function - Session Tracking - String and Form Processing - Database: Relational database – SQL - SQL Queries - Database design and normalization - connecting to database - Database security and backup strategies. - web development frameworks - MVC (Model – View - Controller) architecture - Building dynamic web applications. - case study.

UNIT IV **9 Hours**

WEB USER EXPERIENCE (UX) TECHNOLOGIES

Principles of web design - Typography color theory and visual design - User experience and Usability - Responsive and mobile - friendly Design-Ecommerce Platforms and Technologies Introduction to ecommerce platforms (Woo Commerce, Shopify) Payment gateways - Content Management Systems (CMS) - Security and privacy in ecommerce.

UNIT V **9 Hours**

ECOMMERCE WEB APP DEVELOPMENT

Introduction Product catalog management Shopping cart implementation Order processing and fulfilment Ecommerce Analytics and SEO (Search Engine Optimization): Tracking and analysing user behaviour Conversion rate optimization SEO techniques for ecommerce websites Data visualization and
reporting tools case study

Total: 45 Hours

Reference(s)

1. "Learning Web Design: A Beginners Guide to HTML, CSS, JavaScript, and Web Graphics" by Jennifer Niederst Robbins
2. "Web Development and Design Foundations with HTML5 " by Terry Felke-Morris
3. "Ecommerce Evolved: The Essential Playbook to Build, Grow & Scale a Successful Ecommerce Business" by Tanner Larsson
4. "Database Systems: Design, Implementation, & Management" by Carlos Coronel, Steven Morris, and Peter Rob
5. "The Design of Everyday Things" by Don Norman (for UX design principles)

21AM028 Mobile and Web Application 3 0 0 3

Course Objectives

- Understand the concept of Mobile system
- Understand the mobile application development
- Understand the mobile OS
- Understand the concepts Android and IOS

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 analyse 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.

Course Outcomes (COs)

1. Build interface for mobile applications and web applications
2. Design mobile application for Android platform using primitive UI features, SQLite and GPS
3. Design a mobile application for Android platform using advanced features like animations and graphics.
4. Develop mobile application for IOS platform

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Introduction to mobile applications - cost of development - Market and business drivers for mobile applications - Publishing and delivery of mobile applications - Requirements gathering and validation for mobile applications. Third party Frameworks. - Mobile Content - Mobile Applications.

UNIT II **9 Hours**

BASIC DESIGN

Introduction to - Web Services Web service language Format - Creating a Web service - using Microsoft stack Using the Linux Apache MySQL PHP (LAMP) Stack Debugging Web Services. Mobile User Interface Design. - Mobile Web Apps Using HTML5.

UNIT III **9 Hours**

ANDROID

Introduction to Android - IOS - Android Studio UI Elements - Activity Intent Menus Containers - Layouts - Fragments - Permissions. Data storage - types of Data Storage - Shared Preferences Internal Storage - External Storage - cache. Storage - SQLite - Firebase storage.

UNIT IV **9 Hours**

NOTIFICATIONS AND SENSORS

Notifications - Toast - Alerts - Dialog Builder - Sensor Registers - Reading value - Event Listeners - Handlers. GOOGLE SIGNIN: Developer Console - API Key – Dependencies - Session Management - Revoke Access. GOOGLE MAPS: Maps API key - Google Map UI - Map types - Getting Location - Places - Search View.

UNIT V **9 Hours**

TECHNOLOGY III - IOS

Introduction to Objective C - iOS features - UI implementation - Touch Frameworks Data persistence using Core - Data and SQLite - Location aware applications using Core Location and Map Kit - Integrating calendar and address book with social media application - Using Wi Fi - CASE STUDY - iPhone marketplace and mobile application development.

Total: 45 Hours

Reference(s)

1. Dawn Griffiths and David Griffiths, Head “First Android Development”, Second Edition, OReilly 2018
2. Bill Phillips, Chris Stewart and Kristin Marsicano, “Android Programming”, Third Edition, Big Nerd Ranch Guides, February 9, 2017.
3. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", Wrox, Wiley Publications, 2012
4. Charlie Collins, Michael Galpin and Matthias Kappler, “Android in Practice”, Manning Publications Co., 2012
5. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, “Beginning iOS 6 Development”:

21AM029 NOSQL Database 2 0 2 3

Course Objectives

- Explore the origins of NoSQL databases and the characteristics that distinguish them from traditional relational database management systems.
- Understand the architectures and common features of the main types of NoSQL databases (key-value stores, document databases, column-family stores, graph databases)
- Discuss the criteria that decision makers should consider when choosing between relational and non-relational databases and techniques for selecting the NoSQL database that best addresses specific use cases.

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 analyse 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 modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Explain and compare different types of NoSQL Databases.
2. Compare and contrast RDBMS with different NoSQL databases.
3. Demonstrate the detailed architecture and performance tune of Document-oriented NoSQL databases.
4. Explain performance tune of Key-Value Pair NoSQL databases.
5. Apply NoSQL development tools on different types of NoSQL Databases.

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

UNIT I **6 Hours**

INTRODUCTIONTO NOSQL CONCEPTS

Overview and History of NoSQL Databases. Definition of the Four Types of NoSQL Database, The Value of Relational Databases, Getting at Persistent Data, Concurrency, Integration, Impedance Mismatch, Applicationand Integration Databases, Attack of the Clusters, The Emergence of NoSQL.

UNIT II **6 Hours**

KEY VALUE DATABASE

Comparison of relational databases to new NoSQL stores, MongoDB, Cassandra, HBASE, Neo4j use and deployment, Application, RDBMS approach, Challenges NoSQL approach, Key Value and Document Data Models, Column-Family Stores, Aggregate-Oriented Databases. Replication and sharding, Map Reduce on databases. Distribution Models, Single Server, Sharding, Master-Slave Replication, Peer-to-Peer Replication, Combining Sharding and Replication.

UNIT III **6 Hours**

DOCUMENT ORIENTED DATABASE

NoSQL Key/Value databases using MongoDB, Document Databases, Document oriented Database Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Web Analytics or Real-Time Analytics,E-Commerce Applications, Complex Transactions Spanning Different Operations, Queries against Varying Aggregate Structure.

UNIT IV **6 Hours**

COLUMNAR DATA MODEL

Column- oriented NoSQL databases using Apache HBASE, Colum oriented NoSQL databases using Apache Cassandra, Architecture of HBASE, Column-Family Data Store Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Counters, Expiring Usage.

UNIT V **6 Hours**

DATA MODELING WITH GRAPH

NoSQL Key/Value databases using Riak, Key-Value Databases, Key-Value Store, Key-Value Store Features, Consistency, Transactions, Query Features, Structure of Data, Scaling, Suitable Use Cases, Storing Session Information, User Profiles, Preferences, Shopping Cart Data, Relationships among Data, Multi operation Transactions, Query by Data, Operations by Sets. Graph NoSQL databases using Neo4, NoSQL database development tools and programming languages, Graph Databases, Graph Database. Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases.

EXPERIMENT 1 **5 Hours**

Implementation of Document Document-Oriented Database (MongoDB) to perform CRUD operations, Indexing, Sharding query optimization and data modelling

EXPERIMENT 2 **5 Hours**

Implementation of Column-Family Store (Apache Cassandra) to perform data modelling and querying.

EXPERIMENT 3 **5 Hours**

Create a database that stores road cars. Cars have a manufacturer, a type. Each car has a maximum performance and a maximum torque value. Do the following: Test Cassandra's replication schema and consistency models

EXPERIMENT 4 **5 Hours**

Implementation of Column-Family Store (Apache Cassandra) to set up replication across multiple nodes and observe read write operation.

EXPERIMENT 5 **5 Hours**

Implementation of Graph Database (Neo4j) to demonstrate graph algorithms.

EXPERIMENT 6 **5 Hours**

Download a zip code dataset at http://media.mongodb.org/zips.json. Use mongo import to import the zip code dataset into MongoDB. After importing the data, answer the following questions by using aggregation pipelines: (1) Find all the states that have a city called "BOSTON". Find all the states and cities whose names include the string" BOST". Each city has several zip codes. Find the city in each state with the most number of zip codes and rank those cities along with the states using the city populations. MongoDB can query on spatial information.

Total: 30+30=60 Hours

Reference(s)

1. Dan Sullivan, "NoSQL for Mere Mortals", 1st Edition, Pearson Education India, 2015. (ISBN-13: 978-9332557338).
2. Dan McCreary and Ann Kelly, "Making Sense of NoSQL: A guide for Managers and the Rest of us", 1st Edition, Manning Publication/Dreamtech Press, 2013. (ISBN-13: 978-9351192022).
3. Kristina Chodorow, "Mongodb: The Definitive Guide- Powerful and Scalable Data Storage", 2nd Edition, O"Reilly Publications, 2013. (ISBN-13: 978-9351102694).

21AM030 Smart Product Development **3 0 0 3**

Course Objectives

- Understand the fundamentals of Product development and its processes.
- Understand how smart system processes and its functional elements.
- Learn the mapping for smart systems in Industry 4.0
- Understand the processes in product design & development
- Understand how Smart Product Development helps multidisciplinary Engineering

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 analyse 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.

Course Outcomes (COs)

1. Identify the key elements in smart product technologies in Industry
2. Compare the existing smart systems and products in the industry
3. Infer the deep QA process for robotics tooling
4. Develop a Smart product using Watson Discovery Services
5. Design a Smart Expert System

Articulation Matrix

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

UNIT I **9 Hours**

PRODUCT DEVELOPMENT PROCESSES AND SMART PROCESS ELEMENTS

Product Development Life Cycle, Process Models - Prototyping - Agile Models New Product Development Processes - Knowledge based/driven development - Principal Issues and Challenges. - User and Customer Research - User Observation - Customer Interviews Competitor landscape, Cost Analysis - Product Teardown - Analysis input mapping, Concept generation Analysis wrap up idea generation-idea evaluation-concept formulation, Prototype Testing.

UNIT II **9 Hours**

SMART TECHNOLOGIES 4.0 AND KNOWLEDGE BASED SYSTEM DEVELOPMENT

Cloud Services, Big data & Analytics, Engineering Simulation, 3D printing, Additive Manufacturing. Knowledge Discovery, Knowledge Representation, Knowledge Catalogue, Knowledge Graphs, Knowledge Visualization.

UNIT III **9 Hours**

DEEP QA PROCESSES

Deep QA Architecture, Exploring Deep QA - Question Analysis - Primary Search - Hypothesis Generation Merging and Ranking, Micro services and Robust Tooling in Deep QA.

UNIT IV **9 Hours**

WATSON

Watson Community Services and Watson Discovery Services, Watson Deep Learning, Chabot, Natural Language Classifier, Concept Expansion, Concept Insights, Language Identifications and Translations, Visualization and Rendering.

UNIT V **9 Hours**

DESIGN OF AN EXPERT SYSTEM

Expert System Architectures, An analysis of some classic expert systems - WATSON, Deep expert systems, Co-operating expert systems and the blackboard model. Contemporary Issues.

Total: 45 Hours

Reference(s)

1. "Smart Product Design", Send points Publications, 2017
2. Grega Jakus, Veljko Milutinovic, Sanida Omerovic, Saso Tomazic, " Concepts, Ontologies and Knowledge Representation", Springer, 2013
3. Simon Kendal, Malcolm Creen, "An Introduction to Knowledge Engineering", Springer, ISBN-13: 978- 1846284755, 2007.
4. Ronald J. Brachman and Hector J.Levesque, "Knowledge representation and reasoning", 2nd edition, Elsevier publications, 2004.

21AM031 Bio Medical Image Analysis **2 0 2 3**

Course Objectives

- Understand Nature of Biomedical Images, Image Enhancement and Filtering for removal of artifacts
- Understand the image segmentation and analysis of Image shape and Texture
- Understand the pattern classification and diagnostic decision.

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 analyse 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.

Course Outcomes (COs)

1. Capable of survey image processing techniques.
2. Apply the theoretical background of Image processing to solve biomedical imaging problems
3. Represent and recognize objects through patterns in application.
4. Analyze various techniques involved in biomedical systems.
5. Modelling biomedical systems.

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

UNIT I **6 Hours**

THE NATURE OF BIOMEDICAL IMAGES

The Nature of Biomedical Images: Objectives of Biomedical Image Analysis, Computer aided Diagnosis. Image Quality and Information Content: Acquisition and Analysis, The Fourier Transform and Spectral Content.

UNIT II **6 Hours**

REMOVALOF ARTIFACTS

Removal of Artifacts: Random noise, Signal dependent noise, Space domain Local statistics based Filters, Frequency domain Filters. Image Enhancement: Greyscale Transforms, Histogram Transformation, Convolution Mask Operators, Homomorphism Filtering for Enhancement. Detection of Regions of Interest

UNIT III **6 Hours**

ANALYSIS OF SHAPE

Analysis of Shape: Representation of Shapes and Contours, Shape Factors, Fourier Descriptors Analysis of Texture: Texture in Biomedical Images, Statistical Analysis of Texture, Fourier domain Analysis of Texture.

UNIT IV **6 Hours**

ANALYSIS OF ORIENTED PATTERNS

Analysis of Oriented Patterns: Oriented Patterns in Images, Measures of Directional Distribution, Directional Filtering, Gabor Filters, Directional Analysis via Multiscale Edge Detection

UNIT V **6 Hours**

PATTERNS ANALYSIS DECISION

Pattern Classification and Diagnostic Decision: Pattern Classification, Probabilistic Models and Statistical Decision, Logistic Regression, Neural Networks, Measures of Diagnostic Accuracy, Reliability of Features, Classifiers and Decisions.

EXPERIMENT 1 **6 Hours**

Experiment Description: Develop and implement algorithms for automated cell counting and nucleus detection in microscopy images. Utilize Cell Profiler, a modular high-throughput image analysis software, to enhance the structure, function, and compatibility of the analysis.

EXPERIMENT 2 **6 Hours**

Experiment Description: Create and validate a deep learning algorithm for automated detection of diabetic retinopathy in retinal fundus photographs. Employ advanced computational methods to aid inthe early and accurate identification of diabetic retinopathy for effective medical intervention.

EXPERIMENT 3 **6 Hours**

Experiment Description: Focus on developing robust segmentation techniques to identify and characterize tumor regions in breast MRI images. Implement quantitative imaging biomarkers, such asthe Yen method, to improve the accuracy and efficiency of breast cancer diagnosis and assessment.

EXPERIMENT 4 **6 Hours**

Experiment Description: Utilize diffusion tensor imaging (DTI) to analyse white matter tracts in the brain. Implement three-dimensional tracking methods to visualize and track axonal projections, providing critical insights into brain connectivity and neurological conditions.

EXPERIMENT 5 **6 Hours**

Experiment Description: Develop a system to quantitatively analyse cardiac function parameters, including ejection fraction and wall motion abnormalities, using echocardiography images. Adhere to the recommendations provided by the American Society of Echocardiography and the European Association of Cardiovascular Imaging for accurate cardiac disease assessment.

Total: 30+30 =60 Hours

Reference(s)

1. M. A.Joshi, Digital Image Processing: An algorithmic approach, 2nd Edition. PHI 2009
2. Gonzalez, Rafael C. and Woods, Richard E. Digital Image Processing, Addison Wesley, 3rdEdition, reprint 2008.
3. John C.Russ, The Image Processing Handbook, CRC Press,2007.
4. Rangaraj M Rangayyan, R. M. Biomedical Image Analysis, CRC Press, 2005.
5. Jain, Anil K. Fundamentals of digital image processing, PHI, 2002.
6. Chanda and Majumder,D. Dutta. Digital image processing and Analysis, PHI, 2002.

21AM032 Data Analytics and Data Science 3 0 0 3

Course Objectives

- Build computational abilities, inferential thinking, and practical skills for tackling core data scientific challenges
- Explores foundational concepts in data management, processing, statistical computing, and dynamic visualization using modern programming tools.
- Introduce modern data analytic techniques and develop skills for importing and exporting, cleaning and fusing, modelling and visualizing, analysing and synthesizing complex datasets.

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 analyse 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.

Course Outcomes (COs)

1. Identify exploratory and statistical analysis methods to prepare the big data Build interface for mobile applications and web applications.
2. Choose basic tools to carry out exploratory data analysis and produce effective visualization of given data Design mobile application for Android platform using primitive UI features, SQLite and GPS.
3. Perform parallel data processing and duplication with Hadoop and Map-Reduce. Design a mobile application for Android platform using advanced features like animations and graphics.

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

UNIT I **9 Hours**

DATA SCIENCE BASICS

Mathematics foundations for data science, Statistical inference - Statistical modelling, Probability distributions, Fitting a model, Exploratory Data Analysis(EDA) and data visualization Basic tools (Plots, Graphs and Summary statistics) of EDA, Data science process, Data visualization Basic principles, ideas and tools for visualization, Analytic processes and tools Analysis Vs Reporting

UNIT II **9 Hours**

BIG DATA DATABASES

Big data platform - Challenges of conventional systems - Intelligent data analysis - Transition to big data databases - Map reduce - Hadoop, HBase, Hive, MapR – Sharding - NOSQL databases - Hadoop distributed file systems - Anatomy of file write and read - PIG, HIVE, SPARK.

UNIT III **9 Hours**

MINING DATA STREAMS

Stream data model and architecture - Stream computing, sampling data in a stream - Filtering streams - Counting distinct elements in a stream - Estimating moments - Counting oneness in window - Decaying window Real time analytics platform (RTAP) applications.

UNIT IV **9 Hours**

DESCRIPTIVE ANALYTICS

Mining frequent item sets - Apriori algorithm - Handling large data sets in main memory - Limited pass algorithm - Segmentation techniques – Hierarchical - KMeans Clustering high dimensional data - CLIQUE and PROCLUS - Clustering in non-Euclidean space - Clustering for streams and parallelism, online algorithms.

UNIT V **9 Hours**

CASE STUDIES - PRESCRIPTIVE ANALYTICS

Optimization and Simulation with Multiple Objectives, Text Analytics - Text Analytics methods - Metrics-Applications, Predictive Analytics – Models – Evaluation - Applications.

Total: 45 Hours

Reference(s)

1. Data Science & Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data,EMC Education Services, Wiley, 2015
2. Cathy O"Neil and Rachel Schutt. Doing Data Science, Straight Talk from The Frontline. O"Reilly.2014.
3. Jure Leskovek, AnandRajaraman and Je_rey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press. 2014.
4. Foster Provost and Tom Fawcett. Data Science for Business: What You Need to Know aboutData Mining and Data-analytic Thinking. ISBN 1449361323. 2013.
5. Kevin P. Murphy. Machine Learning: A Probabilistic Perspective. ISBN 0262018020. 2013.
6. Easley and Kleinberg, Networks, Crowds, and Markets: Reasoning about a highly connected world. Cambridge University Press, 2010

21AM033 Video Analytics **3 0 0 3**

Course Objectives

- Understand the need for video Analytics
- Understand the basic configuration of video analytics
- Understand the functional blocks of a video analytic system.
- Get exposed to the various applications of video analytics.

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 analyse 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.

Course Outcomes (COs)

1. Develop video analytic algorithms for security applications
2. Develop video analytic algorithms for business intelligence
3. Identify the suitable algorithms for video analytic applications
4. Design custom made video analytics systems for the given target application
5. Understand the algorithms available for performing analysis on video data and address the challenges

Articulation Matrix

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

UNIT I **9 Hours**

VIDEO ANALYTIC COMPONENTS

Need for Video Analytics-Overview of video Analytics- Foreground extraction- Feature extraction - classifier -Pre-processing- edge detection-smoothing- Feature space-PCA-FLD-SIFT features.

UNIT II **9 Hours**

FOREGROUND EXTRACTION

Background estimation - Averaging - Gaussian Mixture Model - Optical Flow based - Image Segmentation - Region growing - Region splitting - Morphological operations - erosion-Dilation - Tracking in a multiple camera environment.

UNIT III **9 Hours**

CLASSIFIERS

Neural networks (back propagation) - Deep learning networks - Fuzzy Classifier - Bayesian classifier - HMM based classifier.

UNIT IV **9 Hours**

LEAD MANAGEMENT

Web to lead forms - Web to case forms - Lead generation techniques - Leads are everywhere - social media and lead gen Inbuilt tools for Digital Marketing - Ip Tracker - CPC reduction (in case of paid ads) Group posting on Social Media platforms.

UNIT V **9 Hours**

VIDEO ANALYTICS FOR BUSINESS INTELLIGENCE

Customer behavior analysis - people counting- Traffic rule violation detection - traffic congestion identification for route planning - driver assistance - lane change warning.

Total: 45 Hours

Reference(s)

1. Nilanjan Dey (Editor), Amira Ashour (Editor) and Suvojit Acharjee (Editor), Applied Video processing in Surveillance and monitoring systems,2017
2. Zhihao Chen (Author), Ye Yang (Author), The Next Generation of Video Surveillance and Video Analytics: The Unified Intelligent Video Analytics Suite, Create Space Independent Publishing Platform,2014
3. Caifeng Shan (Editor), Fatih Porikli (Editor), Tao Xiang (Editor), Shaogang Gong (Editor) Video Analytics for Business Intelligence, Springer, 2012.
4. Graeme A. Jones (Editor), Nikos Paragios (Editor), Carlo S. Regazzoni (Editor) Video- Based Surveillance Systems: Computer Vision and Distributed Processing, Kluwer academic publisher, 2001

21AM034 Cyber Threat Analytics **3 0 0 3**

Course Objectives

- Understand how to leverage intelligence to understand adversary behavior and make use of indicators of compromise to detect and stop malware.
- Understand the security problems and defend the cyberspace.
- Understand and protect against attacks, threats and intrusion.

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 analyse 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 modelling to complex engineering activities with an understanding of the limitations.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.
n. Formulate solutions for interdisciplinary AI problems through acquired programming knowledge in the respective domains fulfilling with real-time constraints.

Course Outcomes (COs)

1. Develop incident response skills to combat network and system.
2. Classify various types of attacks and learn the tools to launch the attacks
3. Evaluate the security of network and system
4. Review and analyze threat intelligence logs and reports.
5. Discover and Respond to the 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	2								2	2
3	2	1	1	1									2	2
4	3	3	2	2	2								2	2
5	3	2	1	1	1								2	2

UNIT I **9 Hours**

CYBER ATTACKS, INTRUSIONS, THREATS

Introduction to cyber-attacks, attack model, Adversary Types, Vulnerability Types, Threat Types, Attacks vs. Intrusion, DDoS, Types, Malware, malware Types, Introduction to Dark net, Cybercrimes.

UNIT II **9 Hours**

CYBER THREATS AND INTRUSION KILL CHAIN

Introduction to Advanced Persistent Threats, Intrusion Kill Chain, Zero days, Attack surface, Attack vectors, Evasion techniques Host and Network level evasions, Covert Communication: Infiltration and Exfiltration, Advanced Evasion techniques

UNIT III **9 Hours**

THREAT INTELLIGENCE

Cyber Threat Intelligence (CTI), Overview of Threat Intelligence Lifecycle and Frameworks, CTI types, generic threat actor, Indicators of Compromise (IoCs).

UNIT IV **9 Hours**

THREAT INTELLIGENCE MODEL

Campaign analysis, Diamond model, Threat intel methodologies, Intrusion reconstruction, OSINT, Challenges with detection intrusions.

UNIT V **9 Hours**

SECURITYOPERATION CENTRE (SOC)

Introduction to SIEM, Threat Intelligence Data Collection, Threat Intelligence Collection Management, Threat Intelligence Data Feeds and Sources, Data Processing and analysis, building your own SOC, Visualizing the threat intelligence data. Threat Intelligence Reports: Baseline and Diff,Blacklists and Whitelists, Tracking, Integration.

Total: 45 Hours

Reference(s)

1. Wilson Bautista, Practical Cyber Intelligence: How Action-based Intelligence Can be an Effective Response to Incidents, 2018, Packt publisher
2. Arun E Thomas, Security Operations Center - SIEM Use Cases and Cyber Threat Intelligence, 2018
3. Michael Hale Ligh, Andrew Case, Jamie Levy, Aaron Walters, The Art of Memory Forensics: Detecting Malware and Threats in Windows, Linux and Mac Memory, Wiley Publisher,2014
4. John Sammons, The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics, Syngress publisher ,2012
5. Eoghan Casey, Digital Evidence and Computer Crime: Forensic Science, Computers, and the Internet, Elsevier,2011

21AM035 Business Intelligence 3 0 0 3

Course Objectives

- To give an insight into Business Intelligence and its concepts.
- To enable the students in understanding project planning and application development.
- To introduce the students to modern information technology.
- To comprehend the process of acquiring Business Intelligence.

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 analyse 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 modelling to complex engineering activities with an understanding of the limitations.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.
n. Formulate solutions for interdisciplinary AI problems through acquired programming knowledge in the respective domains fulfilling with real-time constraints.

Course Outcomes (COs)

1. Understand the use of Business Intelligence for Decision Support.
2. Execute a Business Intelligence Project by proper planning and analysis.
3. Carry out Meta Data Repository Analysis.
4. Design, implement and evaluate the meta data application.
5. Understand the modern information technology and its business opportunities.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Definition, BI process - Private and Public intelligence, BI Decision Support Initiatives, Business Drivers, Cost- Benefit analysis, Risk Assessment, Enterprise Infrastructure Evaluation-Technical and Non-technical -Risk Assessment Tools.

PROJECTPLANNINGAND DATAANALYSIS

BI Project planning, Requirements definition and gathering, deliverables, Business focused data analysis, Top-down Logical data modeling, Bottom-up source data analysis, data cleansing, Prototyping. Metrics of Deliverables.

UNIT III **9 Hours**

METADATAREPOSITORYANALYSIS AND DESIGN

Meta Data models, Analysis, Database design, Extract/ Transform / Load (ETL) design, Metadata design, ETL Development-Descriptive Metadata.

UNIT IV **9 Hours**

APPLICATION DEVELOPMENT

OLAP Tools-Multidimensional analysis factors, architecture - Data mining, Risks, Metadata repository Development - Implementation- Release Evaluation- Data Clustering

UNIT V **9 Hours**

MODERNINFORMATION TECHNOLOGY AND ITS BUSINESSOPPORTUNITIES

Business intelligence software, BI on web, Ethical and legal limits, Industrial espionage, BI software, Modern techniques of crypto analysis, Managing and organizing for an effective BI Team. Symmetric-key cryptography.

Total: 45 Hours

Reference(s)

1. Larissa T. Moss and Shaku Atre, Business Intelligence Roadmap: The complete project Lifecycle for Decision Support Applications, Addison Wesley, 2011.
2. GalitShmueli, Nitin R. Patel and Peter C. Bruce, Data Mining for Business Intelligence Concepts, Techniques and Applications Wiley India, 2011.
3. Efraim Turban, Ramesh Sharda, Jay E. Aronson and David King, Business Intelligence, Prentice Hall, 2010
4. Elizabeth Vitt and Michael Luckevich StaciaMisner, Business Intelligence, Microsoft, 2010.
5. Z. Michalewicz, M. Schmidt. M. Michalewicz and C. Chiriac, Adaptive Business Intelligence, Springer Verlag, 2009.

21AM036 Digital Marketing and Techniques 3 0 0 3

Course Objectives

- Understand the Digital marketing platforms.
- Understand the theoretical aspects of creating a website.
- Understand the role of digital marketing in business administration.
- Familiarize with search engine optimization.
- Understand MISC tools.

Course Outcomes (COs)

1. Explain the concept of digital marketing and the role of a digital manager
2. Administer the website and identifies the search engines
3. Discuss the various MISC tools
4. Describe the concepts of lead management and digital marketing
5. Explain the various trending digital marketing skills

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO DIGITAL MARKETING

Basics of Marketing – Types of Marketing - Digital Marketing Platforms- Types of Organic and Paid Digital Marketing- Difference between Traditional Marketing and digital Marketing- Advantage of Digital Marketing - Role of a Digital Marketing Manager–Remix.

UNIT II **9 Hours**

DIGITAL MODEL AND DIGITAL CUSTOMER

Digital Model – Revenue Model – Intermediary Model – Attribution Model – Communication Model – Processing Model – Loyalty Model – Social Media Model – Digital Customers: Introduction to Digital Customer – Online information process – Online buying process – Customer Profiles & Customer types.

UNIT III **9 Hours**

SOCIAL MEDIA MARKETING AND SEARCH ENGINE

Social Media Marketing - Benchmarking and Setting - Strategy and plan to manage social media – Social listening - online reputation management - content marketing - social media communications strategy - Social Media optimization - Search Engine Marketing - Paid or Pay Per Click search marketing - Banner VS Native advertising - Online partnerships - Viral marketing - Offline traffic building.

UNIT IV **9 Hours**

CUSTOMER LIFECYCLE MANAGEMENT

e-CRM - customer lifecycle marketing - Database marketing and marketing automation – marketing technology to support CRM - Profiling - Personalization - Email marketing - Control issues - Cleaning the database - social business through implementing social CRM - reviewing digital marketing capabilities.

UNIT V **9 Hours**

DIGITAL MARKETING PLAN AND MANAGEMENT

Managing digital marketing - Budgeting for digital marketing - digital marketing investment- suppliers for digital marketing - Change management - digital analytics & Automation - Digital business security –digital marketing planning - Situational analysis – Tactics, Action, and Control - The 3Ms resources – case study

Total: 45 Hours

Reference(s)

1. Chaffey, D., & Smith, P. R. (2017). Digital marketing excellence: planning, optimizing and integrating online marketing. Taylor & Francis.
2. Dodson, I. (2016). The art of digital marketing: the definitive guide to creating strategic, targeted, and measurable online campaigns. John Wiley & Sons.
3. Kaufman, I., & Horton, C. (2014). Digital marketing: Integrating strategy and tactics with values, a guidebook for executives, managers, and students. Routledge.
4. Royle, J., & Laing, A. (2014). The digital marketing skills gap: Developing a Digital Marketer Model for the communication industries.
5. Stokes, R. (2011). E-Marketing: The essential guide to digital marketing. Quirk eMarketing.

21AM037 Internet of Things and Its Application 3 0 0 3

Course Objectives

- Understand how connected devices work together to update other applications
- Acquire knowledge to interface sensors and actuators with microcontroller-based Arduino/Raspberry Pi platform.
- Understand the Communication between microcontroller and PC using IOT protocol
- Understand IoT security and challenges
- Understand IoT applications with case studies.

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 analyse 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 modelling to complex engineering activities with an understanding of the limitations.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.
n. Formulate solutions for interdisciplinary AI problems through acquired programming knowledge in the respective domains fulfilling with real-time constraints.

Course Outcomes (COs)

1. Interpret the impact and challenges posed by IoT networks leading to new architectural models.
2. Design portable IoT using Arduino/Raspberry Pi /open platform.
3. Appraise the role of IoT protocols for efficient network communication.
4. Elaborate the need for IOT security and challenges.
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	2	3	1	1	1								2	2
2	3	3	2	3	3								1	3
3	2	3	3	2	2								1	2
4	1	1	2	2	2								3	2
5	3	2	3	2	2								1	2

UNIT I **6 Hours**

INTRODUCTION TO IOT

IoT Definition, IoT characteristics, M2M and IoT, End to End IoT Architecture, Physical design of IoT,Logical Design of IoT, Overview of IoT protocols, IoT levels and deployment templates, Challenges for IoT,Inter dependencies of IoT and cloud computing, Web of things.

12 Hours

UNIT II

EMBEDDED IOT DEVICES

Sensors and actuators for IoT applications, IoT components and implementation, Programming of NodeMCU and Raspberry PI, Implementation of IoT with Edge devices, reading sensor data and transmit to cloud, controlling devices through cloud using mobile application and web application, Types and configurations of gatways, Specifications of IoT gateways

UNIT III **10 Hours**

IOT PROTOCOL*S*

Link layer protocols, Network/internet layer protocols, Transport layer protocols, Application layer protocols: Hypertext transfer protocol (HTTP), Systematic HTTP access methodology, Web Socket, Constrained application protocol CoAP), Message Queue Telemetry Transport Protocol (MQTT), XMPP, DDS, AMQP .

UNIT IV **7 Hours**

IOT SECURITY AND CHALLENGES

IOT Security, Dangers, Assigning values to Information, Security Components, Key Management, Update Management, Challenges in IoT security.

UNIT V **10 Hours**

IOT APPLICATIONS AND CASE STUDY

Broad categories of IoT applications: Consumer IoT, Commercial IoT, Industrial IoT, Infrastructure IoT, Military Things (IoMT).IoT Case studies: Home automation with IoT, River water pollution monitoring, Smart city street light control and monitoring, Health care monitoring, Voice Apps on IoT device.

Total: 45 Hours

Reference(s)

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1stEdition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978- 9386873743),2017
2. Raj Kamal, "Internet of Things: Architecture and Design Principles", 1st Edition, McGraw Hill Education, 2017. (ISBN: 978-9352605224)
3. Srinivasa K G, "Internet of Things",CENGAGE Leaning India, 2017
4. Vijay Madisetti and Arshdeep Bahga, "Internet of Things" (A Handson-Approach), 1stEdition, VPT, 2014. (ISBN: 978-8173719547)
5. A. McEwen, H. Cassimally, "Designing the Internet of Things", Wiley, 2013

21AM038 Bioinformatics **3 0 0 3**

Course Objectives

- Understand the fundamental concepts of structural biology (chemical building blocks, structure, superstructure, folding, etc.)
- Acquire knowledge the sequence and structure alignment, protein structure prediction, protein folding, and protein- protein interaction
- Understand and use bioinformatics databases and understand protein design
- Understand the current approaches in bioinformatics application.
- Understand the methodology of protein structure prediction and assessment.

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 analyse 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 modelling to complex engineering activities with an understanding of the limitations.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.
n. Formulate solutions for interdisciplinary AI problems through acquired programming knowledge in the respective domains fulfilling with real-time constraints.

Course Outcomes (COs)

1. Apply computational based solutions for biological perspectives.
2. Practice life-long learning of applied biological science
3. Develop the ability to design, predict, analyze and compare the protein structures as well as predict the function of target proteins.
4. Ability to reach the frontier of bioinformatics and use bioinformatics tools to solve the research problems.
5. Develop bioinformatics tools with programming skills.

Articulation Matrix

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

UNIT I **7 Hours**

BASICS OF BIOINFORMATICS

Introduction: What is bioinformatics, Principles of protein structure, Tertiary structure, Quaternary structure, Similarity of ternary and quaternary structure; Bioinformatics databases: Introduction, Nucleotide sequence databases, Protein sequence databases, Sequence motif databases, Protein structure database.

UNIT II **10 Hours**

SEQUENCE ALIGNMENT

Similarity and Homology, Types of divergence, Conserved regions, Methodological principles, Substitution scores, Insertion/deletion scores, Statistical significance, Database search, Multiple alignment, Structure alignment, matching algorithms, Searching 3D Databases.

UNIT III **8 Hours**

PROTEIN STRUCTURE AND MODELING

Protein secondary structure: Introduction, Hydrogen bond, defining a secondary structure element, Methods for predicting secondary structure; Experimental methods for protein structure determination: X-ray crystallography, Nuclear magnetic resonance (NMR); Protein folding and dynamic simulation.

UNIT IV **10 Hours**

CURRENT TECHNIQUES AND DRUG DISCOVERY

Bayesian Networks, Nearest neighbourhood approach, Neural Networks, Genetic algorithms, Ensemble learning. Computer Aided Drug Designing (CADD): SBDD, LBDD, Drug discovery, Drug Target Identification, Drug Target Validation.

UNIT V **10 Hours**

STRUCTURAL DOMAINS IN PROTEIN AND APPLIED BIOINFORMATICS TOOLS

Basics, First and second-generation algorithms for domain assignments, domain assignment based on graph theoretical methods, prediction of binding sites and characterization. Designing protein interfaces: Designing for affinity, designing for specificity. Entrez, ExPASy, BLAST: Online and Local BLAST, Motif Search: SMART Search, MEME Search, HMM Search, Scoring Matrix, Dotlet.

Total: 45 Hours

Reference(s)

1. Bioinformatics and Functional Genomics (2nd edition) by Jonathan Pevsner, Wiley-Liss,2015
2. Basics of Bioinformatics: Lecture notes of the Graduate Summer School, Rui Jiang, Zhang, Springer,2013
3. Bioinformatics Databases: Design, Implementation, and Usage by SorinDraghici,2013
4. Structural Bioinformatics (2nd Edition), Jenny Gu, Philip E. Bourne, 2009
5. Keedwell, Edward, and Ajit Narayanan. Intelligent bioinformatics: The application of artificial intelligence techniques to bioinformatics problems. John Wiley & Sons, 2005
6. Lesk, A.M. 2005, 2nd edition, Introduction to Bioinformatics. Oxford University Press

21AM039 Social and Information Networks **3 0 0 3**

Course Objectives

- Understand the components of social networks.
- Facsimiles and visualize social networks.
- Understand the role of semantic web in social networks.
- Habituate with the security concepts of social networks.
- Discern the various applications of social networks.

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 analyse 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 modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Analyze the different measurements and metrics of social networks.
2. Apply different techniques to detect and evaluate communities in social networks.
3. Apply various types of social network models.
4. Apply semantic web format to represent social networks.
5. Develop social network applications using visualization tools.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Introduction to social network analysis Fundamental concepts in network analysis social network data notations for social network data Graphs and Matrices. Measures and Metrics: Strategic network formation - network centrality measures: degree, betweenness, closeness, eigenvector - network centralization density reciprocity transitivity ego network measures for ego network - dyadic network triadic network - cliques - groups- clustering search.

UNIT II **9 Hours**

COMMUNITYNETWORKS

Community structure - modularity, overlapping communities - detecting communities in social networks – Discovering communities: methodology, applications - community measurement - evaluating communities - applications.

UNIT III **9 Hours**

MODELS

Small world network - Watts Strogatz networks - Statistical Models for Social Networks Network

evolution models: dynamical models, growing models - Nodal attribute model: exponential random graph models Preferential attachment - Power Law - random network model: Erdos Renyi and Barabasi - Albert Epidemics - Hybrid models of Network Formation.

UNIT IV **9 Hours**

SEMANTIC WEB

Modelling and aggregating social network data developing social semantic application evaluation of web-based social network extraction Data Mining Text Mining in social network tools-case study.

UNIT V **9 Hours**

VISUALIZATION AND SECURITY APPLICATIONS

Visualization of social networks novel visualizations and interactions for social networks applications of social network analysis tools - sna: R Tools for Social Network Analysis - Social Networks Visualiser (SocNetV)- Pajek.

Total: 45 Hours

Reference(s)

1. Jalal Kawash, Online Social Media Analysis and Visualization, 2015.
2. John Scott, Social network analysis, 3rd edition, SAGE, 2013.
3. Charu Aggarwal, Social Network data analysis, Springer, 2011.
4. Borko Furht, Handbook of Social Network Technologies and applications, Springer, 2010.
5. Easley and Kleinberg, Networks, Crowds, and Markets: Reasoning about a highly connected world. Cambridge University Press, 2010.
6. Stanley Wasserman, Katherine Faust, Social network analysis: Methods and applications, Cambridge university press, 2009.

21AM040 Information Storage Management 3 0 0 3

Course Objectives

- Understand the challenges in information storage and management
- Understand the core elements in a data center.
- Understand RAID and its various levels for data backup

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 analyse 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.

Course Outcomes (COs)

1. Explain physical and logical components of a storage infrastructure including storage subsystems, RAID and intelligent storage systems.
2. Describe storage networking technologies such as FC-SAN, IP-SAN, FCoE, NAS and object-based, and unified storage.
3. Illustrate and articulate business continuity solutions, backup and replications, along with archives for managing fixed content.
4. Explain key characteristics, services, deployment models, and infrastructure components for Cloud computing.
5. Implement the concept of security storage infrastructure management.

Articulation Matrix

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

UNIT I **9 Hours**

STORAGE SYSTEM

Introduction to information storage, Virtualization and cloud computing, Key data centre elements, Compute, application, and storage virtualization, Disk dive & flash drive components and performance, RAID, Intelligent storage system and storage provisioning (including virtual provisioning)

UNIT II **9 Hours**

STORAGENETWORKING TECHNOLOGIES AND VIRTUALIZATION

Fibre Channel SAN components, FC protocol and operations, Block level storage virtualization, iSCL and FCIP as an IP-SAN solution, converged networking option FcoE, Network Attached Storage (NAS) components, protocol and operations, File level storage virtualization, Object based storage and unified storage platform.

UNIT III **9 Hours**

BACKUP, ARCHIVE AND REPLICATION

Business continuity terminologies, planning and solutions, Clustering and multi pathing to avoid single points of failure, Backup and recovery methods, targets and topologies, data deduplication and backup in virtualized environment, fixed content and data archive.

UNIT IV **9 Hours**

CLOUD COMPUTINGCHARACTERISTICS AND BENEFITS

Cloud Enabling Technologies - Characteristics of Cloud Computing- Benefits of Cloud Computing- Cloud Service Models Cloud deployment models- Cloud Computing Infrastructure-Cloud Challenges, Cloud migration considerations.

UNIT V **9 Hours**

SECURING AND MANAGING STORAGE INFRASTRUCTURE

Security threats, and countermeasures in various domains, Security solutions for FC-SAN, IP-SAN and NAS environments, Security in virtualized and cloud environments, Monitoring and managing various information infrastructure components in classic and virtual environments, Information lifecycle Management (ILM) and storage tiering.

Total: 45 Hours

Reference(s)

1. Information Storage and Management: Storing, Managing and Protecting Digital Information in classic, Virtualized and Cloud Environments, 2nd Edition, EMC Educations Services, Wiley, May 2012.
2. Information Storage and Management: Storing, Managing, and Protecting Digital Information, EMC Education Services, Wiley, January 2010.
3. Ulf Troppens, Rainer Erkens, Wolfgang Mueller-Friedt, Rainer Wolafka, Nils Haustein ,"Storage Networks Explained: Basics and Application of Fibre Channel SAN, NAS, iSCSI, InfiniBand and FCoE, 2nd Edition, Wiley, July 2009.

21AM041 Software Project Management 3 0 0 3

Course Objectives

- Understand the Software Project Planning and Evaluation techniques.
- Understand the project management at each stage of the software development life cycle (SDLC).
- Learn about the activity planning and risk management principles.
- Understand the various phases involved in project management and people management.

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 analyse 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.
m. Develop models in Data Science, Machine learning, deep learning and Big data technologies, using AI and modern tools.
n. Formulate solutions for interdisciplinary AI problems through acquired programming knowledge in the respective domains fulfilling with real-time constraints.

Course Outcomes (COs)

1. Able to plan and manage projects at each stage of the software development life cycle (SDLC).
2. Able to manage software projects and control software deliverables.
3. Develop skills to manage the various phases involved in project management and people management.
4. Deliver successful software projects that support organization s strategic goals.
5. Understand staffing maintenance in software projects.

Articulation Matrix

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

UNIT I **9 Hours**

PROJECT EVALUATION AND PROJECTPLANNING

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 CYCLEAND 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**

STAFFINGIN SOFTWARE PROJECTS

Managing people - Organizational behaviour - Best methods of staff selection - Motivation - the Oldham - Hackman job characteristic model - Stress - Health and Safety - Ethical and Professional Concerns - Working in teams - Decision making - Organizational Structures - Dispersed and Virtual Teams - Communications Genres - Communication Plans Leadership.

Total: 45 Hours

Reference(s)

1. Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management Fifth Edition, TataMcGrawHill, New Delhi, 2012.
2. Robert K. Wysocki Effective Software Project Management Wiley Publication, 2011.
3. Gopalaswamy Ramesh, Managing Global Software Projects McGraw Hill Education(India), Fourteenth Reprint 2011.
4. Walker Royce: Software Project Management Addison Wesley, 1998.

21AM042 Intellectual Property Rights 3 0 0 3

Course Objectives

1. Understand the fundamental aspects of Intellectual Property Rights to students who are going to play a major role in development and management of innovative projects in industries.
2. Understand the patents registration procedure in India and abroad.
3. Understand the concept of copyrights and its related rights.
4. Understand the concept of trademarks and its registration.

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 analyze 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.

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Course Outcomes (COs)

1. Describe the fundamental aspects of Intellectual Property Rights to students who are going to play a major role in development and management of innovative projects in industries.
2. Disseminate knowledge on patents, patent regime in India and abroad and registration aspects.
3. Disseminate knowledge on copyrights and its related rights and registration aspects.
4. Disseminate knowledge on trademarks and registration aspects.
5. Disseminate knowledge on Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registration aspects.

Articulation Matrix:

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

UNITI **9 Hours**

OVERVIEW OF INTELLECTUAL PROPERTY

Introduction and the need for intellectual property right (IPR) – Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret – IPR in India: Genesis and development – IPR in abroad – Major International Instruments concerning Intellectual Property Rights: Paris Convention, 1883, the Berne Convention,1886, the Universal Copyright Convention, 1952, the WIPO Convention, 1967, the Patent Co-Operation Treaty, 1970, the TRIPS Agreement, 1994.

UNITII **9 Hours**

PATENTS

Patents - Elements of Patentability: Novelty, Non Obviousness (Inventive Steps), Industrial Application - Non - Patentable Subject Matter - Registration Procedure, Rights and Duties of Patentee, Assignment and license, Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties – Patent office and Appellate Board.

UNIT III **9 Hours**

COPYRIGHTS

Nature of Copyright - Subject matter of copyright: original literary, dramatic, musical, artistic works; cinematograph films and sound recordings - Registration Procedure, Term of protection, Ownership of copyright Assignment and license of copyright - Infringement, Remedies & Penalties – Related Rights - Distinction between related rights and copyrights.

UNITIV **9 Hours**

TRADEMARKS

Concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non-Registrable Trademarks - Registration of Trademarks- Rights of holder and assignment and licensing of marks - Infringement, Remedies & Penalties - Trademarks registry and appellate board.

UNIT V **9 Hours**

OTHER FORMS OF IP

Design concept of novel and original - Procedure for registration, effect of registration and term of protection. Geographical Indication (GI) and difference between GI and trademarks - Procedure for registration, effect of registration and term of protection. Layout Design protection and it procedure for registration, effect of registration and term of protection. India`s New National IP Policy- Career Opportunities in IP - IPR in current scenario with case studies.

Total: 45 Hours

Reference(s)

1. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN:CengageLearning India Private Limited.
2. Subramanian, N., & Sundararaman, M. (2018). Intellectual Property Rights – An Overview. Retrievedfromhttp://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf.
3. Ahuja, V K. (2017). Lawrelating to Intellectual Property Rights. India, IN: Lexis Nexis.
4. Neeraj, P., & Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning private Limited.
5. World Intellectual Property Organisation. (2004). WIPO Intellectual Property Handbook. Retrieved fromhttps://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf.

ONE CREDIT

21AM0XA Machine Learning With Tensorflow 1 0 0 1

Course Objectives

- Understand the fundamental concepts of TensorFlow Framework and Keras.
- Implementation of deep learning concepts in 2D data using TensorFlow.

Course Outcomes (COs)

1. Understand the basics of TensorFlow Framework Architecture.
2. Apply the concept of deep learning in Keras.
3. Analyze the outcome of the Deep Learning models and the optimization technique to improve the modelperformance.

UNIT I **15 Hours**

Need for AI in Industry- Introduction to ML and DL- Introduction to TensorFlow – Basic Components of TensorFlow –Architecture of Tensor Flow- Deep Learning Fundamentals – Introduction to Keras – Application of Keras on Deep Learning Problems– Optimizers – Case study on Prediction analysis on 2- Dimensional data- Case study on Prediction analysis on Image analytics.

Total: 15 Hours

Reference(s)

1. Hands-on machine learning with Scikit-learn Keras and TensorFlow by Aurelion Geron published by O`Reilley.

2. https://www.tensorflow.org/api_docs

3. https://www.kaggle.com/learn/intro-to-deep-learning.

21AM0XB Introduction To Tableau 1 0 0 1

Course Objectives

Learn how to build visualizations, organize data and design dashboards to empower more meaningful business decisions.

Course Outcomes (COs)

1. Understand the main concepts of data visualization.
2. Create data visualizations and dashboards using Tableau.

UNIT I: 15 Hours

Introduction to Tableau - Different Products by Tableau - Advantages of Tableau- Introduction to Data Visualization- Applications of Tableau- Companies using Tableau- Features of Tableau- Tableau Terminologies- Tableau Navigations- Tableau Design Flow- How to Connect to a File Source- Understanding of Different Data Sources- Data Source Filters- Data Types - Tableau Operators- String Functions in Tableau- Date Functions - Logical Statements - Aggregate Functions- Joins- Data Blending- Field Operator-Filter- Changing Data Type of a Field from Data Pane-Formatting- Worksheet- Line Chart- Bar Chart- Histogram- Scatter Plot- Pie Chart- Bubble chart- Tableau Forecasting- Tableau Dashboard.

Total: 15 Hours

Reference(s)

1. https://help.tableau.com/current/guides/get-started-tutorial/en-us/get-started-tutorial-home.html

21AM0XC Kubernetes: Developer Perspective **1 0 0 1**

Course Objectives

- Understand the kubernetes for automating deployment, scaling, and management of containerized applications.

Course Outcomes (COs)

1. Understand the basics of Kubernetes
2. Analyze to automate operational tasks of container management
3. Design the managing containerized workloads and services

Introduction to Kubernetes and Setting Up Kubernetes Environment **3 Hours**

Overview of containerization and its benefits, Introduction to Kubernetes and its features, Architecture and components of Kubernetes, a Kubernetes distribution (e.g., Minikube, k3s), Installation of Kubernetes on a local machine or cloud provider, configure kubectl and accessing the cluster.

Pod Deployments, Services Networking and Persistent Storage **3 Hours**

Pods in Kubernetes - Creating and managing Pods using YAML manifests,Deploying applications using Deployments and ReplicaSets, Services and their role in Kubernetes, managing Services for application access, Networking concepts in Kubernetes, including ClusterIP, NodePort, and LoadBalancer, storage options in Kubernetes, Persistent Volumes (PVs) and Persistent Volume Claims (PVCs), different types of storage providers.

Scaling Auto scaling, ConfigMaps & Secrets, Deploying Stateful Applications **4 Hours**

Scaling applications manually using replicas, Implementing Horizontal Pod Autoscaling (HPA), Configuring and managing cluster autoscaling, configuration using ConfigMaps, Storing and accessing sensitive information with Secrets, Using ConfigMaps and Secrets in application deployment,Stateful application deployments, Managing databases and other stateful workloads in Kubernetes, Handling data persistence and ordering in StatefulSets.

Monitoring, Logging Managing Updates &Rollbacks, Security Best Practices **4 Hours**

Monitoring Kubernetes clusters and applications, Exploring popular monitoring tools (e.g., Prometheus, Grafana), Configuring logging with Fluentd and Elasticsearch, Setting up a CI/CD pipeline for Kubernetes applications, Using tools like Jenkins or GitLab CI/CD, Automating application deployments and updates, rolling updates to update application versions, rollbacks in case of failures or issues, upgrades with minimal downtime, Securing Kubernetes clusters and components, RBAC (Role-Based Access Control) and user authentication, Implementing network policies for communication control.

Total: 15 Hours

Reference(s)

1. The Kubernetes Book , Nigel Poulton , SPD 2023.
2. Kubernetes Operators: Automating the Container Orchestration Platform,Joshua Wood,Jason Dobies, O'reilly, 2020.
3. Kubernetes in Action , Marko Luksa , Manning,2018.

21AM0XD Natural Language Processing With Attention Model 1 0 0 1

Course Objectives

- Understand the concept of neural networks and deep learning models, and their application tosolve challenging natural language analysis problems.

Course Outcomes (COs)

1. Understand the Deep learning (DL) and neural networks fundamental Concepts.
2. Illustrate the Deep learning models using linear algebra and probability theory.
3. Apply the models in text analysis, classification and text similarity for solving real worldproblems.

Articulation Matrix

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

Deep learning(DL) and neural networks **4 Hours**

Overview of Deep learning(DL) , neural networks fundamental, Computational frameworks for neuralnetwork implementation, DL Models-Convolutional neural networks.

Recurrent neural networks (RNN) **4 Hours**

LSTM, GRU, Sequence to Sequence RNN, bidirectional RNNs, Attention models, Other models:generative adversarial networks, memory neural networks-

Text analysis and understanding **7 Hours**

Review of natural language processing and analysis fundamental concepts, Word level semantics, Textclassification: sentiment analysis, author profiling, author identification, text categorization, Languagemodel: OCR output correction, Conditional language models: summarization, Text Similarity: community question answering, Build a Chatbot using Reformer Model.

Total: 15 Hours

Reference(s)

1. [JM2017] Jurafsky, D. and Martin, J. Speech and Language Processing, 3rd editiondraft Chapters.
2. [Goodfellow2016] Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deeplearning. MIT Press.
3. [JM2008] Jurafsky, D. and Martin, J. Speech and Language Processing, 2ndedition.