Dayananda Sagar University

School of Engineering

Kudlu Gate, Hosur Road, Bengaluru 560068

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Artificial Intelligence & Machine Learning)

DAYANANDA SAGAR UNIVERSITY

Kudlu Gate, Hosur Road, Bengaluru 560068

SCHOOL OF ENGINEERING

SCHEME & SYLLABUS

FOR

BACHELOR OF TECHNOLOGY (B.Tech)

1st & 2nd Semester COMMON TO ALL BRANCHES

3rd – 8th Semester BRANCH SYLLABUS

(With effect from 2020)

Dayananda Sagar University

School of Engineering

Kudlu Gate, Hosur Road, Bengaluru 560068

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Artificial Intelligence & Machine Learning)

Vision and Mission

Vision

To be a centre of excellence in education, research & training, innovation & entrepreneurship and to produce citizens with exceptional leadership qualities to serve national and global needs.

Mission

To achieve our objectives in an environment that enhances creativity, innovation and scholarly pursuits while adhering to our vision.

Values

The Pursuit of Excellence

A commitment to strive continuously to improve ourselves and our systems with the aim of becoming the best in our field.

Fairness

A commitment to objectivity and impartiality, to earn the trust and respect of society.

Leadership

A commitment to lead responsively and creatively in educational and research processes.

Integrity and Transparency

A commitment to be ethical, sincere and transparent in all activities and to treat all individuals with dignity and respect.

Dayananda Sagar University

School of Engineering

Kudlu Gate, Hosur Road, Bengaluru 560068

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Artificial Intelligence & Machine Learning)

ORGANIZATIONAL HIERARCHY

SL.NO.	NAME	DESIGNATION
	MANAGEMENT	
1	DR. D. HEMACHANDRA SAGAR	CHANCELLOR, DSU
2	DR. D. PREMACHANDRA SAGAR	PRO CHANCELLOR, DSU
	ADMINISTRATORS	
3	SHRI. GALISWAMY	SECRETARY, DSI
4	DR. K. N. BALASUBRAMANYA MURTHY	VICE CHANCELLOR, DSU
5	SHRI . R. JANARDHAN	PRO -VICE CHANCELLOR, DSU
6	DR. AMIT R. BHATT	PRO -VICE CHANCELLOR, DSU
7	DR. C. PUTTAMADAPPA,	REGISTRAR, DSU
8	DR. UDAYA KUMAR REDDY K. R.,	DEAN -SOE , DSU

GOVERNING REGULATIONS FOR BACHELOR OF TECHNOLOGY (B. TECH) – 2021

PREAMBLE

The School of Engineering under Dayananda Sagar University (DSU) provides Science & Technology based education leading to the development of high caliber engineers suitable for Industry and Scientific Organization. The curriculum focuses on knowledge based course work integrated with skill development as a part of training. It equally helps in inculcating the scientific temper for the lifelong processes of learning. At the Under Graduate level, a candidate goes through the foundation courses in Science, Humanities & Engineering. Each department ensures that the courses cover both the core & electives courses, as required. Provision for Institutional elective help the candidates to acquire interdisciplinary knowledge base or specialize significantly in an area outside the parent discipline.

DEFINITIONS OF KEY WORDS

(i) **Academic Year:** Two consecutive odd, even semesters and a summer term for make up if required.

(ii) **Course:** Usually referred to as a subject, a course may consist of any of Lecture/Tutorials/Practical /Seminar/Mini project/Project work.

(iii) **Credit:** A unit by which the course work is measured. One credit is equivalent to one hour of lecture or one hour of tutorial or two hours of laboratory/practical/ workshop practice per week.

(iv) **Credit Point:** It is the product of grade point and number of credits per course.

(v) **Cumulative Grade Point Average (CGPA):** It is the measure of overall cumulative performance over all semesters. It is expressed upto two decimal places.

(vi) **First Attempt:** If a candidate has completed all formalities of academic requirement in a term and become eligible to attend the examinations and attend all the end semester examinations, such attempt shall be considered as first attempt.

(vii) **Grade Point:** It is a numerical weight allotted to each letter grade on a 10 point scale.

(viii) **Letter Grade:** It is an index of the performance in a said course. Grades are denoted by alphabets.

(ix) **Programme:** An educational activity leading to award a Degree or Certificate.

(x) **Semester Grade Point Average:** It is a measure of performance during a semester. It shall be expressed up to two decimal places.

(xi) **Transcript:** Based on the grades earned, a grade certificate shall be issued after every semester to the candidate registered.

(xii) **Failure:** It is the case of appearing for Semester End Examinations, but fails to obtain minimum passing marks in Semester End Examinations.

(xiii) **Detain**: It is the case of not satisfying the eligibility criteria w.r.t Attendance /Internal Assessment in each course to appear for Semester End Examination.

(xiv) **Audit Course** : A course to be taken by the student without benefit of a grade or a credit.

(xv) **Not Fit For The Program(NFFTP)**: It is the failure of satisfying the criteria laid down by regulations to continue the program of study, which leads to the termination from the University

RULES AND REGULATIONS

UG 1. All B.Tech programmes offered by the University shall be governed by the DSU B.Tech Rules and Regulations – 2021.

UG 2. The B. Tech. rules and regulations shall be applicable to any new discipline(s) that may be introduced in future.

UG 3. A candidate shall become eligible for the award of the B.Tech. Degree after fulfilling all the academic requirements as prescribed by the B.Tech. Rules and Regulations of DSU.

UG 4. ELIGIBILITY FOR ADMISSION

UG 4.1. Admission to First Year Bachelor of Technology shall be open to candidates who have passed the second year Pre-University or XII standard or equivalent examination recognized by the University.

UG 4.2. The candidate shall have studied and passed English as one of the courses and secured not less than forty five percent (45%) marks in aggregate with Physics and Mathematics as compulsory courses, along with any one of the following courses, namely, Chemistry, Bio- Technology, Computer Science, Biology and Electronics. Eligibility shall be 40% in optional courses in case of candidates belonging to SC/ST and OBC candidates from Karnataka.

UG 4.3. Admission to II year /III Semester Bachelor of Technology under Lateral entry shall be open to the candidates who have passed diploma or equivalent qualification as recognized by statutory and regulatory body.

UG 4.4. For candidates who have completed Diploma from other than State of Karnataka, their eligibility shall be based on the recognition of the Diploma awarding Boards by the University.

UG 4.5. Diploma candidates seeking admission under Lateral entry shall take up bridge courses as prescribed in the Scheme of Teaching.

UG 4.6. Admission to II year /III Semester Bachelor of Technology shall be open to candidates who have passed B. Sc. degree from a recognized University or equivalent as recognized by the University and secure not less than 45% marks in aggregate (including all semesters). Eligibility shall be 40% in case of candidates belonging to SC/ST and OBC candidates from Karnataka.

UG 4.7. B.Sc. Graduates seeking admission under Lateral entry shall take up bridge Courses as prescribed in the Scheme of Teaching.

UG 5. ACADEMIC SESSION

UG 5.1. Each academic session is divided into two semesters of approximately sixteen Weeks duration and a summer term: an odd semester (August -December), an even semester (January - May) and summer term (Make-up term) June-July.

UG 5.2. The approved schedule of academic activities for a session, inclusive of dates for registration, mid-semester and end-semester examinations, vacation breaks, shall be laid down in the Academic Calendar for the session.

UG 6. CHANGE OF BRANCH

UG 6.1. Normally a candidate admitted to a particular branch of the undergraduate programme will continue studying in that branch till completion.

UG 6.2. However, in special cases, the University may permit a candidate to change from one branch of studies to another after the first two semesters. Such changes will be permitted, in accordance with the provisions laid down hereinafter.

UG 6.3. Only those candidates will be considered eligible for change of branch after the second semester, who have completed all the credits required in the first two semesters of their studies in their first attempt, without having to pass any course requirement in the summer term examination.

UG 6.4. Applications for a change of branch must be made by intending eligible candidates in the prescribed form. The academic section will call for applications at the end of second semester of each academic year and the completed forms must be submitted by the last date specified in the notification.

UG 6.5. Candidates may enlist their choices of branch, in order of preference, to which they wish to change over. It will not be permissible to alter the choices after the application has been submitted.

UG 6.6. Change of branch shall be made strictly in the order of merit of the applicants. For this purpose the CGPA obtained at the end of the second semester shall be considered. In case of a tie, SGPA of second semester followed by SGPA of first semester shall decide the tie.

UG 6.7. The applicants may be allowed a change in branch, strictly in order of merit, course to the limitation that the strength of a branch should not fall below the existing strength by more than ten percent and should not go above the sanctioned strength by more than ten percent. The minimum class strength of 75% should be maintained, while considering the change of branch.

UG 6.8. All changes of branch made in accordance with the above rules shall be effective from the third semester of the applicants concerned. No change of branch shall be permitted after this.

UG 7. COURSE STRUCTURE

UG 7.1. Medium of instruction, examination and project reports shall be in English except in case of any language audit courses.

UG 7.2. Teaching of the courses shall be reckoned in credits: Credits are assigned to the Courses based on the following general pattern:

(a) One credit for each lecture period.

(b) One credit for each tutorial period.

(c) One credit per two hours for each Laboratory or Practical or

work shop session.

(d) Credits for seminar, mini project, project as indicated in the scheme/curriculum of teaching.

UG 7.3. In order to qualify for a B. Tech. degree of the University, a candidate is required to complete the credit requirement as prescribed in the scheme/curriculum for a particular programme.

UG 7.4. The program of a study consists of the following components:

(i) Humanities and Social Sciences including Management courses
(ii) Basic Science courses
(iii) Engineering Science courses
(iv) Professional core courses
(v) Open Electives
(vi) Project work, seminar and internship
(vii) Mandatory/Audit Courses

UG 7.5. Every B. Tech. Programme shall have a curriculum and syllabi for the courses approved by the Board of Governors. Board of Studies will discuss and recommend the syllabi of all the under graduate courses offered by the department from time to time before sending the same to the Academic Council. Academic Council will consider the proposals from the Board of Studies and make recommendations to the Board of Management and Board of Governors for consideration and approval. For all approved courses, the copyright shall be with DSU.

UG 7.6. Faculty Advisor: To help the candidates in planning their courses of study and getting general advice on the academic programme, the concerned department will assign a Faculty Advisor to each candidate.

UG 8. REGISTRATION

UG 8.1. Every candidate is required to register for approved courses through the assigned Faculty Advisor at the end of previous semester or first week of the current semester, as notified by the Academic Calendar.

UG 8.2. The Dean may cancel the registration of one or more courses if they are found to violate some rules or if there are restrictions imposed due to disciplinary reasons.

UG 8.3. The student is permitted to drop a course/s from the registered courses, within 4 weeks after the start of the Semester/Year as notified in the academic calendar, with the permission of Faculty Advisor and Chairperson / Dean / Principal of the respective School/College and no mention will be made in the grade card for dropped courses.

UG 8.4. The student is permitted to withdraw course/s from the registered courses, within 4 weeks before the start of the Semester/Year End Examinations as notified in the academic calendar, with the permission of Faculty Advisor and Chairperson / Dean / Principal of the respective School / College and Grade "W" will be awarded for course/s that were withdrawn.

UG 8.5. For the courses with "W" grade, the students should re-register subsequently when offered, either in MOOCS or in-class or summer term and fulfill the passing criteria to secure a grade in that course for change from "W" grade.

UG 8.6. Only those candidates shall be permitted to register who have:

(a) The academic eligibility to move to higher semesters (UG 9 & UG 11)
(b) Cleared all University, Hostel and Library dues and fines (if any) of the previous semesters,
(c) Paid all required advance payments of University and Hostel dues for the current semester,
(d) Not been debarred from registering on any specific ground.
(e) A minimum CGPA of 4 in the previous semesters

UG 9. EXAMINATION: ASSESSMENT CRITERIA & ELIGIBILITYFOR PROGRESSION

Every student shall be assessed for eligibility to higher semester through Continuous Internal Assessment (CIA) and Semester End Examination (SEE) as prescribed.

UG 9.1. The Continuous Internal Assessment (CIA), shall normally be conducted by the assessment components spread through the running semester; the components of CIA may be tests, mid-term exam, quiz, term paper, simulation-based problem solving, open-book test, solving open-end problems, miniprojects, seminars, viva-voce, awarding marks for attendance and such activities that enhance original thinking of students. The Course instructor shall announce the detailed methodology for conducting the various components of CIA together specifying component-wise weightages right in the commencement of each semester.

UG 9.2. The Semester End Examinations (SEE), shall be conducted at the end of each semester. The SEE components may be a closed or open book examination, project demo, viva-voce, and/or a portfolio presentation.

UG 9.3. CIA and SEE shall respectively have 60:40 percent weightage. The ViceChancellor, on the recommendations of the Dean of Faculty and Department Chair, in exceptional cases, may approve the variation in this weightage ratio.

UG 9.4. The performance of a student with respect to a course in a semester shall be the combined score of marks/points, he/she secures in CIA and SEE, put together. A minimum of securing 40% marks, combining both the CIA with SEE marks secured with respect to a course, shall entail the student a PASS in the course. The Vice-Chancellor, in such cases where the entire class has fared poorly in the course, upon receiving a representation by the students / department, and based on the recommendations of the committee constituted for the purpose, may review the criterion of 40%.

UG 9.5. ATTENDANCE ELIGIBILITY

UG 9.5.1. Candidates are required to attend all the classes (Lectures, Tutorials, Practical, Workshop Practice, etc.) for which they have been registered.

UG 9.5.2. The candidate shall not be allowed to appear for the end semester examination if his/her attendance falls below 85% in each course and shall be awarded a “NE” grade in that course.

UG 9.5.3. A provision for condonation of 10% of the attendance by the Vice-Chancellor on the specific recommendation of the chairman of the department and Dean, showing reasonable cause such as:

(a) Any medical emergencies/ illness where the candidate requires rest for the specified number of days certified by a Government Doctor only /any death in the family (near and dear ones).

(b) If the student represents the University in Sports/ Cultural Activities/Extra- curricular activities/Co-curricular activities.

(c) If a student presents a Paper in National/ International Conferences or attends any recognized Workshops/Seminars.

UG 9.5.4. If the period of leave is for a short duration (less than two weeks), prior application for leave shall have to be submitted to the Chairman of the Department concerned stating fully the reasons for the leave requested for along with supporting document(s). Such leave will be granted by the Chairman of the Department. However the student shall comply with 9.5.2 and 9.5.3.of regulations.

UG 9.5.5. If the period of absence is likely to exceed two weeks, a prior application for grant of leave will have to be submitted through the Chairman of the Department to the Dean with supporting documents in each case. The decision to grant leave shall be taken by the Dean on the recommendation of the Chairman of the Department. However the student shall comply with 9.5.2 and
9.5.3.of regulations.

UG 9.5.6. It shall be the responsibility of the candidate to intimate the concerned course instructor(s) regarding his/her absence before availing the leave.

UG 9.6 .CONTINUOUS INTERNAL ASSESSMENT

UG 9.6.1. Candidate shall participate in all components of Continuous Internal Assessment (CIA) to become eligible to take Semester End Examination or else 'NE' grade shall be awarded. However, the Vice-Chancellor, under exce circumstances on the recommendations of Dean of Faculty and Department Chair, may exempt a student from partic in CIA component/s and permit taking up SEE.

UG 9.6.2. There shall be no marks improvement of Continuous Internal Assessment; however, the withdrawal and re-registering of the course shall be permitted.

UG 9.6.3. Continuous Evaluation consists of:

UG 9.6.3.1. Under normal circumstances for theory courses, total CIA weightage shall be a total of 60%, put together all components with varying weightages; Under exceptional circumstances with the approval of the Vice-Chancellor on the recommendation of Dean of the School, the

weightage of CIA may be lower/higher than 60% .

The components of CIA may be tests, mid-term exam, quiz, term paper, simulation based problem solving, open-book test, solving open-end problems, mini-projects, seminars, viva-voce, awarding marks for attendance and such activities that enhance original thinking of students.

UG 9.6.3.2 Under normal circumstances for the practical courses (laboratory, workshops, and any such hands-on activity), total CIA weightage shall be a total of 60%, put together all components with varying weightages; Under exceptional circumstances with the approval of the Vice-Chancellor on the recommendation of Dean of the School, the weightage of CIA may be lower/higher than 60% .

CIA may have components such as conduction of an experiment, record writing, viva-voce, tests, simulation, mid-term exam, quiz, demo, term paper, mini-projects, seminars, marks for attendance and activities which enhances original thinking of students.

UG 10. GRADING

UG 10.1 There shall be continuous assessment of a candidate's performance throughout the semester and grades shall be awarded by the concerned course instructor and/or the appropriate committee appointed for this purpose on the following basis.

UG 10.2 The grading will normally be based on CIA and SEE.

UG 10.3. Practical Courses/ Work Shop Practice: The evaluation will be based on instructor's continuous internal assessment, a test and end semester examination.

UG 10.4. The weightage assigned to different components of continuous internal assessment will be announced by the concerned instructor(s) in the beginning of the semester.

UG 10.5. The results of performance of the candidates in the Continuous Internal assessment Test shall be announced by the instructors.

UG 10.6. In case of seminar, evaluation will be as determined by the grade awarding Committee (as per the Program scheme).

UG 10.7. Mini project /projects will be based on Continuous evaluation by Guide(s) and Semester End Examination(as per the Program scheme).

UG 10.8. The results of performance of the candidates shall be announced by the Controller of Examinations.

UG 10.9. METHOD OF AWARDING LETTER GRADES

UG 10.9.1. Relationships among Grades, Grade points and % of marks are listed in Table1.

UG 10.10. DESCRIPTION OF GRADES

UG 10.10.1 Table 1 shows the relationships among the grades, grade points and percentage of marks.

Table 1: Grade, Points, Grade Description and % of marks

GRADE	GRADE POINTS	DESCRIPTION	% MARKS
O	10	Outstanding	90 to 100
A+	9	Excellent	80 to 89
A	8	Very Good	70 to 79
B+	7	Good	60 to 69
B	6	Above Average	55 to 59
C	5	Average	50 to 54
P	4	Pass	40 to 49
F	0	Fail	< 40
AP	-	Audit Pass	-
AF	-	Audit Fail	-
IC	-	In Complete	-
NE	-	Not Eligible	-
W	-	Withdrawn	-

UG 10.10.2. A student will have to ensure a minimum CGPA of 4, to become eligible for the award of the degree.

UG 10.10.3. A candidate shall have to repeat all courses in which he/she obtains 'F' Grades until a passing grade is obtained.

UG 10.10.4. An IC grade denotes incomplete performance in any Theory and/or Practical Assessment. It may be awarded in case of absence on medical grounds or other special circumstances for SEE. Requests for IC grade should be made at the earliest but not later than the last day of SEE.

UG 10.10.5. The student can appear for the course/s with IC grade, when exams are conducted subsequently by the University for those Courses.

UG10.11.EVALUATION OF PERFORMANCE

UG10.11.1. The performance of a candidate shall be evaluated in terms of the Semester Grade Point Average (SGPA) which is the Grade Point Average for a semester, Cumulative Grade Point Average (CGPA) which is the Grade Point Average for all the completed semesters.

UG 10.11.2. The Earned Credits (EC) are defined as the sum of course credits for courses in which candidates have been awarded grades between O to P. (Table 1)

UG 10.11.3. Points earned in a semester = (Course credits X Grade point) for Grades O - P

UG 10.11.4. The SGPA is calculated on the basis of grades obtained in all courses, except audit courses and courses in which F grade or below, registered for in the particular semester.

$$\text{SGPA} = \frac{\text{Points secured in the semester (O} - \text{P Grades)}}{\text{Credits registered in the semester, excluding audit}}$$

UG 10.11.5. The CGPA is calculated on the basis of all pass grades, except audit courses .

$$\text{CGPA} = \frac{\text{Cumulative points secured in all the passed courses (O – P Grades)}}{\text{Cumulative registered credits, excluding audit}}$$

UG 10.12. WITHHOLDING OF GRADES

UG 10.12.1. Grades shall be withheld when the candidate has not paid his/her dues or when there is a disciplinary action pending against him/her

UG 10.13. CONVERSION OF CGPA INTO PERCENTAGE

UG 10.13.1. Conversion formula for the conversion of CGPA into percentage is

Percentage of Marks Scored = (CGPA Earned − 0.75) × 10

UG 11. PROMOTION CRITERIA AND ENROLLMENTS TO HIGHER SEMESTERS

UG 11.1. During registration to the higher semesters, the following criteria/conditions for promotion, shall be satisfied.

UG 11.1.1. A student shall 'Not Eligible' (NE) for writing SEE if he/she does not comply to

the minimum prescribed attendance in any course that carry a credit.

Students shall register afresh for such course/s, whenever offered next, to meet the attendance requirements and secure a pass grade, subsequently in that course/s.

UG 11.1.2. In a semester (ODD / EVEN), a student is deemed to be Not Eligible (NE) if he/she does not satisfy minimum attendance requirements criteria in a credit course.

If this course happens to be a prerequisite to a connected course in the subsequent semester, then the student shall not be permitted to register for that connected course until he / she secures pass grade in the prerequisite course by complying to the minimum attendance requirement when the prerequisite course is offered next (either during summer term or regular semester).

UG 11.1.3. A student shall be permitted to register for FOUR credited courses or to a total of 16 credits whichever is higher along with pending audit courses, if any, during a summer term by paying the prescribed course registration fee per credit notified by the university from time to time.

UG 11.1.4. The students with NE ('NOT ELIGIBLE' due to shortage in attendance) in any Credit Course/s other than Audit Courses in a semester shall have to secure a pass grade by compliance to minimum attendance requirements in the NE course to register for connected courses if NE course happens to be prerequisite course for those connected courses offered in the subsequent semesters.

UG 11.1.5. Candidates who secure 'F' grade in any courses in regular semester or summer term shall secure PASS grade in such course/s either in the subsequent summer term examination or shall repeat in the next appropriate semester whenever it is/they are offered, i.e. odd semester courses during odd semesters examinations and even semester courses during even semester examinations, respectively.

UG 11.2. In case of failure in Practical/Workshop practice course the candidate in any semester may clear it in the subsequent summer term examination or semester examination.

UG 11.3. In case a candidate fails in Practical/ Workshop practice he/she shall register when it is offered next either in the summer term or subsequent semester, as the case may be.

UG 11.4. Candidates may add and drop course(s) with the concurrence of the Faculty Advisor, and under intimation to the concerned course instructors and the academic section provided this is done within the date mentioned in the Academic Calendar.

UG 11.5. SUMMER TERM & MAKEUP EXAMINATIONS

UG 11.5.1. A summer term program may be offered by a department and with the approval of the Dean.

UG 11.5.2. Summer term courses will be announced by the Academic Affairs Office at the end of the even semester and before the commencement of the end semester examination. A candidate will have to register for summer term courses by paying the prescribed fees within the stipulated time in the announcement.

UG 11.5.3. The total number of contact hours in any summer term program will be the same as in the regular semester course. The assessment procedure in a summer term course will also be similar to the procedure for a regular semester course.

UG 11.5.4. Candidates granted semester drop by the Board of Governors, on medical ground, shall be allowed to clear the concerned courses in summer term course and subject to conditions as stated under clauses 11.5.1, 11.5.2.and 11.5.3.

UG 11.5.5. The Candidates with "NE" grade shall register for summer term by paying the prescribed fees.

UG 11.5.6. Candidates who are awarded 'F' grades in regular semester examinations have the option to register for the concerned courses in summer term examinations to the conditions as stated under clauses 11.5.1, 11.5.2.and 11.5.3above, or they can re-sit for subsequent semester/summer term examination only.

UG 11.5.7. Provision for make-up exam shall be available to the students who might have missed to attend the Semester / Annual end examinations of one or more courses for exceptional cases arising out of natural calamities / medical emergencies / death of a member in the family, with the permission of Faculty Advisor and Chairperson / Dean / Principal of the respective School/College. All such cases have to be exclusively to be approved by the Vice-Chancellor and ratified in the Academic Council / BOM / BOG. All such courses approved for makeup examinations are awarded a transitory grade "IC" (incomplete grade)

UG 11.5.8. The makeup examinations shall be held as notified in the academic calendar or through an exclusive notification duly approved by the Vice-chancellor.

UG 12. DURATION OF THE PROGRAMME

UG 12.1. Normally a candidate should complete all the requirements for undergraduate programme in four years. However, academically weaker candidates who do not fulfil some of the requirements in their first attempt and have to repeat them in subsequent semesters may be permitted up to eight consecutive years (from the first year of registration) to complete all the requirements of the degree.

UG 12.2. Normally a candidate under lateral entry should complete all the requirements for undergraduate programme in three years. However, academically weaker candidates who do not fulfil some of the requirements in their first attempt and have to repeat them in subsequent semesters may be permitted up to six consecutive years (from the second year registration) to complete all the requirements of the degree.

UG 13. TERMINATION FROM THE PROGRAMME

UG 13.1. A candidate may also be compelled to leave the Program in the University on disciplinary grounds.

UG 13.2. On having been found to have produced false documents or having made false declaration at the time of seeking admission.

UG 13.3. On having been found to be pursuing regular studies and/or correspondence courses (leading to degree or diploma) in any other college, university or an educational institution simultaneously.

UG 13.4. On having been found to be concurrently employed and performing duty or carrying out business in contravention to academic schedules of the University and without seeking approval from the University.

UG 13.5. If a student fails to earn a pass grade even after 4 attempts such a student is terminated from the university on the grounds of NOT FIT FOR THE PROGRAM (NFFTP).

UG 13.6. If a student secures a CGPA less than 4.0 , 4 times during entire duration of the program of study, such a student is terminated from the university on the grounds of NOT FIT FOR THE PROGRAM (NFFTP).

UG 13.7. However, if the student appeals for reconsideration of termination from the university under NFFTP rule by providing the guanine reasons to the ViceChancellor through the Dean of Faculty, then the Vice-Chancellor may consider constituting a committee for the purpose of review and provide 2 additional attempts on the recommendations of the committee .

UG 14. TEMPORARY WITHDRAWAL FROM THE UNIVERSITY

UG 14.1. Candidate who has been admitted to an undergraduate programme of the University may be permitted to withdraw temporarily from the University on the grounds of prolonged illness or grave calamity in the family for a period of one semester or more, provided:

UG 14.1.1. He/she applies to the University within at least 6 weeks of the commencement of the semester or from the date he last attended his/her classes whichever is later, stating fully the reasons for such withdrawal together with supporting documents and endorsement of his/her guardian.

UG 14.1.2. The University is satisfied that, counting the period of withdrawal, the candidate is likely to complete his/her requirements of the B. Tech. Degree within the time limits specified in Clause 12.1 or 12.2 above.

UG 14.1.3. There are no outstanding dues or demands in the University/Hostel/Department/ Library.

UG 14.1.4. Normally, a candidate will be permitted only one such temporary withdrawal during his/her tenure as a candidate of the undergraduate programme.

UG 15. TRANSFER OF CANDIDATES

UG 15.1. Transfer of candidates from higher education institutions outside University shall be considered at the beginning of Third and Fifth Semesters but subject to confirmation of equivalence.

UG 15.2. The candidates shall apply for equivalence with the No-objection for admission to DSU from the University where they are perusing their study.

UG 15.3. The candidates must have passed in all courses in the earlier semesters prior to transfer.

UG 16. ELIGIBILITY FOR THE AWARD OF B. TECH. DEGREE

A candidate shall be declared to be eligible for the award of B. Tech. degree if he/she has:

UG 16.1. Completed all the credit requirements for the degree with a CGPA 4.0 or higher at the end of the programme.

UG 16.2. Satisfactorily completed all the mandatory audit courses.

UG 16.3. No dues to the University, Department, Hostels.

UG 16.4. No disciplinary action pending against him/her.

UG 17. AWARD OF DEGREE

The award of B. Tech. degree must be recommended by the Academic Council and approved by the Board of Management and Board of Governors of the DSU.

UG 18.CONDUCT AND DISCIPLINE

UG 18.1. Candidates shall conduct themselves within and outside the precincts of the University in a manner befitting the candidates of an institution of national importance. The University has a separate ordinance Code and Conduct of Candidates which is applicable to all candidates of the University.

UG 19. REPEAL AND SAVINGS

Notwithstanding anything contained in these Regulations, the provisions of any guidelines, orders, rules or regulations in force at the University shall be inapplicable to the extent of their inconsistency with these Regulations. The Academic Council, Board of Management and Board of Governors of Dayananda Sagar University may revise, amend or change the regulations from time to time.

UG 20. INTERPRETATION

Any questions as to the interpretation of these Regulations shall be decided by the University, whose decision shall be final. The University shall have the powers to issue clarifications to remove any doubt, difficulty or anomaly which may arise during the implementation of the provisions of these regulations.

Computer Science and Engineering

(Artificial Intelligence and Machine Learning)

Program Educational Objectives (PEO's)

- **PEO1.** Promote design, research, product implementation and services in the field of Artificial Intelligence Engineering through strong technical, communication and entrepreneurial skills
- **PEO2.** Engage to work productively as design and development Engineers, cater to supportive and leadership roles in multidisciplinary domains.
- **PEO3.** Learn and advance their careers by attaining professional certification and seeking higher education.
- **PEO4.** Possess skill in AI & ML expertise ready to serve the society locally and internationally.

Programme Outcome (PO's)

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

- **PO6. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- **PO7. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **PO8. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **PO9. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- **PO10. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **PO11. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- **PO12. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSO's)

- **PSO1.** Apply the principal concepts of AI Engineering to design, develop, deploy and prototype AI Subsystems
- **PSO2.** Apply the knowledge gained pertaining to data storage, data analytics and AI concepts to solve real world business problems.
- **PSO3.** Apply, analyse, design, develop, and test principles of AI concepts on Intelligent Systems.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Artificial Intelligence & Machine Learning)

AIML FRATERNITY

SL.NO.	NAME	DESIGNATION
1	DR. JAYAVRINDA VRINDAVANAM V	PROFESSOR AND CHAIRPERSON
2	DR. RANGARAJ	RESEARCH PROFESSOR
3	PROF. SANJEEV KUMAR	PROFESSOR OF PRACTICE
4	DR. VINUTHA N	ASSOCIATE PROFESSOR
5	DR. MONIKA GOYAL	ASSISTANT PROFESSOR
6	DR. PIYALI DATTA	ASSISTANT PROFESSOR
7	PRADEEP KUMAR K	ASSISTANT PROFESSOR
8	UDAYABHASKARA N	ASSISTANT PROFESSOR
9	MARY JASMINE	ASSOCIATE PROFESSOR
10	SWETHA C B	ASSISTANT PROFESSOR
11	JEEVARAJ R	ASSISTANT PROFESSOR
12	APARAJITA SINHA	ASSISTANT PROFESSOR
13	J.RAJALEKSHMI	ASSISTANT PROFESSOR
14	MITHAGURU	ASSISTANT PROFESSOR
15	PAVITHRA A	ASSISTANT PROFESSOR
16	RAKSHITA R	ASSISTANT PROFESSOR
17	AYAIN JOHN	ASSISTANT PROFESSOR

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

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SCHEME - B.TECH – 2020-21 ONWARDS

I SEM - CHEMISTRY CYCLE

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	CR / AU	SCHEME OF TEACHING					PREREQUISITE	
					L	T	P	S/ P	C	SEM	COURSE CODE
1	101-105 & 121-123	20EN1101	ENGINEERING MATHEMATICS – I	CR	03	01	--	--	04	*	***
2	101-105 & 1 121-123	20EN1102	ENGINEERING CHEMISTRY	CR	03	--	02	--	04	*	***
3	101-105 & 121-123	20EN1103	FUNDAMENTALS OF PROGRAMMING	CR	03	--	04	--	05	*	***
4	101-105 & 121-123	20EN1104	BASIC ELECTRICAL ENGINEERING	CR	03	--	--	--	03	*	***
5	101-105 & 121-123	20EN1105	ENVIRONMENTAL STUDIES	CR	02	--	--	--	02	*	***
6	101-105 & 121-123	20EN1106	ELEMENTS OF MECHANICAL ENGINEERING	CR	02	--	02	--	03	*	***
					16	**01**	**08**	**--**	**21**		

7	101-105 & 121-123	20AU0004	CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS	AU	02	--	--	--	--	*	***

CR – Credit, AU – Audit, L – Lecture, T – Tutorial, P – Practical, S/P – Seminar/Project, C – No. of Credits

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

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SCHEME - B.TECH – 2020-21 ONWARDS

I SEM - PHYSICS CYCLE

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	CR / AU	SCHEME OF TEACHING					PREREQUISITE	
					L	T	P	S/ P	C	SEM	COURSE CODE
1	101-105 & 121-123	20EN1101	ENGINEERING MATHEMATICS – I	CR	03	01	--	--	04	*	***
2	101-105 & 121-123	20EN1107	ENGINEERING PHYSICS	CR	03	--	02	--	04	*	***
3	101-105 & 121-123	20EN1108	BASIC ELECTRONICS	CR	03	--	02	--	04	*	***
4	101-105 & 121-123	20EN1109	BIOLOGICAL SCIENCES	CR	02	--	--	--	02	*	***
5	101-105 & 121-123	20EN1110	TECHNICAL COMMUNICATION	CR	02	--	02	--	03	*	***
6	101-105 & 121-123	20EN1111	ENGINEERING GRAPHICS & DESIGN	CR	01	--	04	--	03	*	***

7	101-105 & 121-123	20EN1112	DESIGN THINKING & INNOVATION	CR	--	--	02	--	01	*	***
					14	**01**	**12**	**--**	**21**		
8	101-105 & 121-123	20AU0021	KANNADA KALI – II	AU	02	--	--	--	--	*	***
		20AU0025	KANNADA MANASU – II	AU	02	--	--	--	--	*	***

CR – Credit, AU – Audit, L – Lecture, T – Tutorial, P – Practical, S/P – Seminar/Project, C – No. of Credits

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SCHEME - B.TECH – 2020-21 ONWARDS

II SEM - PHYSICS CYCLE

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	CR / AU	SCHEME OF TEACHING					PREREQUISITE	
					L	T	P	S/ P	C	SEM	COURSE CODE
1	101-105 & 121-123	20EN1201	ENGINEERING MATHEMATICS – II	CR	03	01	--	--	04	*	***
2	101-105 & 121-123	20EN1107	ENGINEERING PHYSICS	CR	03	--	02	--	04	*	***
3	101-105 & 121-123	20EN1108	BASIC ELECTRONICS	CR	03	--	02	--	04	*	***
4	101-105 & 121-123	20EN1109	BIOLOGICAL SCIENCES	CR	02	--	--	--	02	*	***
5	101-105 & 121-123	20EN1110	TECHNICAL COMMUNICATION	CR	02	--	02	--	03	*	***
6	101-105 & 121-123	20EN1111	ENGINEERING GRAPHICS & DESIGN	CR	01	--	04	--	03	*	***

7	101-105 & 121-123	20EN1112	DESIGN THINKING & INNOVATION	CR	--	--	02	--	01	*	***
					14	**01**	**12**	**--**	**21**		
9	101-105 & 121-123	20AU0021	KANNADA KALI	AU	02	--	--	--	--	*	***
		20AU0025	KANNADA MANASU	AU	02	--	--	--	--	*	***

CR – Credit, AU – Audit, L – Lecture, T – Tutorial, P – Practical, S/P – Seminar/Project, C – No. of Credits

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SCHEME - B.TECH – 2019 -20 ONWARDS

II SEM - CHEMISTRY CYCLE

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	CR / AU	SCHEME OF TEACHING					PREREQUISITE	
					L	T	P	S/ P	C	SEM	COURSE CODE
1	101-105 & 121-123	20EN1201	ENGINEERING MATHEMATICS – II	CR	03	01	--	--	04	*	***
2	101-105 & 121-123	20EN1102	ENGINEERING CHEMISTRY	CR	03	--	02	--	04	*	***
3	101-105 & 121-123	20EN1103	FUNDAMENTALS OF PROGRAMMING	CR	03	--	04	--	05	*	***
4	101-105 & 121-123	20EN1104	BASIC ELECTRICAL ENGINEERING	CR	03	--	--	--	03	*	***
5	101-105 & 121-123	20EN1105	ENVIRONMENTAL STUDIES	CR	02	--	--	--	02	*	***
6	101-105 & 121-123	20EN1106	ELEMENTS OF MECHANICAL ENGINEERING	CR	02	--	02	--	03	*	***
					16	**01**	**08**	**--**	**21**		

7	101-105 & 121-123	20AU0004	CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS	AU	02	--	--	--	--	*	***

CR – Credit, AU – Audit, L – Lecture, T – Tutorial, P – Practical, S/P – Seminar/Project, C – No. of Credits

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

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SEMESTER/YEAR : I SEM
COURSE CODE : 20EN1101
TITLE OF THE COURSE : ENGINEERING MATHEMATICS – I
L: T/A: P: C : 3 : 1 : 0 : 4

Course Objectives

1. Understanding basic concepts of linear algebra to illustrate its power and utility through applications to science and Engineering.
2. Apply the concepts of vector spaces, linear transformations, matrices and inner product spaces in engineering.
3. The course is discussed with algebraic as well as geometric perspectives.
4. Solve problems in cryptography, computer graphics and wavelet transforms.

Expected Course Outcomes

At the end of this course the students are expected to learn

1. the abstract concepts of matrices and system of linear equations using decomposition methods
2. the basic notion of vector spaces and subspaces
3. apply the concept of vector spaces using linear transforms which is used in computer graphics and inner product spaces
4. applications of inner product spaces in cryptography

Student Learning Outcomes

1. Having an ability to apply knowledge or Mathematics in Science and Engineering
2. Having a clear understanding of the subject related concepts and of contemporary issues .
3. Having computational thinking

Module: 1 LINEAR EQUATIONS 8 hours

Introduction - The Geometry of Linear Equations - Row reduction and echelon forms- Gaussian Elimination - Solution sets of linear equations – LU decomposition - Inverse of a matrix by Gauss Jordan method.

Self Learning Component : Algebra of Matrices.

Module: 2 VECTOR SPACES AND SUBSPACES 8 hours

Linear spaces – Subspaces - Linear independence – Span - Bases and Dimensions -Finite dimensional vector space.

Self Learning Component : Examples of vector spaces and subspaces, Rank of a matrix.

Module3 LINEAR TRANSFORMATIONS AND ORTHOGONALITY 8 hours

Linear transformations – Basic properties - Invertible linear transformation - Matrices of linear transformations - Vector space of linear transformations – change of bases – Orthogonal Vectors - Projections onto Lines - Projections and Least Squares - The Gram-Schmidt Orthogonalization process.
Self Learning Component: Inner Products

Module 4 EIGEN VALUES AND EIGEN VECTORS 10 hours
Introduction to Eigen values and Eigen vectors - Diagonalization of a Matrix- Diagonalization of symmetric matrices - Quadratic forms - Singular Value Decomposition - QR factorization.
Self Learning Component : Determinant and Properties of Eigen values and Eigen vectors

Module 5 APPLICATIONS OF LINEAR EQUATIONS 6 hours
An Introduction to coding - Classical Cryptosystems –Plain Text, Cipher Text, Encryption, Decryption and Introduction to Wavelets from Raw data – curve fitting

Contemporary Issues
Industry Expert Lecture

Tutorial
- Variety of minimum 10 problems to be worked out by students in every Tutorial Class **12 hours**
- Another set of 5 problems per Tutorial Class to be given for self solving.

Text Book(s)

1. D C Lay, S R Lay and JJMcDonald, Linear Algebra and its Applications, Pearson India, Fifth edition.
2. Linear Algebra and its Applications by Gilbert Strang, 4 th Edition, Thomson Brooks/
   Cole, Second Indian Reprint 2007.
3. Introductory Linear Algebra- An applied first course, Bernard Kolman and David, R. Hill, 9th Edition, Pearson Education, 2011.

Reference Books

1. Introduction to Linear Algebra, Gilbert Strang, 5th Edition, Cengage Learning (2015).
2. Higher Engineering Mathematics by B S Grewal, 42 nd Edition, Khanna Publishers.
3. Elementary Linear Algebra, Stephen Andrilli and David Hecker, 5th Edition, Academic Press(2016)
4. Contemporary linear algebra, Howard Anton, Robert C Busby, Wiley 2003

SCILAB components

There will be a computational component to the course, using a mix of computational packages like SCILAB to solve engineering problems using the mathematical concepts developed in the course :

1. Gaussian Elimination
2. The LU Decomposition
3. Inverse of a Matrix by the Gauss- Jordan Method, curve fitting
4. The Span of Column Space of a Matrix
5. Fundamental Subspaces
6. Projections by Least Squares
7. The Gram-Schmidt Orthogonalization
8. Eigen values and Eigen Vectors of a Matrix
9. The Largest Eigen Value of a Matrix by the Power Method
10. Singular value decomposition

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
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SEMESTER/YEAR : II SEM
COURSE CODE : 20EN1201
TITLE OF THE COURSE : ENGINEERING MATHEMATICS – II
L: T/A: P: C : 3 : 1 : 0 : 4

Course Objectives

1. To provide the requisite and relevant background necessary to understand the other important engineering mathematics courses offered for Engineers and Scientists.
2. To introduce important topics of applied mathematics, namely Single and Multivariable Calculus and Vector Calculus etc.
3. To impart the knowledge of Laplace transform, an important transform technique for Engineers which requires knowledge of integration

Expected Course Outcomes

At the end of this course the students should be able to

1. apply single variable differentiation and integration to solve applied problems in engineering and find the maxima and minima of functions
2. evaluate partial derivatives, limits, total differentials, Jacobians, Taylor series and
   optimization problems involving several variables with or without constraints
3. evaluate multiple integrals in Cartesian, Polar, Cylindrical and Spherical coordinates.
4. understand gradient, directional derivatives, divergence, curl and Greens', Stokes, Gauss
   theorems

Student Learning Outcomes

1.Having an ability to apply mathematics and science in engineering applications
2.Having a clear understanding of the subject related concepts and of contemporary issues
3.Having problem solving ability- solving social issues and engineering problems

Module: 1 Application of Single Variable Differential Calculus 8 hours

Differentiation- Extrema on an Interval-Rolle's Theorem and the Mean Value Theorem - Increasing and Decreasing functions and First derivative test-Second derivative test-Maxima and Minima-Concavity.
Integration-Average function value - Area between curves - Volumes of solids of revolution - Beta and Gamma functions

Module: 2 MULTI VARIABLE DIFFERENTIAL CALCULUS 8 hours

Functions of two or more real variables, Partial derivatives of second and higher order, Euler's theorem on homogenous function, Total derivatives, Differentiation of composite and implicit functions, Change of variable, Jacobians, Maxima and minima of functions of two or more variable, Lagrange's method of undetermined multipliers, Taylor's formula for two variables

Module 3 MULTI VARIABLE INTEGRAL CALCULUS 8 hours

Double integrals, Triple integrals, Change of order of integration in a double integral, Change of variables in double and triple integrals, Area as a double integral, Volume as a triple integral, Line integrals, Vector Fields and Line integrals.

Module 4 VECTOR CALCULUS 10 hours

Scalar and vector valued functions – gradient, tangent plane–directional derivative-divergence and curl–scalar and vector potentials-Simple problems
Line integral- Surface integral - Volume integral - Path independence- Green's theorem-Stoke's Theorem- Divergence Theorem

Module 5 LAPLACE TRANSFORM 6 hours

Basic concepts, Linearity and First shifting theorem, Laplace transforms of derivatives and integrals, Second shifting theoerem, Initial and Final value theorems, Some basic transforms, Inverse Laplace transform, Convolution theorem, Applications to differential equations.

Tutorial
- Variety of minimum 10 problems to be worked out by students in every Tutorial Class **12 hours**
- Another set of 5 problems per Tutorial Class to be given for self solving.

Text Book(s)

1. Thomas' Calculus, George B.Thomas, D.Weir and J. Hass, 2014, 13th edition, Pearson.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 2015, 10th Edition, Wiley India.

Reference Books

1. Higher Engineering Mathematics, B.S. Grewal, 2015, 43rd Edition, Khanna Publishers.
2. Higher Engineering Mathematics, John Bird, 2017, 6 th Edition, Elsevier Limited.
3. Calculus: Early Transcendentals, James Stewart, 2017, 8 th edition, Cengage Learning.
4. Engineering Mathematics, K.A.Stroud and Dexter J. Booth, 2013, 7 th Edition, Palgrave Macmillan.

SCILAB components

There will be a computational component to the course, using a mix of computational packages like SCILAB to solve engineering problems using the mathematical concepts developed in the course :

1. Plotting and visualizing curves
2. Plotting and visualizing surfaces
3. Evaluating Extremum of a single variable function
4. Evaluating maxima and minima of functions of several variables
5. Tracing of curves
6. Applying Lagrange multiplier optimization method
7. Line integral
8. Surface integral
9. Volume integral
10. Solving Differential equation using Laplace transform

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Artificial Intelligence & Machine Learning)

SEMESTER/YEAR : II SEM / I
COURSE CODE : 20EN1102
TITLE OF THE COURSE : ENGINEERING CHEMISTRY
L: T/A: P: C : 3 : 0 : 2 : 4

Course learning objectives:

The Theory Course intends to provide chemical concepts most relevant to engineering students and demonstrate them in an applied context. The student is exposed to the principles required to understand important contemporary topics like alternate energy sources, corrosion control, polymer technology, phase equilibria nanomaterials and green chemistry and catalysis. The underlying theme is to emphasize on applications of these concepts to real world problems

Course outcome:

- Appreciate the basic principles of electrochemistry, use of different types of electrodes in analysis and evaluate cell potential for different cell reactions.
- Know construction, working and applications of various energy storage devices such as batteries, fuel cells and supercapacitors.
- Understand basic principles of corrosion and apply suitable techniques for corrosion control. Also know the technological importance and processes involved in metal finishing.
- Understand and interpret phase equilibria of one and two-component systems.
- Know the synthesis, structure –property relationship and applications of commercially important polymers and polymer composites. Understand properties and applications of nanomaterials. Also learn the principles of green chemistry for a sustainable and eco-friendly world.

Engineering Chemistry (Theory –Syllabus) **Total: 52 Hrs**

Module 1

Chemical Energy Source:

- Introduction to energy; Fuels - definition, classification, importance of hydrocarbons as fuels; Calorific value-definition, Gross and Net calorific values (SI units). Determination of calorific value of a solid / liquid fuel using Bomb calorimeter. Numerical problems on GCV&NCV. Petroleum cracking-fluidized catalytic cracking. Reformation of petrol. octane number, cetane number, anti-knocking agents, power alcohol, Biodiesel & Biogas-Dry gas harvesting and its efficiency.

Note: Video lecture on
(i) Fractional distillation of crude petroleum
(ii) Biogas
(iii) Biodiesel

Solar Energy:

- Thermal energy: Photovoltaic cells- Introduction, definition, importance, working of PV cell. Solar grade silicon physical and chemical properties relevant to photo-voltaics, doping of silicon by diffusion technique.

Module 2
Energy Science and Technology

- Single electrode potential - Definition, origin, sign conventions. Standard electrode potential- Definition-Nernst equation expression and its Applications. EMF of a cell-Definition, notation and conventions. Reference electrodes– Calomel electrode, Ag/AgCl electrode. Measurement of standard electrode potential. Numerical problems on electrode potentials and EMF. Ion-selective electrode- glass electrode-Derivation electrode potential of glass electrode
- Battery technology: Basic concepts including characteristics of anode, cathode, electrolyte and separator. Battery characteristics. Classification of batteries–primary, secondary and reserve batteries. State of the art Batteries-Construction working and applications of Zn-air, Lead acid battery, Nickel-Metal hydride and Lithium ion batteries.
  Introduction to fuel cells, types of fuel cells. Construction, working and application of Methanol-Oxygen fuel cell.

Module 3
Corrosion Science:

- Definition, Chemical corrosion and Electro-chemical theory of corrosion, Types of corrosion, Differential metal corrosion, Differential aeration corrosion (pitting and water line corrosion), Stress corrosion. Factors affecting the rate of corrosion, Corrosion control: Inorganic coatings-Anodization. Metal coatings-Galvanization, Tinning and its disadvantages. Cathodic protection of Corrosion: Sacrificial anode method and current impression method.

Surface Modification Techniques:

- Definition, Technological importance of metal finishing. Significance of polarization, decomposition potential and over-voltage in electroplating processes. Electroplating of Chromium. Electroless Plating. Distinction between electroplating and Electroless plating, advantages of electroless plating. Electroless plating of copper.

Note: Video lecture on surface modification using polymer

Module: 4

- **High Polymers:** Introduction to polymers, Glass transition temperature, structure and property relationship. Synthesis, properties and applications of Teflon. PMMA. Elastomers - Deficiencies of natural rubber and advantages of synthetic rubber. Synthesis and application of silicone rubber, Conducting polymers-Definition, mechanism of conduction in polyacetylene. Structure and applications of conducting Polyaniline.
- **Nanotechnology:** Introduction, properties, synthesis by sol-gel. Fullerenes, Carbon nanotubes, dendrimers and nano-composites-metal oxide-polymer nano-composite

  Note: Video lecture on metal oxide-polymer nano-composite.
- **Advances in engineering chemistry**: Synthesis of carbon and sulphur containing compounds.

Module: 5

- **Water Technology:** Impurities in water. Hardness of Water: Types of Hardness and determination of total hardness of water by using disodium salt of ethylenediaminetetraacetic acid method. Alkanity. Potable water treatment by Electro dialysis and Reverse Osmosis. Water analysis- Biochemical oxygen demand and Chemical oxygen demand. Determination of COD. Numerical problems on COD. Sewage treatment, problems on quantity of flocculent required in sewage treatment. Principle and applications of green chemistry
- **Instrumental Methods of Analysis:**
  Instrumental methods of analysis, Principles of spectroscopy-Beer's Lamberts law, Difference between spectrometer and spectrophotometer, Potentiometry, Conductometry (Strong acid against strong base, weak acid against strong base, mixture of strong acid and a weak acid against strong base) and viscometer.

Text Books

1. Dr. S. Vairam, Engineering Chemistry, Wiley-India Publishers, 2017,

2. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 2015

Reference Books

1. Prasanta Rath, "Engineering Chemistry", Cengage Learning India PVT, LTD, Delhi, 2015.

2. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge

University Press, Delhi, 2015.

ENGINEERING CHEMISTRY- LABORATORY

Volumetric Analysis and Preparations

1. Evaluation of quality of water in terms of total hardness by Complexometic titration.
2. Determination of Chemical Oxygen Demand (COD) of the given industrial waste water sample.
3. Determination of Alkalinity of the given water sample
4. Preparation of MgO nanoparticles by solution combustion method (Demonstration experiment) and spectrometric analysis.
5. Electroless plating of copper (Demo experiment)
6. Preparation of Polyaniline (Demo experiment)

Instrumental methods of Analysis

1. Potentiometric titration–Estimation of FAS using standard $K_2Cr_2O_7$ solution.
2. Conductometric estimation of hydrochloric acid using standard sodium hydroxide solution
3. Determination of viscosity coefficient, surface tension, density of a given liquid
4. Colorimetric estimation of copper in a given solution
5. Determination of Pka of given weak acid.
6. Determination of calorific value of coal/oil using Bomb calorimeter (Group experiment)

Reference books:

1. Dayanada Sagar University laboratory manual.
2. J. Bassett, R.C. Denny, G.H. Jeffery, Vogels, Text book of quantitative inorganic analysis, 4th Edition.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Artificial Intelligence & Machine Learning)

SEMESTER/YEAR	**: II SEM/ I**
COURSE CODE	**: 20EN1103**
TITLE OF THE COURSE	**: FUNDAMENTALS OF PROGRAMMING**
L: T/A: P: C	**: 3: 0: 4: 5**

Course objective: To develop student competence in writing clear, correct, and maintainable programs that implement known algorithms.

Course outcomes: After completing this course, students will be able to:

- **Express** algorithms learned implicitly in school explicitly in algorithmic form and **calculate** the number of basic operations (exact or upper bound)
- **Trace** the execution of short programs/code fragments involving fundamental programming constructs
- **Explain** what a short program/code fragment involving fundamental programming constructs does
- **Determine** whether code meets consistent documentation and programming style standards, and **make changes** to improve the readability and maintainability of software using a modern IDE
- **Write** a short program/code fragment for a given task using fundamental programming constructs
- **Rewrite** a short program/code fragment with fundamental programming constructs using more appropriate programming constructs
- **Debug** a short program/code fragment with fundamental programming constructs manually, and debug more complex code using a modern IDE and associated tools
- **Add/modify** functionality and decompose monolithic code into smaller pieces
- **Design** a large program, conduct a personal code review, and contribute to a small-team code review focused on common coding errors and maintainability using a provided checklist
- **Use** appropriate tools to build source code for testing and deployment
- **Identify** potential computing ethics issues in a given programming task and **suggest** ways to address these issues

Course Content:

Module 1. The primary focus is on code comprehension. Simple expressions, operator precedence, integer issues (overflow, integer division), floating point issues, implicit and explicit typecasting, conditionals, Boolean expressions, lazy evaluation. 14 Hours

Module 2. The primary focus will be on debugging (gdb) and code rewriting. Simple recursion (factorial and GCD), functions with variables, functions with loops (e.g., Taylor series), switch statements, command line arguments. 14 Hours

Module 3. The primary focus is on writing code for given specifications. Functions with const array arguments (e.g., linear search, binary search), arrays and pointers, library functions (especially strings), functions with side-effects (non-const arrays, pointers), structs as arguments and return value, global variables. 14 Hours

Module 4. The primary focus is on managing heap memory (malloc, free, realloc), memory leaks (valgrind). 14 Hours

Module 5. Header files and multiple implementations (e.g., using dictionary ADT and array-based implementations), file I/O. 14 Hours

Note: The hours include 4 Hours of Lab per week.

Textbook:

Brian W. Kernigham and Dennis M. Ritchie, (2012) "The C Programming Language", 2nd Edition, PHI.

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SEMESTER/YEAR : II SEM/I
COURSE CODE : 20EN1108
TITLE OF THE COURSE : BASIC ELECTRONICS
L: T/A: P: C : 3: 0: 2: 4

COURSE OBJECTIVE:

1. Imparting knowledge of fundamentals of semiconductor devices
2. Understanding electronic circuits

COURSE OUTCOME:

1. Analyze and design the basic electronic circuits containing semiconductor devices
2. Identify the need of Integrated Circuits and use them in realizing circuit applications.
3. Analyze and implement basic Digital Electronic circuits for a given application.
4. Identify the applications and significance of electronics in interdisciplinary engineering domains.

Module 1: Semiconductors
Semiconductor diodes, Diode types, Bipolar junction transistors BJT, FET characteristics, Packages and coding, Integrated circuits
Power supplies: Rectifiers, Reservoir and smoothing circuits, improved ripple filters Full-wave rectifiers, Voltage regulators, Practical power supply circuits, Related Problems.
Module 2: Amplifiers
Types of amplifier, Gain, Class of operation, Input and output resistance, Frequency response, Bandwidth, Phase shift, Negative feedback, Transistor amplifiers Bias, Predicting amplifier performance, Practical amplifier circuits
Oscillators: Positive feedback, conditions for oscillation, types of oscillators, practical oscillator circuits. , Related Problems.

Module 3: Operational Amplifiers
Symbols and connections, Operational amplifier parameters, Operational amplifier characteristics, Operational amplifier applications, Related Problems Circuit simulation: Introduction, types of analysis, net lists and component models.

Module 4: Logic Circuits
Logic functions, Switch and lamp logic, logic gates, combinational logic,bistables/flipflops, Integrated circuit logic devices, Logic simulation using SPICE **Microprocessors:**

Microprocessor a n d microcontrollers, Microprocessor systems, architecture, operation, microcontroller systems, Related Problems.

Module 5: Radio

The radio frequency spectrum, Electromagnetic waves, a simple CW transmitter and receiver, Modulation, Demodulation, Types of transmitters and receivers, aerials, Related Problems.

Text book(s)

1. Electronic Circuits: Fundamentals and Applications by Michael Tooley BA Elsevier Ltd., Third Edition, 2006.
2. Electronic Devices and Circuits, Allan Mottershed, PHI.

Reference book(s)

1. Robert. L. Boylestad and L.Nashelsky, Electronic Devices and circuit Theory, Pearson Education,9th edition, 2005.
2. David A Bell, Electronic Devices and Circuits, PHI, 5th edition 2007.
3. Millman & Halkias, Electronics Devices and Circuits, McGraw Hill.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Artificial Intelligence & Machine Learning)

SEMESTER/YEAR : II SEM/ I
COURSE CODE : 20EN1112
TITLE OF THE COURSE : DESIGN THINKING & INNOVATION
L: T/A: P: C : 1: 0: 0: 1

Course Summary

The course 'Design Thinking and Innovation' gives an overview of design thinking to helps students in understanding design thinking as a problem-solving approach. Ideas are developed through these processes and then applied to a basic approach to understand their value in the market place.

This course integrates the laboratory component into the theory enabling students to understand different phases of Design thinking by creating models using various workbenches from Autodesk Fusion 360 platform.

This course also aims at developing skillsets by using different design approaches to create components that can provide solutions to various engineering problems. It also enables students to use the tool proficiently to create their engineering models independently.

Course Objectives

Theory Component:

The objectives of the Course are to:

- Introduce students to a discipline of design thinking that enhances innovation activities in terms of value creation, speed, and sustainability
- Understand the importance and phases of design thinking and innovation
- Discuss key concepts and principles related to design process
- Examine approaches to innovation practiced by various organizations
- Explain the fundamental principles that guide design thinking
- Explain design thinking practices, their applications and importance.
- Enable students to use basic presentation techniques.
- Come up with new ideas and potential innovations.
- Understand the significance of Team Work and roles of individuals within a team.

Lab Component:

- To impart knowledge and skills to use various workbenches in Autodesk Fusion 360.
- To provide hands-on training on different commands to create part models in Autodesk Fusion 360.

Course Outcomes (CO):

After undergoing this course students will be able to:

- **Apply** the design thinking principles and recognize the significance of innovation
- **xplain** the importance of approaching innovation projects with concept development
- **Discuss** both individual and contextual factors that are linked to creativity
- **Discuss** the need for and significance of adopting a design thinking mind set
- **Develop** creative ideas through design criteria & brainstorming sessions
- **Design** various part models related to engineering field using Autodesk Fusion 360

Module 1: Introduction to Design Thinking & Innovation
Design Thinking Phases, Scoping, and Importance of storytelling. Design brief and visualization, Creativity and Idea Generation.

Module 2: Scope of Design Process
Introduction, Steps of Design Process, Design Components, Product and Process design, Ethnography and Identifying Insights, Requirements of a good product, Customer Satisfaction and Profitability

Module 3: Morphology of Design Process
Establishing design criteria, Design Morphology, Creative Design & Engineering Design, Product life cycle, Concept Development, Testing and Prototyping, Brainstorming & decision making.

Module 4: Analysis of Design Problem
Design inputs and outputs, Constraints in Design, Tools for Preliminary Design-
Prescriptive and Descriptive Design, Market & Technology driven process.

Module 5: Communication & Presentation
Types of design communications, Qualities of a Good Poster & Presenter, Barriers & Difficulties in Communication, Effective Communication, Presentation Skills, Professional Ethics in Engineering.

Text Book(s)

1. C. L. Dym and Patrick Little, Engineering Design- A Project Based Introduction, John Wiley, 1995.
2. N. Cross, Engineering Design Methods: Strategies for Product Design, John Wiley, 1995.

References(s)

1. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation (Harper Business, 2009)
2. Bruce Hannington and Bella Martin, Universal Methods of Design: 100 Ways to Research Complex Problems, Develop Innovative Ideas, and Design Effective Solutions (Rockport Publishers, 2012)
3. Ian C. Wright, Design Methods in Engineering & Product Design, McGraw-Hill, 1998.
4. M. A. Parameswaran, an Introduction to Design Engineering, Narosa, 2004.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Artificial Intelligence & Machine Learning)

SEMESTER/YEAR : II SEM/I
COURSE CODE : 20EN1106
TITLE OF THE COURSE : ELEMENTS OF MECHANICAL ENGINEERING
L: T/A: P: C : 2: 0:2: 3

Course Summary

The course 'Elements of Mechanical Engineering' aims at introducing principles of energy resources, thermodynamics, prime movers, pumps, materials science & composites, mechanical design, power transmission, manufacturing techniques (metal cutting, joining & foundry), mechatronics, 3D printing, robotics, electric mobility and applications.

This course integrates the laboratory component into the theory enabling students to understand the working and application of various mechanical systems. Students belonging to all branches of engineering are introduced to fundamental topics related to mechanical engineering.

This course also aims at developing skills by using workshop tools, equipment's and materials to create various physical models. The course deals with basic manufacturing processes like fitting, sheet metal work, welding, soldering, machining, carpentry, casting and smithy useful for industries.

Course Objectives:

Theory Component:

The objectives of the Course are to:

- Explain the basic concepts of renewable & non-renewable energy resources
- State first and second laws of thermodynamics
- Describe Carnot, Otto, diesel, Brayton, Rankine & refrigeration cycles
- Discuss 4 stroke petrol & diesel engines, turbines and pumps
- Study materials types, properties and stress- strain diagram
- Explain simple stresses, strains, elastic constants and power trains
- Discuss the operations of lathe, drilling, shaper, milling, and grinding machines
- Describe Joining Processes and foundry
- Explain mechatronics, PLC, instrumentation & control systems
- Explain robot anatomy, configurations, sensors and applications
- Discuss rapid prototyping, 3D printing and electric mobility

Lab Component:

- To impart knowledge and skills to use tools, machines, equipment, and measuring instruments

- To cultivate safety aspects in handling of tools and equipments
- To provide hands-on training on fitting, sheet metal, carpentry, casting , smithy, machining operations
- To provide hands-on training on soldering and welding processes

Course Outcomes (CO):

- Explain various energy resources, laws of thermodynamics, gas and vapour cycles, prime movers and pumps
- Discuss fundamentals of materials and mechanical design aspects
- Describe basics of machine tools, joining processes and foundry
- Explain advanced topics in mechanical engineering
- Construct different types of fitting, welding, sheet metal, turning models
- Demonstrate working of engines, turbines, pumps, 3D printing; wood working, foundry & smithy operations

Course content

Module 1: Energy Conversion

Renewable & Nonrenewable energy resources – Introduction to Steam, Hydro & Nuclear power plants, solar, wind and biomass energy based power plants, Effect of power generation on environment

Thermodynamics- First and second laws of thermodynamics, Efficiency, COP, Carnot theorem, Numericals

Module 2: Prime Movers & Pumps
Gas and Vapour cycles -Carnot, Otto, Diesel, Brayton, Rankine & Refrigeration cycles
Prime movers- 4 stroke- petrol and Diesel engines, Gas turbines-open and closed Cycle, steam turbines-Impulse and reaction, Numericals.
Introduction to pumps-working of centrifugal and reciprocating

Module 3: Materials & Mechanical Design
Materials- Introduction to ferrous, non-ferrous & composites, Stress-strain diagrams, Mechanical Properties for materials.
Mechanical Design-Introduction, Simple Stresses and strains, Elastic constants.
Power Transmission- Gear & Belt Drives, Numerical problems.

Module 4: Manufacturing Processes
Metal cutting: Introduction, classification of machine tools, basic operations on lathe,

drilling, shaper, milling, grinding, introduction to CNC machining.
Joining Processes- Welding- classification, gas, arc, laser & friction welding, brazing and soldering
Foundry- Basic terminology, Types of patterns, sand moulding.

Module 5: Advanced Technologies in Mechanical Engineering
Mechatronics - Introduction, Mechatronics, PLC, Instrumentation & control systems
Robotics- Introduction, Robot anatomy, configurations, Sensors, applications.
Rapid prototyping & 3D Printing- Introduction & applications, powder-based additive manufacturing processes.
Electric Mobility -Introduction, electric, hybrid and autonomous vehicles

Lab Component

1. Fitting Shop- Simple exercises involving fitting work-Dove tail.
2. Welding Shop- Simple butt and Lap welded joints using arc welding
3. Sheet-metal Shop- Fabrication of tray, Making Funnel complete with soldering
4. Lathe machining on plain and step turning

Demonstration of

1. Pelton wheel, and Francis turbine
2. 4 stroke petrol and diesel engines
3. Lathe, milling, drilling, grinding & CNC milling machines and wood turning lathe
4. Foundry and smithy operations
5. 3D printing

Text book(s)

1. Nag P K, Basics and applied thermodynamics, Second edition, Tata McGraw Hill, New Delhi -2017.
2. P.N. Rao-Manufacturing Technology-Foundry, Forming and Welding, Volume 1, 4 Edition, Tata McGraw Hill Publishing Co Ltd, 2018.
3. P.N. Rao-Manufacturing Technology- Metal Cutting and Machine Tools, Volume 2, 4 Edition, Tata McGraw Hill Publishing Co Ltd, 2018.

Reference(s)

1. El-Wakil M M, Power plant technology, Tata McGraw Hill edition, New Delhi -2017. Larminie J,Lowry J, Electric vehicle technology explained, John Wiley and &sons Ltd. USA
2. William D. Callister and David G. Rethwisch-Fundamentals of Materials Science and Engineering: An Integrated Approach, John Wiley & Sons; 4th Edition edition, 2011

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
(Artificial Intelligence & Machine Learning)

SEMESTER/YEAR : II SEM /I
COURSE CODE : 20EN1107
TITLE OF THE COURSE : ENGINEERING PHYSICS
L: T/A: P: C : 3: 0:2: 4

Course learning objectives:
This course will enable students to learn the basic concepts in Physics which are very much essential in understanding and solving problems in engineering.

Course Aim and Summary:

The course '**Engineering Physics'** aims at introducing principles of physics to understand the working and behaviour of engineering systems. To begin with, the course emphasises upon the basics of Classical mechanics, principles of Quantum mechanics, and subsequently deals with engineering materials such as Electrical-Electronics and Mechanical properties of materials. Semiconductor Physics, devices like , LED, photodiode, Solar cell and BJT. The course also covers topics like Laser Physics and Crystallography. Finally the course concludes with Thin-Film deposition techniques and Nano science & technology. During the course virtual lab and physical tools/models will be used to demonstrate the behaviour of different engineering systems.

Course Objectives

The Objectives of the Course are:

- To introduce the basic concepts of Quantum mechanics which are essential in understanding and solving problems in engineering.
- To review different types of Engineering materials –Electronic, electrical, mechanical and Magnetic materials Properties and their applications in Science and Engineering.
- To understand Band structure of solids, Semiconductors and electrical conductivity of SC's, and their applications.
- To explain semiconductor devices like LED, Photodiode and Solar cell and Semiconductor BJT.
- To learn how to find Lattice parameters of different crystalline solids by using X-

ray diffraction methods

- To explain Principle and working of LASERS, Different types of Lasers. and Applications of Lasers in defence, engineering and medicine.
- To introduce Polar and non-polar dielectrics, dielectric constant, electronic, ionic and orientation polarization mechanisms.

- Lorentz field in cubic materials, Clausius-Mossotti equation, Ferro, Piezo and Pyro electric materials and their applications in engineering.
- To explain Thin-film Phenomena, Thin-film fabrication Process and their applications in engineering.
- To learn how to fabricate Nano materials by using Top-down and Bottom –up approach

To review Nano science and technology and its practical applications in science and engineering.

Course Outcomes (CO's):

On completion of the Course the Students are able to

- Describe the concepts of Quantum mechanics, basics of Quantum computing and select for solving problems in engineering.
- Discuss the different engineering materials such as Electronic, electrical and mechanical materials properties and their applications in engineering
- Illustrate Semiconductors , Semiconductor devices like Photo diode, LED, Solar cell and BJT and its applications
- Classify Lattice parameters of different crystalline solids by using X-ray diffraction methods and Summarize theoretical background of laser, construction and working of different types of lasers and its applications in science and engineering
- Interpret Basic concepts of Thin films and Thin film deposition processes and their applications leads to Sensors and engineering devices
- Discuss Nano materials ,Properties and fabrication of Nano materials by using Top-down and Bottom –up approach's-Applications for Science and technology

Module 1: Introduction to Basics of Classical mechanics

Quantum Mechanics 1: Foundations of quantum theory, Wave function and itsproperties, One dimensional time independent Schrodinger wave equation, Eigenvalues and Eigen functions, Uncertainty principle, Applications: one dimensional motion of an electron in a potential-well.
Quantum Mechanics 2: Matrix formulation: Linear & matrix algebra, Dirac's bra & ket notation, matrix representation of vectors & operators, Expectation values, Basics of quantum computing - Concepts of Superposition, entanglement, Interference and Qubit

Module 2:
Introduction to Engineering materials: Introduction to Principles of Electromagnetic theory (Maxwell's Equations).Classification of Engineering Materials such as Conductors, Semiconductors, Insulators and Magnetic materials ; Electrical conductivity of metals and Semiconductors. Effect of temperature, composition on resistivity/conductivity of materials.
Mechanical Engineering materials – mechanical properties: stress- strain curve for different materials. Introduction to Tensile strength, Compressive strength, Ductility, Malleability, Toughness, Brittleness, Impact strength, Fatigue, Creep. Testing of engineering materials: Hardness Tests: Brinell, Rockwell and Vickers hardness test-Numericals
Dielectrics: polar and non-polar dielectrics, internal fields in a solid, Different Polarization techniques. Clausius-Mossotti equation, applications of dielectrics. Ferro, Piezo and Pyro electric materials and their applications.

Module 3:
Semiconductor Physics: Band structure, Fermi level in intrinsic and extrinsic semiconductors, Density of energy states in conduction and valence bands of a semiconductor (Mention the expression), Expression for concentration of electrons in conduction band (Derivation), Hole concentration in valance band (Mention the expression), Intrinsic carrier concentration Conductivity of semiconductors, Measurement of Electrical resistivity using 4 probe method.
Semiconducting devices of interest for optoelectronics applications: Principle and working of LED, photodiode, and solar cell. BJT, FET-JFET and MOSFET

Module 4:
LASER PHYSICS: Einstein's coefficients (expression for energy density). Requisites of a Laser system. Conditions for laser action. Principle, Construction and working of Nd-YAG, Semiconductor Laser and CO2 Lasers. Application of Lasers in Defense (Laser range finder), Engineering (Data storage) and Applications of Lasers in medicine [6 hours]
Crystallography: Lattice, unit cell, lattice parameters, crystal systems, Bravais lattices, Introduction to Miller Indices. Determination of Crystal structure by Miller Indices. X-ray diffraction, Bragg's law and Powder method.

Module 5:

Thin films technology: Introduction to thin-films-Advantages of thin-films over bulk materials. Thin film deposition processes- Physical vapour deposition (Thermal evaporation technique, and sputtering technique) process, Applications of Thin film.

Nano Science & technology: Introduction to Nano materials, Classification of nano materials, Scaling laws in miniaturization electrical systems, Size dependent properties of materials, Top-down and Bottom-up approach- Ball milling, self-assembly process. Fundamental Principles of Bio-Physics and Applications of Nano technology in Biology and Engineering.

Introduction to Micro machining techniques: Silicon micromachining techniques- Etching (isotropic and anisotropic etching)-Numiricals

Lab component

1. I-V characteristics of a Zener Diode

I–V Characteristics of a Zener diode in forward and reverse bias condition

Four probe technique

Measurement of resistivity of a semiconductor using Four probe technique

2. Newton's Rings

Measurement of radius of curvature of a plano-convex lens using Newton's Rings

3. Dielectric constant

Determination of dielectric constant of a dielectric material

4. Torsional Pendulum

Determination of moment of inertia of a circular disc using torsional pendulum

5. Band gap energy

Determination of energy gap of an intrinsic semiconductor

6. Diffraction grating

Determination of wavelength of a laser light using diffraction grating

7. Planck's constant

Measurement of Planck's constant using LED

8. LCR series and parallel resonance

Study the frequency response of a series and parallel LCR circuit

9. Transistor characteristics

Input and output characteristics of a NPN transistor in C-E configuration

Text Book(s)

1. M N Avadhanulu, P G Kshirsagar, TVS Arun Murthy (2018), A textbook of Engineering Physics, S Chand, New Delhi.
2. Materials Science and Engineering by V S Raghavan
3. Engineering Physics (2019), DSU Pearson, New Delhi
4. Engineering Physics (2017), DSU WILEY Publications
5. Engineering Physics Laboratory manual, DSU

Reference Book(s)

1. M. Young (1977), Optics & Lasers an Engineering Physics approach, Springer, Verlag
2. S. O. Pillai (2018), Solid State Physics, revised edition, New Age International Publishers, New Delhi.
3. Thin-Films Phenomena-K L Chopra, McGraw -Hill Publishing
4. K. Thyagarajan, A.K. Ghatak (1981), Lasers: Theory & Applications, Plenum Press, New York.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Artificial Intelligence & Machine Learning)

SEMESTER/YEAR	**: II SEM /I**
COURSE CODE	**: 20EN1104**
TITLE OF THE COURSE	**: BASIC ELECTRICAL ENGINEERING**
L: T/A: P: C	**: 3: 0:0: 3**

COURSE OBJECTIVE:

1. Imparting Knowledge of basic circuits.
2. Understanding analysis of circuits.
3. Basics of electric and magnetic fields.
4. Working principles of machines, measuring equipments.

COURSE OUTCOME:

1. Able to get the basic knowledge about the Electric and Magnetic circuits.
2. Able to understand the AC fundamentals.
3. Able to understand the working of various Electrical Machines.
4. Able to get the knowledge about various measuring instruments and house wiring.

Course content

Module 1: INTRODUCTION TO ELECTRICAL ENGINEERING

Introduction to Electrical Engineering: General structure of electrical power systems, Electric current, ohm's law, Resistance, Inductance and capacitance parameter, Kirchoff's laws, node voltage and mesh current methods, Series and parallel combinations, current division, voltage division rule, Electrical power and energy. Related Numerical problems.
Domestic Wiring: Earthing-significance and types, two way & three way control of lamps, basic protective devices like MCB's and Fuses.

Module 2: Magnetic Circuits

Faradays laws of electromagnetic induction, Lenz's law, Magnetic circuit- concept and analogies, Force on a current carrying conductor placed in a magnetic field, Dynamically induced emf, Fleming's rules and its applications. Self and mutual inductance. Related Numerical Problems.

Module 3: Alternating Quantities

Average and effective values of periodic functions, solution of R,L,C series circuits, the j operator, complex representation of impedances, phasor diagram, instantaneous and average power, power factor, power in complex notation, response of series, parallel and series – parallel circuits. Related numerical problems.

Necessity and advantages of Three phase supply, delta and Y – connections, line and phase quantities, solution of balanced three phase circuits, phasor diagram, Three phase three wire and four wire circuits.

Module 4: DC Machines

Construction, Working principle and analysis of DC motor and generator, EMF and Torque equations, Connections and working of DC generators and motors- series and shunt, back emf. Related numerical problems.

Module 5: Transformers

Principle of operation, Construction, Equivalent circuit, EMF equation, ratings, losses, Efficiency and voltage regulation, related simple problems.
Induction motors: brief idea about construction, concept of rotating magnetic field. Slip and its significance, Ratings and applications, Problems on slip calculation

Text Book(s)

1. M. Maria Louis, Elements of Electrical Engineering, fifth edition, PHI Publications, 2014.
2. D.P.Kothari and I.J. Nagrath, Basic Electrical Engineering, TataMcGraw Hill.

Reference book(s)

1. S.S. Parker Smith and NN Parker Smith, Problems in Electrical Engineering.
2. Rajendra Prasad, "Fundamentals of Electrical, PHI Publications, 3RDEdition.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Artificial Intelligence & Machine Learning)

SEMESTER/YEAR : II SEM /I
COURSE CODE : 20EN1109
TITLE OF THE COURSE : BIOLOGICAL SCIENCES
L: T/A: P: C : 2: 0:0:2

Biology in the 21st century: The new world in the post genome era. Past, present and future of our society, industry and life style: Impact of discoveries and technological innovations in biology. Challenges and excitement of research in biology and bioengineering. Bioengineering as an emerging science at the intersection of biology, engineering, physics and chemistry.

Carrier opportunities in biotechnology, biomedical engineering, pharmaceutical industry, agro-biotechnology and in the diverse areas of basic science and medical research. Emerging trends of collaboration between industry and academia for development of entrepreneurship in biotechnology.

Quantitative views of modern biology. Importance of illustrations and building quantitative/ qualitative models. Role of estimates. Cell size and shape. Temporal scales. Relative time in Biology. Key model systems - a glimpse.

Management and transformation of energy in cells. Mathematical view - binding, gene expression and osmotic pressure as examples. Metabolism. Cell communication.

Genetics. Eukaryotic genomes. Genetic basis of development. Evolution and diversity. Systems biology and illustrative examples of applications of Engineering in Biology

Text Book(s)

1. R. Phillips, J. Kondev and J. Theriot, Physical biology of the cell, Garland Science Publisher, 2008, Ist Edition.
2. J.B. Reece, L.A. Urry, M.L. Cain, S.A. Wasserman, P.V. Minorsky and R.B. Jackson. Campbell Biology, Benjamin Cummings Publishers, 2010, 9th Edition.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

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SEMESTER/YEAR : II SEM /I
COURSE CODE : 20EN1110
TITLE OF THE COURSE : TECHNICAL COMMUNICATION
L: T/A: P: C : 2: 0:2:3

Course Aim and Summary

The course 'Technical Communication Skills' aims at enhancing Communication skills of the students in dimensions of - Listening, Speaking, Reading, Writing, Grammar and Vocabulary. The course introduces Communication and types of Communication and deals in detail the listening, referencing, report writing and group discussions. The course covers team, team building skills and effective leadership skills. The course also deals with resume writing, covering letter, job application and e-mail etiquettes. The practical course is designed to acquire correct pronunciation and to enable students to get rid of stage fear and become a good orator.

Course Objectives

The objectives of the Course are:

- To improve students lexical, grammatical competence
- To enhance their communicative skills
- To equip students with oral and appropriate written communication skills
- To inculcate students with employability and job search skills
- To achieve proficiency in English
- To Develop professional communication skills
- To create interest among the students about a topic by exploring thoughts and ideas
- To enable students with good use of tenses
- To learn the use of body language and improve verbal message
- To equip with Types of Teams and Leadership styles -to develop managing skills in corporate world.
- To Acquire skills for placement

Course Outcomes

After undergoing this course students will be able to:

- Explain communication and types of Communication: Managerial, Corporate, Technical & Organizational Communication.
- Distinguish Listening and hearing. Demonstrate various aspects of speaking. Discuss Word formation and types.

- Write a report, essay. Minutes of Meeting. Evaluate current issues and debate
- Use Leadership skills and Team building. Solve Tense exercise.
- Write a job application and CV.
- Discuss E-Mail etiquettes.
- Discuss topic and speak on the spot. Interpret data

Course content

1. Communication; Types of Communication: Managerial, Corporate, Technical & Organizational Communication.
Listening: Types & its Importance. Difference between hearing & listening.
Speaking: Different aspects of Effective Speaking
Word Formation and Types of Word Formation**,** Word Family.

2. Referencing Skills: Academic Writing: Definition & Tips for writing
Report Writing: Importance. Steps for Report Writing.
Group Discussion: Definition, How GD helps in Student Life & Corporate Life.
Minutes of Meeting: Importance; Steps for writing MOM in Organizations.

3. TEAM & TEAM BUILDING: Definition, Importance, Types of Team; Team Building & Team Dynamics.
Leadership: Styles of Leadership; Characteristics of a good leader, Influence of different forces on leadership.

4. JOB Application, Covering Letter; Resume/CV Writing; Difference between Job Application & Resume.

5. E-mail Etiquettes: Definition, Rules for e-mail etiquettes, Business E-mail etiquettes, Tips for perfecting e-mail etiquettes.

6. ICE Breaking activity and JAM sessions

7. Situational Dialogues/ Role Play (Greetings, enquiring, complaining**)**

8. Tenses and Subject Verb Concord

9. Extempore, Public Speaking, Debates.

10. Data Interpretation.

Reference(s)

1. Chauhan, Gajendra S., L. Thimmesha and Smita, Kashiramka (2019) Technical Communication, Cengage Learning, New Delhi

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Artificial Intelligence & Machine Learning)

SEMESTER/YEAR : II SEM /I
COURSE CODE : 20EN1111
TITLE OF THE COURSE : ENGINEERING GRAPHICS & DESIGN
L: T/A: P: C : 1: 0:4:3

Course Aim & Summary:

The course aims at introducing engineering graphics as a language of engineers for universal communication. This course covers orthographic projections of points, lines, planes and solids. It also deals with development of surfaces and isometric projections of planes and solids. Students solve problems using manual sketching and professional CAD software for modelling and assembly of simple engineering components from various engineering domains. They work in teams to develop conceptual designs for an identified need.

Course Objectives

The objectives of the Course are:

- To create awareness and emphasize the need for Engineering Graphics
- To follow basic drawing standards and conventions
- To Introduce free hand sketching as a tool for technical Communication
- To understand the principles of geometrical curves and construct manually
- To learn using professional CAD software for construction of geometry
- To understand the concepts of orthographic and isometric projections
- To construct orthographic projection of points, lines, planes and solids
- To develop the lateral surfaces of solids
- To construct isometric projections of planes and solids
- To create simple engineering 3D components and assembly
- To work in a team for creating conceptual design of products

Course Outcomes

After undergoing this course students will be able to:

- Explain usage of instruments, dimensioning & tolerances, conventions and standards related to working drawings
- Construct points, lines, planes and solids using orthographic projections principles

- Construct geometries of planes and solids using isometric projection principles
- Prepare the lateral surfaces of the given solid by applying the basic concepts
- Construct lateral surfaces of solids using geometry development principles
- Create associative models at the component and assembly levels for product design

Course content

Module 1:
Introduction: Fundamentals, Drawing standard - BIS, dimensioning, Lines, lettering, scaling of figures, symbols and drawing instruments, Introduction to orthographic & perspective projection. Types of projections, Principles of Orthographic projection
Plain & Miscellaneous Curves: Construction of ellipse, parabola, hyperbola, Construction of Tangent and Normal at any point on these curves. Construction of Cycloid, Epicycloid and Hypocycloid, Involute of a circle. Construction of Tangent and Normal at any point on these curves.

Module 2:
Projection of Points and Lines: Projections of points located in same quadrant and different quadrants. Projection of straight lines inclined to both the principal planes – Determination of true lengths and true inclinations by rotating line method.
Projection of planes: Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by change of position method.

Module 3:
Projection of Solids: Projection of solids such as prisms, pyramids, cone, cylinder, tetrahedron, Projections of solids with axis perpendicular and parallel to HP and VP, solids with axis inclined to one or both the planes, suspension of solids.

Module 4:
Sections of Solids: Sectioning of solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other, obtaining true shape of section.
Development of Surfaces: Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.

Module 5:
Isometric Projection: Principles of isometric projection, isometric scale, Isometric projections of simple solids and truncated solids – Prisms, pyramids, cylinders, cones,

combination of two solid objects in simple vertical positions, Conversion of orthographic views into isometric projection and vice versa

Module 6:

Computer Aided Design: Introduction to computer aided drafting and tools to make drawings. Layout of the software, standard tool bar/menus and description, drawing area, dialog boxes and windows, Shortcut menus, setting up and use of Layers, layers to create drawings, customized layers, create, zoom, edit, erase and use changing line lengths through modifying existing lines (extend/lengthen) and other commands

Demonstration of a simple team design project: Product Design- Introduction, stages, Design Geometry and topology of engineered components creation of engineering models and their presentation in standard 3D view. Use of solid-modeling software for creating associative models at the component and assembly levels; include: simple mechanical components-bolts, nuts, couplings; simple civil

Text Book(s)

1. Gopalakrishna, K. R. (2005) Engineering Graphics, 32nd edition, Subash Publishers Bangalore, India
2. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House, Gujarat, India
3. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education, New Delhi.
4. DSU Text book, Wiley-India Publications, Bangalore

Reference(s)

1. Luzzader, Warren. J and Duff John M., (2005) ,Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi.
2. Basant Agarwal and Agarwal C.M., (2008), Engineering Drawing, Tata McGraw Hill Publishing Company Limited, New Delhi.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
(Artificial Intelligence & Machine Learning)

SEMESTER/YEAR : II SEM /I
COURSE CODE : 20EN1105
TITLE OF THE COURSE : ENVIRONMENTAL STUDIES
L: T/A: P: C : 2: 0:0:2

Course Aim
This course aims at creating awareness regarding preservation of environment for providing safe and healthy atmosphere. This course deals with concepts of ecosystem, renewable and non-renewable energy resources, environmental pollution, laws and regulations governing the environment.

Course Objectives
The objectives of the Course are:
- To explain the importance of this course
- To expose engineering students to the basic concepts and principles of environment;
- To have knowledge of the current issues of pollution endangering life on earth
- To educate about the environmental resources, energy, pollution, management, impact assessment and law

Course Outcomes
After undergoing this course students will be able to:

• Delineate basic concepts that govern environmental quality, atmospheric principles and environmental standards;
• Recognize and conversant with sources and nature of pollution types, control and management
• Explain Energy resource types and their environmental implications
• Apply the process of environmental impact assessment and implications of Indian Environment Laws

Course content

Module 1: Basic Concepts of Environment
Scope and importance of environmental studies, Definition of environment- comprehensive understanding of environment, Basic concepts: Xenobiotic, natural & anthropogenic; why are we concerned? Types of xenobiotics: Chemical, Physical, Biological pollutants; Hazard &

Risk, Eco-kinetic & Bio-kinetic Properties of a xenobiotic, Dose-Response Relationships-chronic and acute effects, Environmental Standards: AAQS, TLV's, Appraisal, Assessment & Abatement (Recognition, Evaluation & Control) of pollutants- Structure of Atmosphere; Atmospheric inversions, Environmental System.

Air Pollution: Criteria pollutants – Ozone, Particulate Matter, Carbon Monoxide, Nitrogen, Oxides, Sulphur Dioxide, Lead; SMOG & Air-pollution episodes

Aerosols: Primary & Secondary pollutants, Acid Rain Cycle.

Module 2: Water Treatment

Hydrosphere, Lentic and Lotic Water Systems, Fresh Water as a resource; Rain Water Harvesting, Treatment of potable water, Waste water- Characteristics, Municipal Sewage Water and Treatment.

Waste Management

Types of Wastes: Municipal Solid Waste, Hazardous Waste, Nuclear Waste, Electronic Waste, Biomedical Waste, Solid Waste Management: Landfills, compostingnWater Standards

Module 3: Energy

Types of energy: Conventional sources of energy, fossil fuel, Coal, Nuclear based, Solar, wind, sea-Tidal Wave energy, Geo-Thermal, Non-conventional sources of Energy, Biofuels - biomass, biogas, Natural Gas; Hydrogen as an alternative future source of energy.

Module 4: Disasters & Management

Definition, origin and classification. Natural (Earthquakes, landslides, floods, Cyclones),Man-made disasters (biological, chemical, nuclear, radiological explosions) – definition,causes and management and/or mitigation strategies; Bhopal & Chernobyl Disasters, Environment & Health - Occupational Health Hazards, Occupational Diseases, Epidemics, Pandemics, Endemics (Fluoride, Arsenic), Principles and Significance of Sanitation

Module 5: Environmental Impact Assessment (EIA) and Indian acts and regulations

Principles of EIA, Indian Acts and Rules, Wildlife (Protection) Act 1972. Water Act – 1974 (Rules 1975), Forest Conservation Act 1980 (Rules 2003), Air Act -1981 (Rules 1982, 1983), Environment Protection Act, 1986

Text Book(s)

1. R.C. Gaur, “Basic Environmental Engineering (2008)”, New age international (p) limited, publishers.
2. J. Glynn Henry and Gary. W. Heinke, “Environmental Science and Engineering (2004)”, Pretice Hall of India.
3. P. Venugopala Rao, “A Text Book of Environmental Engineering (2012)”, PHI Learning Pvt. Ltd.

Reference(s)

1. P.Aarne Vesilind, Susan M.Morgan, Thomson, “Introduction to Environmental Engineering” (2008), Thomson learning, Second Edition, Boston.
2. R Rajagopalan, “Environmental Studies – From Crisis to Cure” (2005) Oxford University Press, New Delhi.
3. R J Ranjit Daniels and Jagadish Krishnaswamy, “Environmental Studies” (2014), Wiley India Pvt Limited, New Delhi.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
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SEMESTER/YEAR	**: I SEM / I YEAR**
COURSE CODE	**: 20AU0004**
TITLE OF THE COURSE	**: CONSTITUTION OF INDIA & PROFESSIONAL ETHICS**
L : T : P : S/P : C	**: 2 : 0 : 0 : 0 : 0**

Course objectives

1. To provide basic information about Indian constitution.
2. To identify individual role and ethical responsibility towards society.

Course outcomes

At the end of the course student will be able

- Understand state and central policies, fundamental duties
- Understand Electoral Process, special provisions
- Understand powers and functions of Muncipalities, Panchayats and Cooperative Societies,
- Understand Engineering ethics and responsibilities of Engineers

Introduction to the Constitution of India, The Making of the Constitution and Sailent features of the Constitution. Preamble to the Indian Constitution Fundamental Rights & its limitations.
Directive Principles of State Policy & Relevance of Directive Principles State Policy fundamental Duties.
Union Executives – President, Prime Minister Parliament Supreme Court of India. State Executives – Governor Chief Minister, State Legislature High Court of State.

Electoral Process in India, Amendment Procedures, 42nd, 44th, 74th, 76th, 86th&91st Amendments.

Special Provision for SC & ST Special Provision for Women, Children & Backward Classes Emergency Provisions.

Powers and functions of Municipalities, Panchyats and Co – Operative Societies.

Text Books:

1. Brij Kishore Sharma,"Introduction to the Constitution of India", PHI Learning Pvt. Ltd., New Delhi, 2011.

2. Durga Das Basu: "Introduction to the Constitution on India", (Students Edn.) PrenticeHall, 19th / 20th Edn., 2001

Reference Books:

1. M.V.Pylee, "An Introduction to Constitution of India", Vikas Publishing, 2002.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

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SEMESTER/YEAR	**:**	**I YEAR**
COURSE CODE	**:**	**20AU0021**
TITLE OF THE COURSE	**:**	**KANNADA KALI – II**
L : T : P : S/P : C	**:**	**2 : 0 : 0 : 0 : 0**

Course Learning Objectives:

Learners are Non – Kannadigas, so this course will make them,

· To Read and understand the simple words in Kannada language
· To learn Vyavaharika Kannada (Kannada for Communication)
· will create a some interest on Kannada Language and Literature

Lesson 1 : Introducing each other – 1. Personal Pronouns, Possessive forms, Interrogative words.
Lesson 2 : Introducing each other – 2. Personal Pronouns, Possessive forms, Yes/No Type Interrogation
Lesson 3 : About Ramanaya. Possessive forms of nons, dubitive question, Relative nouns
Lesson 4 : Enquiring about a room for rent. Qualitative and quantitative adjectives.
Lesson 5 : Enquiring about the college. Predicative forms, locative case.
Lesson 6 : In a hotel Dative case defective verbs.
Lesson 7 : Vegetable market. Numeral, plurals.
Lesson 8 : Planning for a picnic. Imperative, Permissive, hortative.
Lesson 9 : Conversation between Doctor and the patient. Verb- iru, negation – illa, non – past tense.
Lesson 10: Doctors advise to Patient. Potential forms, no – past continuous.
Lesson 11: Discussing about a film. Past tense, negation.
Lesson 12: About Brindavan Garden. Past tense negation.
Lesson 13: About routine activities of a student. Verbal Participle, reflexive form, negation.
Lesson 14: Telephone conversation. Past and present perfect past continuous and their negation.
Lesson 15: About Halebid, Belur. Relative participle, negation.
Lesson 16: Discussing about examination and future plan. Simple conditional and negative
Lesson 17: Karnataka (Lesson for reading)
Lesson 18: Kannada Bhaashe (Lesson for reading)
Lesson 19: Mana taruva Sangati alla (Lesson for reading)
Lesson 20: bEku bEDagaLu (lesson for reading)

1. Kannada Kali (ಕನ್ನಡ ಕಲಿ) – ಲಿಂಗದೇವರು ಹಳೆಮನೆ. A Text Book to Learn Kannada by Non – Kannadigas who come to study Diploma, Engineering and Health Sciences in Karnataka, ಪ್ರಕಟಣೆ: ಪ್ರಸಾರಾಂಗ ಕನ್ನಡ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಹಂಪಿ.
2. Spoken Kannada – ಮಾತಾಡುವ ಕನ್ನಡ, ಪ್ರಕಟಣೆ – ಕನ್ನಡ ಸಾಹಿತ್ಯ ಪರಿಷತ್ ಬೆಂಗಳೂರು.
3. Kannada Kirana - ಕನ್ನಡ ಕಿರಣ, ಪ್ರಕಟಣೆ – ಬೆಂಗಳೂರು ಇನ್ಸ್ಟಿಟ್ಯೂಟ್ ಅಪ್ ಲಾಂಗ್ವೇಜಸ್, ಬೆಂಗಳೂರು .

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
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SEMESTER/YEAR : I SEM / I YEAR
COURSE CODE : 20AU0025
TITLE OF THE COURSE : KANNADA MANASU – II
L : T : P : S/P : C : 2 : 0 : 0 : 0 : 0

COURSE OBJECTIVES:

1. To equip the native Kannada speaking students with advanced skills in Kannada communication and understanding
2. To enrich the students with creative writing

COURSE OUTCOMES:

1. Students will have better speaking and writing communication skills in Kannada

ಕನ್ನಡ ಭಾಷಾ ಕಲಿಕೆಯ ಉದ್ದೇಶಗಳು:

- ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಕನ್ನಡ ಭಾಷೆಯ ವ್ಯಾಕರಣದ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು.
- ಪದವಿ ವಿದ್ಯಾರ್ಥಿಳಾಗಿರುವುದರಿಂದ ಆಡಳಿತ ಕನ್ನಡದ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.
- ಕನ್ನಡ ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ಒಲವು ಮತ್ತು ಆಸಕ್ತಿಯನ್ನು ಬೆಳೆಸುವುದು

1. ಆಡಳಿತ ಭಾಷೆಯಾಗಿ ಕನ್ನಡ
2. ವಿವಿಧ ರೀತಿಯ ಅರ್ಜಿ ಸಮೂಹಗಳು
3. ಪತ್ರ ವ್ಯವಹಾರ – ಸರ್ಕಾರಿ ಅರೆಸರ್ಕಾರಿ ಪತ್ರಗಳು – ಆಹ್ವಾನ ಪತ್ರಿಕೆ, ಜಾಹೀರಾತು, ಪತ್ರಿಕಾ ಪ್ರಕಟಣೆ ಇತ್ಯಾದಿ ಪತ್ರಗಳು
4. ಭಾಷೆ ಮತ್ತು ಬರಹ – ಡಾ. ಎಂ ಚಿದಾನಂದ ಮೂರ್ತಿ ರವರ ಭಾಷಾ ವಿಜ್ಞಾನದ ಮೂಲ ತತ್ವಗಳು ಪುಸ್ತಕದಿಂದ
5. ಭಾಷಾಭ್ಯಾಸ – ತತ್ಸಮ ತದ್ಭವ, ಸಮಾನಾರ್ಥಕ ಪದಗಳು, ವಿರುದ್ಧಾರ್ಥಕ ಪದಗಳು, ನಾನಾರ್ಥ ಪದಗಳು, ನುಡಿಗಟ್ಟುಗಳು, ಅನುಕರಣಾವ್ಯಯಗಳು (ದ್ವಿರುಕ್ತ) ಮತ್ತು ಜೋಡು ನುಡಿಗಳು, ಕನ್ನಡದ ದೇಶ್ಯ ಪದಗಳು, ಅನ್ಯದೇಶ್ಯ ಪದಗಳು.
6. ಭಾಷಾ ರಚನೆ – ವಾಕ್ಯ ಪದ್ಧತಿ ಮತ್ತು ಲೇಖನ ಚಿಹ್ನೆಗಳು, ಪತ್ರ ಲೇಖನ, ವರದಿ ಲೇಖನ, ಪ್ರಬಂಧ ಲೇಖನ.
7. ಶ್ರವಣ (ಕವನ) – ದ ರಾ ಬೇಂದ್ರೆ
8. ಡಾ. ವಿಶ್ವೇಶ್ವರಯ್ಯ – ವ್ಯಕ್ತಿ ಮತ್ತು ಐತಿಹ್ಯ (ವ್ಯಕ್ತಿ ಚಿತ್ರ) – ಎ ಎನ್ ಮೂರ್ತಿರಾವ್
9. ದೋಣಿ ಹರಿಗೋಲುಗಳಲ್ಲಿ (ಪ್ರವಾಸ ಕಥನ) – ಶಿವರಾಮ ಕಾರಂತ
10. ಅಣ್ಣಪ್ಪನ ರೇಷ್ಮೆ ಕಾಯಿಲೆ (ಪ್ರಬಂಧ) – ಕುವೆಂಪು
11. ನಮ್ಮ ಎಮ್ಮೆಗೆ ಮಾತು ತಿಳಿಯುವುದೆ? (ವಿನೋದ) – ಗೊರೂರು ರಾಮಸ್ವಾಮಿ ಅಯ್ಯಂಗಾರ್
12. ಆನೆಹಳ್ಳದಲ್ಲಿ ಹುಡುಗಿಯರು (ವಿಜ್ಞಾನ ಲೇಖನ) – ಬಿ ಜಿ ಎಲ್ ಸ್ವಾಮಿ
13. ಬೆಡ್ ನಂಬರ್ ಏಳು (ಕತೆ) – ತ್ರಿವೇಣಿ
14. ರೊಟ್ಟಿ ಮತ್ತು ಕೋವಿ (ಕವನ) – ಸು ರಂ ಎಕ್ಕುಂಡಿ
15. ಗುಬ್ಬಚ್ಚಿಯ ಗೂಡು (ಅಂಕಣ ಬರಹ) – ಪಿ ಲಂಕೇಶ್

16. ಚೀಂಕ್ರ ಮೇಸ್ತ್ರಿ ಮತ್ತು ಅರಿಸ್ಟಾಟಲ್ (ಪರಿಸರ ಲೇಖನ) – ಕೆ ಪಿ ಪೂರ್ಣಚಂದ್ರ ತೇಜಸ್ವಿ
17. ಗಾಂಧಿ (ಕತೆ) – ಬೆಸಗರಹಳ್ಳಿ ರಾಮಣ್ಣ
18. ಬೆಲ್ಚಿಯ ಹಾಡು (ಕವನ) – ಸಿದ್ಧಲಿಂಗಯ್ಯ
19. ಎಲ್ಲ ಹುಡುಗಿಯರ ಕನಸು (ಕವನ) – ಸವಿತಾ ನಾಗಭೂಷಣ
20. ನೀರು (ಕತೆ) – ಬಸವರಾಜ ಕುಕ್ಕರಹಳ್ಳಿ
21. ಕರ್ನಾಟಕ ಸಂಸ್ಕೃತಿಯ ಒಂದು ಚಿತ್ರಣ (ಪರಿಚಯ ಲೇಖನ) – ರಹಮತ್ ತರೀಕೆರೆ
22. ವೃತ್ತಿ ಶಿಕ್ಷಣದಲ್ಲಿ ಕನ್ನಡ ಮಾಧ್ಯಮ (ತಂತ್ರಜ್ಞಾನ ಬರಹ) – ಎಸ್ ಸುಂದರ್
23. ಕೊಣಪೇಗೌಡ (ಕಾವ್ಯ) – ಜಾನಪದ

ಪಠ್ಯಪುಸ್ತಕಗಳು

1. ಕನ್ನಡ ಮನಸು – ಇಂಜಿನಿಯರಿಂಗ್ ಪ್ರಥಮ ಪದವಿ ತರಗತಿ ಕನ್ನಡ ಪಠ್ಯ. ಪ್ರಕಟಣೆ: ಪ್ರಸಾರಾಂಗ ಕನ್ನಡ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಹಂಪಿ.
2. ಕ್ಷನಡ – ಆಡಳಿತ ಕನ್ನಡ (ಪತ್ರಿಕೆ – 1, ಬ್ಲಾಕ್ 4) ಪ್ರಕಟಣೆ: ಕರ್ನಾಟಕ ರಾಜ್ಯ ಮುಕ್ತ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಮೈಸೂರು.
3. ಕರ್ನಾಟಕ ರಾಜ್ಯ ಮಟ್ಟದ ಸ್ಪರ್ಧಾತ್ಮಕ ಪರೀಕ್ಷೆಗಳ ಕನ್ನಡ ಸಾಹಿತ್ಯ ಮತ್ತು ಭಾಷೆ ಕುರಿತಾದ ಉತ್ತಮ ಪುಸ್ತಕಗಳು.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
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DAYANANDA SAGAR UNIVERSITY

SCHOOL OF ENGINEERING

SCHEME & SYLLABUS

FOR

BACHELOR OF TECHNOLOGY (B.Tech.) – 2020

COMPUTER SCIENCE & ENGINEERING (ARTIFICIAL INTELLIGENCE & MACHINE LEARNING)

(WITH EFFECT FROM 2020–21)

(III TO VIII SEMESTERS)

Dayananda Sagar University

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Artificial Intelligence & Machine Learning)

SCHEME – B.TECH — 2020–21 ONWARDS

III SEM - COMPUTER SCIENCE & ENGINEERING (ARTIFICIAL INTELLIGENCE & MACHINE LEARNING)

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	CR / AU	SCHEME OF TEACHING					PREREQUISITE	
					L	T	P	S/P	C	SEM	COURSE CODE
1	121	20CS2301	DISCRETE MATHEMATICAL STRUCTURES	CR	3	–	–	–	3	*	***
2	121	20CS2302	DATA STRUCTURES	CR	3	–	–	–	3	*	***
3	121	20CS2303	DIGITAL ELECTRONICS & LOGIC DESIGN	CR	3	–	–	2	4	*	***
4	121	20CS2304	DATABASE MANAGEMENT SYSTEMS	CR	3	–	–	–	3	*	***
5	121	20CS2305	COMPUTATIONAL THINKING WITH PYTHON	CR	3	–	–	–	3	*	***
6	121	20CS2306	AGILE SOFTWARE ENGINEERING	CR	2	–	–	2	3	*	***
7	121	20CS2307	DATA STRUCTURES LAB	CR	–	–	2	–	1	*	***
8	121	20CS2308	DATABASE MANAGEMENT SYSTEMS LAB	CR	–	–	2	–	1	*	***
9	121	20CS2309	MANAGEMENT AND ENTREPRENEURSHIP	CR	2	–	–	–	2	*	***
10	121	20CS2310	LIBERAL STUDIES – I	CR	1	–	–	–	1	*	***
					20	–	04	04	24		

CR – CREDIT, AU – AUDIT, L – LECTURE, T – TUTORIAL, P – PRACTICAL, S/P – SEMINAR/PROJECT, C – NO. OF CREDITS

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(Artificial Intelligence & Machine Learning)

SCHEME – B.TECH — 2020–21 ONWARDS

IV SEM - COMPUTER SCIENCE & ENGINEERING (ARTIFICIAL INTELLIGENCE & MACHINE LEARNING)

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	CR / AU	SCHEME OF TEACHING					PREREQUISITE	
					L	T	P	S/P	C	SEM	COURSE CODE
1	121	20CS2401	PROBABILITY AND STATISTICS	CR	3	–	–	–	3	*	***
2	121	20CS2402	OBJECT ORIENTED DESIGN AND PROGRAMMING	CR	3	–	–	–	3	*	***
3	121	20CS2403	PRINCIPLES OF MICROPROCESSORS AND COMPUTER ORGANIZATION	CR	4	–	–	–	4	*	***
4	121	20CS2404	FINITE AUTOMATA & FORMAL LANGUAGES	CR	3	–	–	2	4	*	***
5	121	20CS2405	INTRODUCTION TO NETWORKS & CYBERSECURITY	CR	3	–	–	–	3	*	***
6	121	20AM2401	ARTIFICIAL INTELLIGENCE - I	CR	3	–	–	–	3	*	***
7	121	20CS2407	OBJECT ORIENTED PROGRAMMING LAB	CR	–	–	2	–	1	*	***
8	121	20CS2408	MICROPROCESSORS LABORATORY	CR	–	–	2	–	1	*	***
9	121	20CS2409	SPECIAL TOPICS - I	CR	–	–	–	4	2	*	***
10	121	20CS2410	LIBERAL STUDIES – II	CR	1	–	–	–	1	*	***
					20	–	04	06	25		

CR – CREDIT, AU – AUDIT, L – LECTURE, T – TUTORIAL, P – PRACTICAL, S/P – SEMINAR/PROJECT, C – NO. OF CREDITS

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Artificial Intelligence & Machine Learning)

SCHEME – B.TECH — 2020–21 ONWARDS

V SEM - COMPUTER SCIENCE & ENGINEERING(AI & ML)

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	CR/ AU	SCHEME OF TEACHING					PREREQUISITE	
					L	T	P	S/ P	C	SEM	COURSE CODE
1	121	20CS3501	COMPUTER NETWORKS	CR	3	–	2	–	4	*	***
2	121	20CS3502	DESIGN AND ANALYSIS OF ALGORITHMS	CR	3	–	–	–	3	*	***
3	121	20CS3503	OPERATING SYSTEMS	CR	3	1	–	–	4	*	***
4	121	20CS3504	MACHINE LEARNING	CR	3	–	2	–	4	*	***
5	121	20CS35XX	PROFESSIONAL ELECTIVE–1	CR	3	–	–	–	3	*	***
6	121	20OE00XX	OPEN ELECTIVE–1	CR	3	–	–	–	3	*	***
7	121	20CS3505	DESIGN AND ANALYSIS OF ALGORITHMS LAB	CR	–	–	2	–	1	*	***
8	121	20CS3506	OPERATING SYSTEMS LAB	CR	–	–	2	–	1	*	***
9	121	20CS3507	SPECIAL TOPICS -II	CR		–	–	4	2	*	***
					18	1	8	4	25		

CR – CREDIT, AU – AUDIT, L – LECTURE, T – TUTORIAL, P – PRACTICAL, S/P – SEMINAR/PROJECT, C – NO. OF CREDITS

PROFESSIONAL ELECTIVE – I

SL	COURSE CODE	COURSE TITLE	SCHEME OF TEACHING					PREREQUISITE	
			L	T	P	S/ P	C	SEM	COURSE CODE
1	20AM3501	MACHINE LEARNING FOR PATTERN RECOGNITION	03	–	–	–	03	*	***
2	20AM3502	PRINCIPLES OF ROBOTICS	03	–	–	–	03	*	***

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Artificial Intelligence & Machine Learning)

SCHEME – B.TECH — 2020–21 ONWARDS

VI SEM - COMPUTER SCIENCE & ENGINEERING-AIML

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	CR/ AU	SCHEME OF TEACHING					PREREQUISITE	
					L	T	P	S/ P	C	SEM	COURSE CODE
1	121	20CS3601	COMPILER DESIGN AND SYSTEM SOFTWARE	CR	3	1	–	–	4	*	***
2	121	20AM3601	DEEP LEARNING	CR	3	–	–	–	3	I/II	20CS2401
3	121	20AM3602	ARTIFICIAL INTELLIGENCE -II	CR	3	–	–	–	3	*	***
4	121	20AM36XX	PROFESSIONAL ELECTIVE-2	CR	3	–	–	–	3	*	***
5	121	20AM36XX	PROFESSIONAL ELECTIVE-3	CR	3	–	–	–	3	*	***
6	121	20OE00XX	OPEN ELECTIVE-2	CR	3	–	–	–	3	*	***
7	121	20CS3604	COMPILER DESIGN AND SYSTEM SOFTWARE LAB	CR	–	–	2	–	1	*	***
8	121	20AM3603	ARTIFICIAL INTELLIGENCE -LAB	CR	–	–	2	–	1	*	***
					17	01	06	–	21		

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VI SEM-PROFESSIONAL ELECTIVE – II & III

SL	COURSE CODE	COURSE TITLE	SCHEME OF TEACHING					PREREQUISITE	
			L	T	P	S/P	C	SEM	COURSE CODE
1	20AM3604	INTRODUCTION TO COMPUTER VISION	3	–	–	–	03	*	***
2	20AM3605	REINFORCEMENT LEARNING	3	–	–	–	03	*	***
3	20AM3606	INDUSTRIAL ROBOTICS	3	–	–	–	03	*	***
4	20AM3607	EXPLAINABLE AI	3	–	–	–	03	I/II	20CS2401
5	20AM3608	NATURAL LANGUAGE MODELS	3	–	–	–	03	*	***
6	20AM3609	DATA SCIENCE	3	–	–	–	03	*	***
7	20AM3610	INTRODUCTION TO IOT AND EMBEDDED COMPUTING	3	–	–	–	03	*	***

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OPEN ELECTIVES LIST – B.TECH PROGRAMME — 2020-21 Batch

SL.No	COURSE CODE	COURSE TITLE	OFFERING DEPARTMENT
1	20OE0001	ARTIFICIAL INTELLIGENCE	CSE
2	20OE0002	DATA STRUCTURES & ALGORITHMS	CSE
3	20OE0003	WEB TECHNOLOGIES	CSE
4	20OE0004	SOCIAL NETWORKS & ANALYTICS	CSE
5	20OE0005	MANAGEMENT INFORMATION SYSTEM	CSE
6	20OE0006	FUNDAMENTALS OF CLOUD COMPUTING	CSE
7	20OE0007	MACHINE LEARNING WITH PYTHON	CSE
8	20OE0008	BUSINESS INTELLIGENCE	CSE
9	20OE0009	EVOLUTION OF TELECOM	ECE
10	20OE0010	SENSORS AND TRANSDUCERS	ECE
11	20OE0011	DIGITAL SYSTEM DESIGN	ECE
12	20OE0012	SENSORS, NETWORKS AND PROTOCOLS	ECE
13	20OE0013	IMAGE PROCESSING AND COMPUTER VISION	ECE
14	20OE0014	AUTOMOTIVE EMBEDDED SYSTEMS	ECE
15	20OE0015	AUTOMOBILE ENGINEERING	MECH
16	20OE0016	RAPID MANUFACTURING TECHNOLOGIES	MECH
17	20OE0017	ROBOTICS ENGINEERING	MECH
18	20OE0018	PRODUCT DESIGN & MANUFACTURING	MECH
19	20OE0019	RENEWABLE ENERGY SOURCES	MECH
20	20OE0020	MICRO ELECTRO MECHANICAL SYSTEMS (MEMS)	MECH
21	20OE0021	PRODUCT ENGINEERING AND ENTREPRENEURSHIP	CST
22	20OE0022	SMALL BUSINESS LAUNCH	CST
23	20OE0023	INTRODUCTION TO AEROSPACE ENGINEERING	ASE

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24	20OE0024	AIRCRAFT SYSTEMS AND INSTRUMENTATION	ASE
25	20OE0025	FOUNDATIONS OF DATA SCIENCE	CSE
26	20OE0026	CALCULUS II	MATH
27	20OE0027	IDEA GENERATION AND VALIDATION	CST
28	20OE0030	INDUSTRIAL ROBOTICS	AIML

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SCHEME - B.TECH – 2020-21 ONWARDS

VII SEM - COMPUTER SCIENCE & ENGINEERING (ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	CR/ AU	SCHEME OF TEACHING					PRE-REQUISITE	
					L	T	P	S/P	C	SEM	COURSE CODE
1	121	20AM47XX	PROFESSIONAL ELECTIVE – 4	CR	3	-	-	-	3	*	AS INDICATED IN THE ELECTIVE LIST
2	121	20AM47XX	PROFESSIONAL ELECTIVE – 5	CR	3	-	-	-	3	*	
3	121	20OEXXXX	OPEN ELECTIVE-3	CR	3	-	-	-	3	*	***
4	121	20AM4701	MAJOR PROJECT PHASE-I	CR	-	-	-	4	2	*	***
					09			**04**	**11**		

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VII SEM-PROFESSIONAL ELECTIVE – IV&V

SL	COURSE CODE	COURSETITLE	SCHEME OF TEACHING					PRE-REQUISITE	
			L	T	P	S/P	C	SEM	COURSE CODE
1	20AM4702	MACHINE LEARNING FOR HEALTHCARE	3			-	03	V	20CS3504
2	20AM4703	SPEECH AND NLP	3			-	03	-	-
3	20AM4704	ADVANCED DEEP LEARNING	3				03	VI	20AM3601
4	20AM4705	CLOUD COMPUTING	3				03		
5	20AM4706	GPU ARCHITECTURE AND PROGRAMMING	3				03	-	-
6	20AM4707	UG RESEARCH PROJECT-I	--			06	03	-	-

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SCHEME - B.TECH – 2020-21 ONWARDS

VIII SEM - COMPUTER SCIENCE & ENGINEERING (ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	CR/ AU	SCHEME OF TEACHING					PRE-REQUISITE	
					L	T	P	S/ P	C	SEM	COURSE CODE
1	121	20AM48XX	PROFESSIONAL ELECTIVE – 6	CR	3	-	-	-	3	*	AS INDICATED IN THE ELECTIVE LIST
2	121	20AM4801	MAJOR PROJECT PHASE – II	CR	-	-	-	12	6	*	***
3	121	20AM4802	INTERNSHIP	CR				6	3		
					03	**-**	**-**	**18**	**12**		

CR – Credit, AU – Audit, L – Lecture, T – Tutorial, P – Practical, S/P – Seminar/Project, C – No. of Credits

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VIII SEM-PROFESSIONAL ELECTIVE – VI

SL	COURSE CODE	COURSE TITLE	SCHEME OF TEACHING					PREREQUISITE	
			L	T	P	S / P	C	SEM	COURSE CODE
1	20AM4803	MOBILE COMPUTING AND ANDROID APPLICATION DEVELOPMENT	3			-	03	IV	20CS2402
2	20AM4804	RESPONSIBLE AI AND ETHICS	3			-	03	-	-
3	20AM4805	HUMAN-COMPUTER INTERACTION	3			-	03	-	-
4	20AM4806	UG RESEARCH PROJECT-II	--	--		06	03	-	-

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EMESTER	**III**					
YEAR	**II**					
COURSE CODE	**20CS2301**					
TITLE OF THE COURSE	**DISCRETE MATHEMATICAL STRUCTURES**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	PracticalHours	Seminar/ProjectsHours	Total Hours	Credits
	3	**-**	**-**	**-**	**42**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES :

- Solve problems using relations and generating functions.
- Understand and Construct mathematical arguments.
- Use propositional and predicate logic in knowledge representation and program verification.
- Develop recursive algorithms based on mathematical induction.
- Know essential concepts in graph theory and related algorithms.
- Apply knowledge of discrete mathematics in Elementary Number Theory and problem solving.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Classify functions, basic set theory relations.	L4
CO2	Demonstrate the correctness of an argument using propositionaland predicate logic, laws and truth tables.	L2
CO3	Compare and differentiate graphs in different geometries related to edges.	L4
CO4	Apply mathematical induction, counting principles,recursion, elementary number theory.	L3
CO5	Apply and solve Euclidean Division Algorithm and ChineseRemainder Theorem.	L3

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COURSE CONTENT:	
MODULE 1	**9Hrs**
RELATIONS AND FUNCTIONS: Relation and Types of relations, Closure Properties, Equivalence Relations, Partial Ordering Relations, n-ary relations, Functions: one-to-one, onto and invertible functions, sequences, indexed classes of sets, recursively defined functions, cardinality Counting Principles: Permutation, combination, the pigeon hole principle,inclusion-exclusion principle Self – Learning Component: Set theory definition and Properties	
MODULE 2	**8Hrs**
LOGIC: Propositions and truth tables, tautologies and contradictions, logical equivalence, algebra of propositions, logical implications, predicate logic, theory of inference for propositional logic and predicate logic. Introduction to Predicate Calculus.	
MODULE 3	**9Hrs**
NUMBER THEORY : Properties of Integers: Introduction, order and inequalities, absolute value, mathematical induction, division algorithm, divisibility, primes, greatest common divisor, Euclidean algorithm, fundamental theorem of arithmetic, congruence relation, congruence equations and Chinese Reminder Theorem (CRT).	
MODULE 4	**7Hrs**
GRAPH THEORY: Graphs and multi-graphs, sub-graphs, isomorphic and homomorphic graphs, paths, connectivity, Euler and Hamilton paths, labelled and weighted graphs, complete, regular and bipartite graphs, planargraphs.	
MODULE 5	**9Hrs**
TREES AND GRAPH COLORING: Trees: Definitions-properties - fundamental theorems of trees-rooted trees-binary trees-spanningtrees- Kruskal's Algorithm- Prims Algorithm- Cut-Set, BFS and DFS. Coloring of planar graphs, Chromatic Number- Chromatic partitioning- The four ColorProblem-Five-color and Four-color theorem- Thickness and crossing.	

TEXT BOOKS :

1. K. H. Rosen, Discrete Mathematics & its Applications, 7th Ed., Tata McGraw-Hill, 2007.
2. Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science, PrenticeHall India (PHI).

REFERENCES:

1. M.Huth and M. Ryan, Logic in Computer Science, Cambridge University N.Press, 2004.

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SEMESTER	**III**					
YEAR	**II**					
COURSE CODE	**20CS2302**					
TITLE OF THE COURSE	**DATA STRUCTURES**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**-**	**-**	**42**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
1	I/II	20EN1103	FUNDAMENTALS OF PROGRAMMING

COURSE OBJECTIVES :

- To introduce the concept of data structure and its applications
- To introduce C language concepts required for data structures
- To design data structure operations to solve problems
- To introduce applications of data structures
- To introduce non-primitive data structures
- To analyse the complexity of a data structure
- To introduce static and dynamic memory allocation using C language
- To explain linear data structures – stack, queue, linked list
- To explain non-linear data structures – trees and graphs
- To train students to design an application as part of the course mini- project using theirchoice of data structure using C language.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Outline basic C program design for data structures	L2
CO2	Iimplement stack & queue data structure and their applications	L3
CO3	Apply concepts of dynamic memory allocation to real-time Problems	L3
CO4	Implement tree data structure and its applications	L3
CO5	Implement graph data structure and its applications	L3

CO6	Outline the concepts of file structures	L2

COURSE CONTENT:	
MODULE 1	**8Hrs**
INTRODUCTION TO DATA STRUCTURES: Definition, Types, Algorithm Design, C Pointers, C Structure, Array Definition, Representation of Linear Array in Memory, Array Operations (Insertion, Deletion, Search and Traversal), Single Dimensional Arrays, Two Dimensional Arrays, Function Associated with Arrays, Arrays as Parameters, Recursive Functions.	
MODULE 2	**9Hrs**
INTRODUCTION TO STACK AND QUEUE: **Stack:** Definition, Array Representation of Stack, Operations Associated with Stacks- Push & Pop,Applications of Stack: Recursion, Polish expressions, Conversion of Infix to Postfix, Infix to Prefix,Postfix Expression Evaluation, Tower of Hanoi. **Queue:** Definition, Representation of Queues, Operations of Queues- QInsert, QDelete, PriorityQueues, Circular Queue.	
MODULE 3	**9Hrs**
DYNAMIC DATA STRUCTURE: **Linked List:** Types, Introduction to Singly Linked lists: Representation of Linked Lists in Memory, Traversing, Searching, Insertion & Deletion from Linked List. Doubly Linked List, Operations on Doubly Linked List (Insertion, Deletion, Traversal). Applications: Polynomial Representation & Basic Operations, Stack & Queue Implementation using Linked Lists.	
MODULE 4	**9Hrs**
TREES & GRAPHS: **Trees:** Basic Terminology, Binary Trees and their Representation, Complete Binary Trees, BinarySearch Trees, Operations on Binary Trees (Insertion, Deletion, Search & Traversal), Application: Expression Evaluation. **Graphs:** Terminology and Representations, Graphs & Multigraphs, Directed Graphs, Sequential Representation of Graphs, Adjacency Matrices, Graph Transversal, Connected Components and Spanning Trees.	
MODULE 5	**7Hrs**
FILE STRUCTURES: Physical storage media, File Organization, Linked Organization of File, Inverted File, Organization Records into Blocks, Sequential Blocks, Indexing & Hashing, Multilevel Indexing, Tree Index, Random File, Primary Indices, Secondary Indices.	

TEXT BOOKS :

1. A M Tannenbaum, Y Langsam, M J Augentien “Data Structures using C”, Pearson, 2013
2. R.L. Kruse, B.P. Leary, C.L. Tondo, “Data Structure and Program Design in C” PHI

REFERENCES :

1. Horowitz Anderson-Freed, and Sahni, "Fundamentals of Data structures in C", 2nd Edition,Orient Longman, 2008
2. Data Structures and Algorithm analysis in C by Mark Allen Weiss, Published by Addison Wesley (3rd Indian Reprint 2000).
3. D E Knuth, The Art of Computer Programming, Volume 1, Addison-Wesley Publishing, 2013

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SEMESTER	**III**					
YEAR	**II**					
COURSE CODE	**20CS2303**					
TITLE OF THE COURSE	**DIGITAL ELECTRONICS & LOGIC DESIGN**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**-**	**2**	**42**	**4**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES :

- To understand various number systems and conversion from one to other number systems
- To introduce basic postulates of Boolean algebra
- To manipulate expressions into POS or SOP form.
- To introduce the methods for simplifying Boolean expressions like K-Map and Quine Mclusky
- To understand the concept of don't care conditions and how they can be used to further optimize the logical functions
- To design simple combinational circuits such as multiplexers, decoders, encoders
- To understand the differences between combinational and sequential Logic circuits
- To familiar with basic sequential logic component-SR Latch
- To understand the basics of various types of memories.
- To present the working of various Flip- Flops (T flip-flop, D flip-flop, R-S flip-flop, JK flip-flop)
- To get familiarized with State Diagram, State Table, State Assignment
- To design combinational circuits using programmable logic devices.
- To design sequential circuits such as different types of Counters, Shift Registers

COURSE OUTCOMES :

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Demonstrate the knowledge of binary number systems,logic families, Boolean algebra and logic gates	L2
CO2	Analyze different methods used for simplification of Boolean expressions	L4
CO3	Design combinational logic circuits using combinationallogic elements	L3
CO4	Design combinational circuits using Programmable Logic Devices	L3

CO5	Analyze sequential logic elements in the design of synchronous and asynchronous systems	L4
CO6	Design sequential systems composed of standard sequential modules, such as counters and registers	L3

COURSE CONTENT:	
MODULE 1	**9Hrs**
NUMBER SYSTEMS: BCD number representation, Unsigned and signed number representation, Binary arithmetic. **BOOLEAN ALGEBRA AND SIMPLIFICATION:** Laws of Boolean algebra, Theorems of Boolean algebra, Boolean/Switching functions and their implementation. **SIMPLIFICATION OF BOOLEAN EXPRESSIONS AND FUNCTIONS:** Sum-of-Products Method, Truth Table to Karnaugh Map, Pairs Quads, and Octets,Karnaugh Simplifications, Don't-care Conditions. Product-of-sums Method, Product-of-sums simplifications, Simplification by Quine-McClusky Method.	
MODULE 2	**8Hrs**
DESIGN OF COMBINATIONAL LOGIC CIRCUITS: Modular combinational logic elements- Multiplexers and Demultiplexers, Decoders,Magnitude comparator, BCD converter, Encoders, Priority encoders.	
MODULE3	**7Hrs**
PROGRAMMABLE LOGIC: Programmable Logic Arrays, Design of Combinational Circuits using Programmable Logic Devices (PLDs): Programmable Read Only Memories (PROMs), Programmable Logic Arrays (PLAs), Programmable ArrayLogic (PAL) devices.	
MODULE 4	**9Hrs**
INTRODUCTION TO SEQUENTIAL CIRCUITS : Introduction to Sequential Circuits. Combinational Vs sequential circuits, Clock, Clock Triggering, Memory elements and their excitation functions – Latches, T flip-flop, D flip-flop, R-S flip-flop. JK flip- flop and their excitation requirements, State diagram,state table and state equation, Design of synchronous sequential circuits like Sequence Detectors and binary counters.	
MODULE 5	**9Hrs**
APPLICATION OF LOGIC CIRCUITS SEQUENTIAL CIRCUITS (REGISTERS AND COUNTERS): Registers-Types of Registers, Serial In - Serial Out, Serial In - Parallel out, Parallel In - Serial Out, ParallelIn -Parallel Out, Universal Shift Register, Applications of Shift Registers, Asynchronous and SynchronousCounters	

TEXT BOOKS :

1. M. Morris Mano and Michael D. Ciletti, "Digital Design", 6th Edition,N.Pearson Education, 2018

2. Donald.P. Leach, Albert Paul Malvino & Goutam Saha: Digital Principles and Applications, 8thEdition, Tata McGraw Hill, 2015

REFERENCES :

1. D Sudhaker Samuel: Illustrative Approach to Logic Design, Sanguine-Pearson, 2010.
2. Charles H. Roth: Fundamentals of Logic Design, Jr., 7th Edition, Cengage Learning, 2014
3. John M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2006.

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SEMESTER	**III**					
YEAR	**II**					
COURSE CODE	**20CS2304**					
TITLE OF THE COURSE	**DATABASE MANAGEMENT SYSTEMS**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	PracticalHours	Seminar/ProjectsHours	Total Hours	Credits
	3	**-**	**-**	**-**	**42**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES :

- To learn data models, conceptualize and depict a database system using ER diagram
- To understand the internal storage structures in a physical DB design
- To know the fundamental concepts of transaction processing techniques

COURSE OUTCOMES

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Demonstrate the basic elements of a relational database management system	L2
CO2	Identify the data models for relevant problems	L2
CO3	Apply normalization for the development of application software's	L3
CO4	Use Structured Query Language (SQL) for database manipulation.	L3
CO5	Understand transactions and their properties (ACID)	L2
CO6	Design and develop a large database with optimal query processing	L6

COURSE CONTENT:	
MODULE 1	**8Hrs**

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Introduction: Purpose of Database System--Views of data–data models, database management system,three-schema architecture of DBMS, components of DBMS. E/R Model - Conceptual data modeling - motivation, entities, entity types, attributes relationships, relationship types, E/R diagram notation,examples.	
MODULE 2	**9Hrs**
Relational Model: Relational Data Model - Concept of relations, schema-instance distinction, keys, referential integrity and foreign keys, relational algebra operators, SQL -Introduction, data definition in SQL, table, key and foreign key definitions, update behaviors. Querying in SQL, notion of aggregation, aggregation functions group by and having clauses. .	
MODULE 3	**9Hrs**
Database Design: Dependencies and Normal forms, dependency theory –functional dependencies, Armstrong's axioms for FD's, closure of a set of FD's, minimal covers, definitions of 1NF, 2NF, 3NF and BCNF, decompositions and desirable properties of them, algorithms for 3NF and BCNF normalization, 4NF, and 5NF	
MODULE 4	**9Hrs**
Transactions: Transaction processing and Error recovery - concepts of transaction processing, ACID properties, concurrency control, locking based protocols for CC, error recovery and logging, undo, redo,undo-redo logging and recovery methods.	
MODULE 5	**7Hrs**
Embedded SQL: triggers, procedures and database connectivity. Introduction to NoSQL	

TEXT BOOKS :

1. Silberschatz, Henry F. Korth, and S. Sudharshan, "Database System Concepts", 5thEd, TataMcGraw Hill, 2006.
2. J. Date, A. Kannan and S. Swamynathan, "An Introduction to Database Systems", 8thed, PearsonEducation, 2006.

REFERENCES :

1. Ramez Elmasri and Shamkant B. Navathe, "Fundamentals of Database Systems", Fourth Edition,Pearson/Addision Wesley, 2007
2. Raghu Ramakrishnan, "Database Management Systems", Third Edition, McGraw Hill, 2003
3. S. K. Singh, "Database Systems Concepts, Design and Applications", First T. Edition, Pearson Education, 2006

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SEMESTER	**III**					
YEAR	**II**					
COURSE CODE	**20CS2305**					
TITLE OF THE COURSE	**COMPUTATIONAL THINKING WITH PYTHON**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**-**	**-**	**42**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES :

- To understand basic concepts of computational thinking.
- To introduce python programming for problem solving.
- To introduce different debugging and unit testing tools.
- To solve real world problems using python data structures.
- Learn to handle files and exception handling in python.
- To explore Python's object-oriented features.
- To build Web services and Networked programs in python.
- To train students to design an application as part of the course mini- project using computationalthinking with python.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Understand basic concepts of computational thinking.	L2
CO2	Outline basic python programming for problem solving.	L2
CO3	Apply computational thinking to solve real world programs usingPython	L3
CO4	Build python programs using core data structures like list, dictionaries and tuples	L3
CO5	Implement object oriented concepts using python	L3
CO6	Design applications related to web services and network Programming.	L3

COURSE CONTENT:

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MODULE 1	**8Hrs**
INTRODUCTION TO COMPUTATIONAL THINKING AND PYTHON: Introduction to computational thinking: Stages of Computational thinking, Design using Flowcharts,Implementation, Testing Python Basics: Values, expressions and statements, Conditional execution, Functions Iterations	
MODULE 2	**9Hrs**
PYTHON ENVIRONMENT AND DATA STRUCTURES : Python Environment: Usage of Debugging and Unit Testing tools in python, Introduction to Github, Executing the python programs using Jupyter notebooks, Python Data Structures: Strings, Arrays,Lists, Tuples, Sets and Dictionaries	
MODULE 3	**9Hrs**
PYTHON FILES AND EXCEPTION HANDLING: Files: File types, modes, File functions, File attributes, File positions, Looping over file, Exception Handling: Try-Except, Exception syntax, examples, Types of exception with except, multiple exceptions with except, Try-Finally, Raise exceptions with arguments, Python built-in exceptions, User-defined exceptions, Assertions	
MODULE 4	**9Hrs**
PYTHON OBJECTS : Classes and Objects: Creating classes, Using Objects, Accessing attributes, Classes as Types, Introduction to Multiple Instances, Inheritance.	
MODULE 5	**7Hrs**
Applications of Python Applications: Networked Programs, Using web services	

TEXT BOOKS :

1. "Python for Everybody-Exploring Data Using Python 3", Dr. Charles R. Severance,
2. "Introduction to Computing & Problem Solving with Python",Jeeva Jose,P.Sojan Lal,Khanna Book Publishing; First edition (2019).

REFERENCES :

1. "Computer Science Using Python: A Computational Problem- Solving Focus", Charles Dierbach, Introduction John Wiley, 2012.
2. "Introduction to Computation and Programming Using Python", John V Guttag,PrenticeHall of India, 2015.
3. "How to think like a Computer Scientist, Learning with Python", Allen Downey,Jeffrey Elkner and Chris Meyers, Green Tea Press, 2014.
4. "Learning to Program with Python", Richard L. Halterman, 2011.

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SEMESTER	**III**					
YEAR	**II**					
COURSE CODE	**20CS2306**					
TITLE OF THE COURSE	**AGILE SOFTWARE ENGINEERING**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	2	**-**	**-**	**2**	**42**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES :

- Agile methodology, Scrums, Sprints.
- Agile testing, test automation, DevOps.

COURSE OUTCOMES :

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Compare and contrast the differences between Agile and other project management methodologies	L4
CO2	Interpret and apply various principles, phases and activities of theScrum methodology	L3
CO3	Define the benefits of using an Agile approach to managing projects	L2
CO4	Understand Agile Testing principles for real life situations and learnthe basics of SAFe for scaled agile	L2
CO5	Identify and use various tools for Agile development and DevOpsprinciples for CI/CD	L3

COURSE CONTENT:	
MODULE 1	**9Hrs**
INTRODUCTION TO AGILE : Introduction to Software engineering, SDLC, Software process models- waterfall, V model, Iterative model, Spiral model; Introduction to Agile: Agile versus traditional method comparisons and process tailoring; Introduction to Agile, Various Agile methodologies -Scrum, XP, Lean, and Kanban, Agile Manifesto.	
MODULE 2	**9Hrs**

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SCRUM AND SPRINT: Scrum: Scrum process, roles - Product Owner, Scrum Master, Team, Release manager, Project Manager,product manager, architect, events, and artifacts; Product Inception: Product vision, stakeholders, initialbacklog creation; Agile Requirements – User personas, story mapping, user stories, 3Cs, INVEST, acceptance criteria, sprints, requirements, product backlog and backlog grooming; Test First Development; Pair Programming and Code reviews;	
MODULE 3	9**Hrs**
AGILE PROJECT MANAGEMENT: Sprint Planning, Sprint Reviews, Sprint Retrospectives, Sprint Planning - Agile release and iteration (sprint) planning, Develop Epics and Stories, Estimating Stories, Prioritizing Stories (WSJF technique from SAFe), Iterations/Sprints Overview. Velocity Determination, Iteration Planning Meeting, Iteration, Planning Guidelines, Development, Testing, Daily Stand-up Meetings, Progress Tracking, Velocity Tracking, Monitoring and Controlling: Burn down Charts, Inspect & Adapt (Fishbone Model), Agile Release Train	
MODULE 4	**7Hrs**
AGILE TESTING : Testing: Functionality Testing, UI Testing(Junit, Sonar), Performance Testing, Security Testing, A/ Btesting; Agile Testing: Principles of agile testers; The agile testing quadrants, Agile automation, Test automation pyramid; Test Automation Tools - Selenium, Traceability matrix;	
MODULE 5	**8Hrs**
DEVOPS: DevOps: Continuous Integration and Continuous Delivery; CI/CD: Jenkins, Git/Github Creating pipelines,Setting up runners Containers and container orchestration (Dockers and Kubernetes) for application development and deployment; Build tools - maven; Checking build status; Configuration management - puppet, chef, ansible; Fully Automated Deployment; CM - Continuous monitoring with Nagios; Introduction to DevOps on Cloud	

List of Laboratory/Practical Experiments activities to be conducted :
1. Setting up Devops Environment
2. Writing Requirements Document, Requirement Analysis (user stories)
3. Estimation and Scrum Planning
4. Implementation and Testing Using Iterative Sprint Model
5. Test Automation using Selenium
6. Unit Testing using Junit or Sonar or Python Test framework
7. CI/CD using Jenkins as Orchestrion platform
8. Containerzation using Docker or Kubernetes

TEXT BOOKS :

1. Essential Scrum: A Practical Guide to the Most Popular Agile Process Kenneth S.Rubin 2012,published by Addison-Wesley Professional

2. Agile Software Development: The Cooperative Game Alistair Cockburn 2nd Edition,2006, Addison-Wesley Professional

REFERENCES :

1 Scrum and XP from the Trenches Henrik Kniberg 2nd Edition, 2015, Published by C4Media,publisher of InfoQ.com
2. Agile Project Management: Creating Innovative Products, Second Edition By Jim Highsmith,Addison-Wesley Professional, 2009
3. Agile Project Management: Managing for Success, By James A. Crowder, Shelli Friess, Springer 2014
4. Learning Agile: Understanding Scrum, XP, Lean, and Kanban, By Andrew Stellman, Jennifer Greene, 2015, O Reilly
5. DevOps: Continuous Delivery, Integration, and Deployment with DevOps: Dive ... By Sricharan Vadapalli, Packt, 2018
6. Agile Testing: A Practical Guide For Testers And Agile Teams, Lisa Crispin, Janet Gregory, Pearson, 2010
7. More Agile Testing: Learning Journeys for the Whole Team By Janet Gregory, Lisa Crispin, Addison Wesley, 2015
8. DevOps: Puppet, Docker, and Kubernetes By Thomas Uphill, John Arundel, Neependra Khare,Hideto Saito, Hui-Chuan Chloe Lee, Ke-Jou Carol Hsu, Packt, 2017

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SEMESTER	**III**					
YEAR	**II**					
COURSE CODE	**20CS2309**					
TITLE OF THE COURSE	**MANAGEMENT & ENTREPRENEURSHIP**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	2		**-**	**-**	**30**	**2**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES :

- Identify and analyze the factors that contribute to the process of successfully launching an entrepreneurial venture and managing a new business.
- Learn the entrepreneurial process from idea generation to implementation.
- Acquaint with special problems of starting new ventures, finding products and services, which cansupport new enterprises, and raising capital.
- Discuss how to start own business and also to work in or with small business or are involved withentrepreneurship.

COURSE OUTCOMES :

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Demonstrate knowledge of the key elements of the entrepreneurial process	L2
CO2	Employ strategies to generate new ideas for startups	L2
CO3	Outline how to protect IP legally	L2
CO4	Examine different ways of generating funding	L2
CO5	Explain organizing managing people, finance and customers	L2

COURSE CONTENT:	
MODULE 1	**6Hrs**

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OVERVIEW OF ENTREPRENEURSHIP: THE ENTREPRENEURIAL PERSPECTIVE :

Nature and Development of Entrepreneurship. Defining Manager, Entrepreneur, Entrepreneurship andEntrepreneurship. Key Elements of Entrepreneurship. Personality Characteristics of Successful Entrepreneurs. Common Myths about Entrepreneurs. Ethics and Social Responsibility of Entrepreneurs. Types of Start-Up Firms. Process of New Venture Creation. Role of Entrepreneurship in Economic Development. Emerging Trends and Issues in Entrepreneurship.

Case Study: Successful Entrepreneurs Narayana Murthy Infosys

MODULE 2	**6Hrs**

THE ENTREPRENEURIAL AND ENTREPRENEURIAL MIND:

The Entrepreneurial Process: Identify and Evaluate the Opportunity, Develop a Business Plan, Determinethe Resources Required, Manage the Enterprise. Managerial Versus Entrepreneurial Decision Making: Strategic Orientation, Commitment to Opportunity, Commitment of Resources, Control of Resources, Management Structure, Entrepreneurial Venturing inside a Corporation, Causes for Interest in Entrepreneurship, Climate for Entrepreneurship, Entrepreneurial Leadership Characteristics.

Case study: How to develop effective Business Plan

MODULE 3	**6Hrs**

CREATIVITY AND BUSINESS IDEA :

Identify and Recognizing Opportunities: Observing Trends and Solving Problems. Creativity: Concept, Components and Types of Creativity, Stages of Creative Process. Sources of New Venture Ideas.Techniques for Generating Ideas. Stages of Analyzing and Selecting the Best Ideas. Protecting the Idea:Intellectual Property Rights and its Components. Linking Creativity, Innovation and Entrepreneurship. **Case study : Application of Design Thinking in New business ideas generation in particular sector (Health care, Water Saving, Energy saving)**

MODULE 4	**6Hrs**

PREPARING THE PROPER ETHICAL AND LEGAL FOUNDATION:

Initial Ethical and Legal Issues Facing a New Firm, Establishing a Strong Ethical Culture, Choosing an attorney (Lawyer), Drafting a founder's agreement, Avoiding legal disputes, Choosing a form of business organization, Obtaining business licenses and permits, Choosing a Form of Business Ownership (Sole, Proprietorship, Partnership, Corporation & Limited Liability Company)

Case study: Startup Law A to Z IP

https://techcrunch.com/2019/02/25/startup-law-a-to-z-intellectual-property/

MODULE 5	**6Hrs**

MANAGING EARLY GROWTH AND CHALLENGES

Recruiting and Selecting Key Employees. Lenders and Investors. Funding Requirements: Sources of Personal Financing. Venture Capital. Commercial Banks. Sources of Debt Financing. Key Marketing Issues for New Ventures. Why marketing is critical for Entrepreneurs. Entrepreneurs face unique Marketing Challenges. Guerrilla Marketing. Business Growth: Nature of Business Growth, Planning for Growth, Reasons for Growth. Managing Growth: Knowing and Managing the Stages of Growth, Challenges of Growing a Firm. Strategies for Firms Growth: Internal and External Growth Strategies. Implications of Growth for the Firm and Entrepreneur. Entrepreneurial Skills and Strategies to OvercomePressures On: Financial Resources (Financial Control, Managing Inventory and Maintaining Good Records). Human Resources, Management of Employees, Time Management.

Case study: 9 ways to get startups funded

https://www.quicksprout.com/how-to-get-your-startup-funded/

TEXT BOOKS :

1. Barringer, Ireland, "Entrepreneurship: Successfully Learning New Ventures", Pearson,Latest Edition.
2. Hisrich, Peters, Shepherd, "Entrepreneurship", Mc Graw Hill, Sixth Edition.

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SEMESTER	**III**					
YEAR	**II**					
COURSE CODE	**20CS2307**					
TITLE OF THE COURSE	**DATA STRUCTURES LAB**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	PracticalHours	Seminar/ProjectsHours	Total Hours	Credits
	-	**-**	**2**	**-**	**30**	**1**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	**	**	***

COURSE OBJECTIVES:

- To introduce C language concepts required for data structures
- To design data structure operations to solve problems
- To introduce applications of data structures
- To implement linear data structures – stack, queue, linked list
- To implement non-linear data structures – trees and graphs

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Design and develop the programs in C to understand the differentconcepts of data structures.	L3
CO2	Implement stack & queue data structure and their applications, Analyse the output based on the given input data.	L3
CO3	Implement Conversions of Polish and reverse polish expressionsand Record Experimental process and results	L4
CO4	Apply and implement concepts of dynamic memoryallocation	L3
CO5	Use the concepts of file structures and communicate results effectively	L3

List of Laboratory/Practical Experiments activities to be conducted

Writing C programs:

1. To perform arithmetic storage/operations using arrays
2. To Implement C programs with concepts of pointers, structures
3. To implement multidimensional array Matrix Multiplication
4. To search element(s) in a multidimensional array
5. To search elements in data structure with different search methods
6. To implement stack , queue and their variations using arrays
7. To implement stack, queue and their variations using linked lists
8. To Implement Linked Lists and variations and use them to store data.
9. To implement graph & binary tree traversal techniques
10. To evaluate/convert infix/prefix/postfix expressions
11. To perform basic file operations

Open-Ended Experiments

1. A man in an automobile search for another man who is located at some point of acertain road. He starts at a given point and knows in advance the probability that the second man is at any given point of the road. Since the man being sought mightbe in either direction from the starting point, the searcher will, in general, must turn around many times before finding his target. How does he search to minimizethe expected distance travelled? When can this minimum expectation be achieved?

2. The computing resources of a cloud are pooled and allocated according to customer demand. This has led to increased use of energy on the part of the serviceproviders due to the need to maintain the computing infrastructure. What data structure will you use for allocating resources which addresses the issue of energysaving? Why? Design the solution.

3. Mini-Project on applying suitable data structure to a given real-world problem

Textbooks

1. A M Tannenbaum, Y Langsam, M J Augentien "Data Structures using C", Pearson, 2013
2. R.L. Kruse, B.P. Leary, C.L. Tondo, "Data Structure and Program Design in C" PHI

Reference Books

1. Horowitz Anderson-Freed, and Sahni, "Fundamentals of Data structures in C", 2nd Edition, OrientLongman, 2008
2. Data Structures and Algorithm analysis in C by Mark Allen Weiss, Published by Addison Wesley (3rdIndian Reprint 2000).
3. D E Knuth, The Art of Computer Programming, Volume 1, Addison-Wesley Publishing, 2013

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SEMESTER	**III**					
YEAR	**II**					
COURSE CODE	**20CS2308**					
TITLE OF THE COURSE	**DATABASE MANAGEMENT SYSTEMS LAB**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	PracticalHours	Seminar/ProjectsHours	Total Hours	Credits
	-	**-**	**2**	**-**	**30**	**1**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	**	**	****

COURSE OBJECTIVES :

- Understand the fundamental concepts of database management. These concepts include aspects of database design, database languages, and database-system implementation.
- To provide a strong formal foundation in database concepts, recent technologies and best industry practices.
- To give systematic database design approaches covering conceptual design, logical design and an overview of physical design.
- To learn the SQL and NoSQL database system.
- To learn and understand various Database Architectures and its use for application development.
- To programme PL/SQL including stored procedures, stored functions, cursors and packages

COURSE OUTCOMES :

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Install and configure database systems.	L3
CO2	Analyze database models & entity relationship models.	L3
CO3	Design and implement a database schema for a givenproblem-domain	L3
CO4	Understand the relational and document type database systems.	L2
CO5	Populate and query a database using SQL DML/DDL commands.	L3

List of Laboratory/Practical Experiments activities to be conducted
1. Design any database with at least 3 entities and relationships between them. Apply DCL and DDL commands. Draw suitable ER/EER diagram for the system.

2. Design and implement a database and apply at least 10 different DML queries for the following task. For a given input string display only those records which match
the given pattern or a phrase in the search string. Make use of wild characters and LIKE operator for the same. Make use of Boolean and arithmetic operators wherever necessary.
3. Execute the aggregate functions like count, sum, avg etc. on the suitable database.Make use of built in functions according to the need of the database chosen. Retrieve the data from the database based on time and date functions like now (),date (), day (), time () etc. Use group by and having clauses.
4. Implement nested sub queries. Perform a test for set membership (in, not in), set comparison (<some, >=some, <all etc.) and set cardinality (unique, not unique).
5. Write and execute suitable database triggers .Consider row level and statementlevel triggers.
6. Write and execute PL/SQL stored procedure and function to perform a suitable task on the database. Demonstrate its use.
7. Write a PL/SQL block to implement all types of cursor.
8. Execute DDL statements which demonstrate the use of views. Try to update thebase table using its corresponding view. Also consider restrictions on updatable views and perform view creation from multiple tables.
9. Mini project.

TEXT BOOKS :

1. Ramon A. Mata-Toledo, Pauline Cushman, Database management systems, TMGH,
ISBN: IS978-0-07-063456-5, 5th Edition.

REFERENCES :

1. Dr. P. S. Deshpande, SQL and PL/SQL for Oracle 10g Black Book,
DreamTech.
2. Ivan Bayross, SQL, PL/SQL: The Programming Language of Oracle, BPB Publication.
3. Dalton Patrik, SQL Server – Black Book, DreamTech Press.

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SEMESTER	**IV**					
YEAR	**II**					
COURSE CODE	**20CS2401**					
TITLE OF THE COURSE	**PROBABILITY AND STATISTICS**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	PracticalHours	Seminar/ProjectsHours	Total Hours	Credits
	3	**-**	**-**	**-**	**42**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES :

- Understand probability, random variable and random process concepts and theirimportance in Computer Engineering course.
- Calculate statistics related to Random variables and process such as mean, variance, etc.
- Evaluate standard distribution functions such as Poisson's, Normal distributions
- Apply functions of random variables such as characteristic function, moment generatingfunction to calculate statistics.
- Understand probability, random variable and random process concepts and theirimportance in Computer Engineering course.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Compute and interpret descriptive statistics using numerical and graphical techniques.	L4
CO2	Understand the basic concepts of random variables and find an appropriate distribution for analyzing data specific to anexperiment.	L2
CO3	Extend the concepts to multiple random variables and apply themto analyze practical problems.	L2
CO4	Make appropriate decisions using statistical inference that is the central to experimental research.	L4

COURSE CONTENT:	
MODULE 1	**6 Hrs**

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INTRODUCTION TO PROBABILITY THEORY : Basic Notions of Probability, Axiomatic definition, properties, Conditional Probability and Independence – Baye's Theorem.	
MODULE 2	**7 Hrs**
DISCRETE PROBABILITY DISTRIBUTIONS: Discrete random variables and its properties - Bernoulli trials – Binomial Distribution and its properties – Poisson Distribution and its properties.	
MODULE 3	**10 Hrs**
CONTINUOUS PROBABILITY DISTRIBUTIONS Continuous random variables and its properties - Gamma Distribution and its properties – ExponentialDistribution and its properties - Normal Distribution and its properties. **BIVARIATE DISTRIBUTIONS:** Bivariate random variables – Joint – Marginal - Conditional distribution**.**	
MODULE 4	**9 Hrs**
RANDOM PROCESS AND QUEUING THEORY Classification – Stationary process – Markov process – Markov chain – Poisson process – Randomtelegraph process. Auto correlation functions – Cross correlation functions – Properties – Power spectral density – Crossspectral density – Properties. Queuing Models, Methods for generating random variables and Validation of random numbers	
MODULE 5	**10 Hrs**
TESTING OF HYPOTHESIS Testing of hypothesis – Introduction-Types of errors, critical region, procedure of testing hypothesis-Large sample tests- Z test for Single Proportion - Difference of Proportion, mean and difference of mean - Small sample tests- Student's t-test, F-test-chi-square test- goodness of fit - independence of attributes.	

TEXT BOOKS :

1. A First Course in Probability, S. Ross, Pearson International Edition, 9th Edition.
2. Fundamentals of Mathematical Statistics, S. C. Gupta and V. K. Kapoor, Sultan Chand & Sons, 11thEdition.

REFERENCES :

1. K. S. Trivedi, Probability and Statistics with Reliability, Queuing, and L.Computer Science Applications, 2nd Ed., Wiley, 2001.
2. Robert V. Hogg, J.W. McKean, and Allen T. Craig: Introduction to Mathematical Statistics, Seventh Edition, Pearson Education, Asia.
3. Rohatgi, V K. and Saleh , A. K. Md. Ehsanes, "An Introduction to Probability and Statistics", (JohnWiley and Sons) , (2nd edition) (2000)
4. Higher Engineering Mathematics by B S Grewal, 42 nd Edition, Khanna Publishers.
5. Probability and Statistics for engineers and scientists, R.,E.Walpole, R.H.Myers, S.L.Mayers andK.Ye, 9th Edition, Pearson Education (2012).

6. An Introduction to Probability Theory and its Applications, W. Feller , Vol. 1, 3rd Ed., Wiley, 1968

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SEMESTER	**IV**					
YEAR	**II**					
COURSE CODE	**20CS2402**					
TITLE OF THE COURSE	**OBJECT ORIENTED DESIGN AND PROGRAMMING**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	PracticalHours	Seminar/ProjectsHours	Total Hours	Credits
	3	**-**	**-**	**-**	**42**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- Understand the basic concepts of object-oriented design techniques.
- Understand the fundamentals of object-oriented programming with Java.
- Draw UML diagrams for the software system.
- Impart basics of multi-threading and database connectivity.
- Develop GUI using event handling techniques in Java.

COURSE OUTCOMES:

CO No.	Outcomes	**Bloom's Taxonomy** Level
CO1	Apply the concepts of object-oriented programming in software design process.	L3
CO2	Develop Java programs using Java libraries and construct tosolve real-time problems.	L3
CO3	Understand, develop and apply various object-oriented featuresusing Java to solve computational problems	L2
CO4	Implement exception handling and JDBC connectivity in Java.	L3
CO5	Build an event-oriented GUI (graphical user interface).	L6
COURSE CONTENT:		

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MODULE 1	**09 Hrs**
An Overview of Object-Oriented Systems Development: Introduction; Two OrthogonalViews of the Software; Object-Oriented Systems Development Methodology; Why an	
Object-Oriented? Overview of the Unified Approach. **Object Basics**: Introduction; An Object-Oriented Philosophy; Objects; Objects are Grouped in Classes; **Attributes**: Object State and Properties; Object behaviour and Methods; Object Respond to Messages; Encapsulation and Information Hiding; **Class Hierarchy:** Inheritance; Multiple Inheritance; **Polymorphism**; Object Relationships and Associations: Consumer-Producer Association; Aggregation and Object Containment; **Case Study** - A Payroll Program; **Object-Oriented Systems Development Life Cycle**: Introduction; Software Development Process; Building High- Quality Software; Object-Oriented Systems Development: A Use Case Driven Approach; Reusability.	
MODULE 2	**08 Hrs**
Unified Modelling Language :Introduction; Static and Dynamic models; Why Modeling? Introduction to the UML; UML Diagrams; UML Class Diagram; Use-Case Diagram. **Introduction to Java**: Java's Magic: The Bytecode; JVM; Object-Oriented Programming; Simple Java programs; Two Control Statements; Lexical Issues; **Data Types; Variables, Arraysand String constructors**; **Operators; Control Statements; Introducing Classes:** Class Fundamentals; objects; methods; constructors; this Keyword; Garbage Collection; finalize() method; Parameter Passing; Overloading; Access Control Keywords. Inheritance basics; method overriding; abstract classes; Packages and interfaces. Exception handling fundamentals; multiple catch; nested try statements.	
MODULE 3	**09 Hrs**
Multi-Threaded Programming :Multi-Threaded Programming: Java Thread Model; The mainThread; Creating a thread and multiple threads; Extending threads; Implementing Runnable;Synchronization; Inter Thread Communication; producer consumer problem. **Input/Output**:I/O Basic; Reading console input Writing Console output.	
MODULE 4	**08 Hrs**
Event and GUI Programming:Introducing Swing; The Origins of Swing; Swing Is Built on theAWT; Two Key Swing Features; The MVC Connection; Components and Containers; The Swing Packages; A Simple Swing Application; Event Handling; JLabel; JTextField; JButton	
MODULE 5	**08 Hrs**
Database Access: The Concept of JDBC; JDBC Driver Types; JDBC Packages; A Brief Overview of the JDBC process; Database Connection; Associating the JDBC/ODBC Bridge with the Database; Statement Objects; ResultSet.	

TEXT BOOK:

1. Bahrami A.; Object Oriented Systems Development using the Unified Modeling Language;McGraw Hill; 1999.
2. Schildt; Herbert. Java The Complete Reference; 8th Edition. US: McGraw-Hill Osborne Media;2011.

3. Jim Keogh; J2EE: The Complete Reference; McGraw Hill Education in 2002.

REFERENCES:

1. Barclay K., J. Savage, Object Oriented Design with UML and Java, Elsevier, 2004.

2.Y. Daniel Liang, Introduction to Java Programming, 7th edition, Pearson, 2013.

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SEMESTER	**IV**					
YEAR	**II**					
COURSE CODE	**20CS2403**					
TITLE OF THE COURSE	**PRINCIPLES OF MICROPROCESSORS & COMPUTER ORGANIZATION**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	PracticalHours	Seminar/ProjectsHours	Total Hours	Credits
	4	**-**	**-**	**-**	**52**	**4**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	*	**	***

COURSE OBJECTIVES:

- To introduce the architecture of 8086
- To understand the importance and function of each pin of 8086 Microprocessor
- To familiarize with the architecture of 8086 microprocessor and its operation
- To understand the various addressing modes required for assembly language
- Programming and to calculate the physical address.
- To learn the 8086 instruction set and write 8086 Assembly level programs
- To understand the importance of different peripheral devices and their interfacing to 8086
- Understand the concepts of Hardwired control and micro programmed control.
- To explain the current state of art in memory system design
- Discuss the concept of memory organization.
- Summarize the types of memory.
- Learn about various I/O devices and the I/O interface.
- Learn the different types of serial communication techniques.
- To understand DMA technique
- To provide the knowledge on Instruction Level Parallelism
- To understand the concepts of pipelining techniques.

COURSE OUTCOMES:

CO No.	Outcomes	**Bloom's Taxonomy** Level
CO1	Identify the basic building blocks of 8086 microprocessor and usethe addressing modes for executing programs efficiently	L2
CO2	Develop 8086 assembly language programs using modern assembler tools	L3
CO3	Discuss the computer arithmetic and design algorithms for various Arithmetic operations.	L2

CO4	Design data part and control part of a processor	L3
CO5	Analyze the performance of various classes of Memories	L4
CO6	Understand pipeline & parallel processing	L2

COURSE CONTENT:

MODULE 1 — **8 Hrs**

Introduction to Microprocessor & its Architecture:
Introduction-Evolution of Microprocessor, The Microprocessor-Based Personal Computer Systems, Internal Microprocessor Architecture, Real mode memory addressing, Memory paging, 8086 pin diagram, Internal Architecture of 8086,Registers, Addressing Modes-Immediate addressing, Register addressing, direct addressing, indirect addressing, relative addressing, Instruction formats

MODULE 2 — **12 Hrs**

Programming 8086:
Assembler directives, Data Movement Instructions, String Data Transfers, Miscellaneous Data Transfer Instructions, Arithmetic and Logic Instructions, BCD and ASCII Arithmetic, Basic Logic Instructions, Shift and Rotate, String Comparisons. Program Control Instructions: The Jump Group,Assembly language programming with 8086, macros, procedures

MODULE 3 — **10 Hrs**

Processor Organization:
Basic organization of computers, Block level description of the functional units as related to the execution of a program; Fetch, decode and execute cycle. Execution cycle in terms machine instructions.
Information representation, Floating point representation (IEEE754), computer arithmetic and their implementation;
Data Part Design: Fixed-Point Arithmetic-Addition, Subtraction, Multiplication and Division, Arithmetic Logic Units control and data path, data path components, design of ALU and data-path,**Control Part Design:** Control unit design; Hardwired and Micro programmed Control unit.
Discussions about RISC versus CISC architectures.

MODULE 4 — **12 Hrs**

Memory Technology:
Memory hierarchy, static and dynamic memory, RAM and ROM chips, Memory address map, Auxiliary Memory, Associative Memory, Cache Memory and organization.
Input/Output Organization:
Peripheral devices, Input-Output Interface; I/O Bus and Interface Modules, Isolated versus Memory-Mapped I/O, Example of an l/0 interface unit, keyboard interface, Modes of Transfer; Programmed I/O, Interrupt-initiated I/O, Direct memory access (DMA)

MODULE 5 — **10 Hrs**

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Pipelining:
Basic Concepts, Arithmetic Pipeline, Instruction Pipeline; Four-Segment Instruction Pipeline, Pipeline hazards and their resolution, **Parallel Processing;** Flynn's classification, Multicore architectures, Introduction to Graphics Processing Units, Example: NVIDIA GPU Architecture

TEXT BOOK:

1. Barry B Brey: The Intel Microprocessors, 8th Edition, Pearson Education, 2009
2. Mano, Morris M. Computer system architecture. Dorling Kindesley Pearson, 2005.

REFERENCES:

1. Krishna Kant, "MICROPROCESSORS AND MICROCONTROLLERS Architecture, programming and system design using 8085, 8086, 8051 and 8096". PHI 2007.
2. Douglas V Hall, "MICROPROCESSORS AND INTERFACING, PROGRAMMING ANDHARDWARE" TMH, 2006.
3. Kenneth J. Ayala, "The 8086 Microprocessor: Programming & Interfacing The PC",Delmar Publishers, 2007
4. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Danny Causey, The x86 PC Assembly LanguageDesign and Interfacing, 5th Edition, Pearson, 2013.
5. V. Carl Hamacher, Safwat G. Zaky and Zvonko G. Vranesic , Computer Organization ,McGraw-Hillseries 2002
6. Hayes, J.P , Computer Architecture and Organization, McGraw-Hill, 1998
7. Vincent P. Heuring and Harry F. Jordan , Computer Systems Design and Architecture (2nd Edition),Dec, 2003
8. David Patterson and John Hennessey , Computer Organization and Design, Elsevier. 2008
9. Comer, Douglas. Essentials of computer architecture. Chapman and Hall/CRC, 2017.
10. Hord, R. Michael. Parallel supercomputing in MIMD architectures. CRC press, 2018.
11. Tanenbaum, Andrew S. Structured computer organization. Pearson Education India, 2016.
12. William Stallings-Computer Organization and Architecture, Seventh Edition, Pearson Education

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SEMESTER	**IV**					
YEAR	**II**					
COURSE CODE	**20CS2404**					
TITLE OF THE COURSE	**FINITE AUTOMATA AND FORMAL LANGUAGES**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**-**	**2**	**50**	**4**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	*	**	***

COURSE OBJECTIVES :

- To learn general theory of automata, properties of regular sets and regular expressions.
- To understand basics of formal languages.
- To know push-down automata, context- free languages, Turing machines.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Understand the concept of Automata	L1
CO2	Explain the concept of Regular Expression, languages andabstract machines to recognize them	L2
CO3	Know the generalized computation model and different typesComputation	L2

COURSE CONTENT:	
MODULE 1	**9Hrs**
Introduction to Finite Automata: Study and Central concepts of automata theory, An informal pictureof finite automata, deterministic and non-deterministic finite automata, applications of finite automata,finite automata with epsilon – transitions.	
MODULE 2	**12Hrs**
Regular expression and languages: Regular expressions, finite automata and regular expressions, algebraic laws of regular expressions. applications of regular expressions such as Grep, and Lex etc..Properties of Regular Languages: closure properties of regular languages, Pumping Lemma, equivalence and minimization of automata .	

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MODULE 3	**10Hrs**
Context – free Grammars and Languages: Context free grammars, Context-free languages, Parse trees, Ambiguity in grammars and languages Pushdown Automata: Pushdown automation (PDA), the language of PDA, equivalence of PDA's and CFG's, Deterministic Pushdown Automata	
MODULE 4	**9Hrs**
Properties of Context – Free Languages: Normal forms of context free grammars, pumping lemma forcontext free languages, closure properties of context free languages. Applications of CFG - such as spec of programming languages, parsing techniques, and Yacc	
MODULE 5	**10Hrs**
Introduction to Turing Machine- The Turing machine, programming techniques for Turing machine,extensions to the basic Turing machine, restricted Turing Machines, Turing Machines and Computers. Chomsky hierarchy	

TEXT BOOKS :

1. Daniel I. A. Cohen, Introduction to Computer Theory, 2nd Edition, Wiley IndiaStudent Edition, 2008.
2. J.E. Hopcroft , R. Motwani, and J. D. Ullman, Introduction to Automata Theory,Languages and Computation, 3rd Edn. Pearson Education , New Delhi 2008

REFERENCES :

1. K.L.P. Misra and N. Chandrashekaran. Theory of Computer Science- Automata, Languages and Computation, 3rd Edn. PHI, New Delhi, 2007

2. C. Martin - Introduction to Languages and the Theory of Computation 2ndEdn,TMH, New Delhi, 2000.

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SEMESTER	**IV**					
YEAR	**II**					
COURSE CODE	**20CS2405**					
TITLE OF THE COURSE	**INTRODUCTION TO NETWORKS AND CYBERSECURITY**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	PracticalHours	Seminar/ProjectsHours	Total Hours	Credits
	3	**-**	**-**	**-**	**42**	**3**

Prerequisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- To introduce the fundamental aspects of various types of computer networks.
- To demonstrate the TCP/IP and OSI models with merits and demerits.
- Understand the basic concepts of cyber security, how it has evolved, and some key techniquesused today.
- Have an insight view of Security, Cryptography, Malware, IDS, Secure Programming etc
- Explore the subject through prescribed book, case studies, seminars and Assignments.

COURSE OUTCOMES:

CO No.	Outcomes	**Bloom's Taxonomy** Level
CO1	Understand and explore the basics of Computer Networks and workingprinciples.	L2
CO2	Understand the concepts of Network security corresponding to variousInternet Layers.	L2
CO3	Determine appropriate mechanisms for protecting the Network.	L2

COURSE CONTENT:	
MODULE 1	**9Hrs**

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Overview of the Internet: Protocol, Layering Scenario, TCP/IP Protocol Suite: The OSI Model, Internet Architecture; Comparison of the OSI and TCP/IP reference model. Top-down approach **Cybersecurity:** Basics of Cyber Security-Attacks, Vulnerabilities and Threats. Need for Network Security, Data Security and physical security.	
MODULE 2	**9 Hrs**
Application Layer- Introduction, providing services, Applications layer paradigms, Client server model, Standard client-server application-HTTP, DNS, SSH. Malware Detection System, Types of Malware, Viruses & Counter Measures, Worms, Bots. **E-mail Security:** PGP, S/MIME. Secure socket programming using UDP and TCP.	
MODULE 3	**9 Hrs**
Transport Level Security: Functionality and services, TCP and UDP basics, Principles of Cryptography, Web Security Considerations, Secure Sockets Layer (SSL), Transport Layer Security, Data/Message Integrity and Digital Signatures.	
MODULE 4	**9 Hrs**
Network Layer Security: Network Security and Services, IP Security Overview, IP Security Policy, Encapsulation Security Payload (ESP), Internet Key Exchange. Virtual Private Network(VPN), Wireless Networks Security.	
MODULE 5	**9 Hrs**
Data Link Layer: LLC and MAC Sublayer services, Error detection and correction Techniques.**Physical Layer:** Introduction to Guided transmission media and wireless transmission media.Transmission mode, Classification of networks. Firewall, Intrusion Detection System (IDS)	

TEXT BOOK:

1. Computer Networking- A top-down approach- James F Kurose and Keith W Ross,6th Edition,Pearson Education.
2. Computer Security- Principles and Practice, William Stalling, Laurie Brown 4th Edition, Pearson

REFERENCES:

1. Behrouz A. Forouzan, Data Communications and Networking -, Fifth Edition TMH, 2013.
2. Computer Networks - Andrew S Tanenbaum, 4th Edition, Pearson Education.
3. James Graham, Richard Howard, Ryan Olson- Cyber Security Essentials CRC Press.

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SEMESTER	**IV**					
YEAR	**II**					
COURSE CODE	**20AM2401**					
TITLE OF THE COURSE	**Artificial Intelligence I**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	PracticalHours	Seminar/ProjectsHours	Total Hours	Credits
	03	**-**	**-**	**-**	**40**	**03**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	**	***	*******

COURSE OBJECTIVES:

- To search and discover intelligent characteristics of existing AI projects,
- To map a new problem – as search and create an animation – showing differentsearch strategies for a problem,
- To program a new game/ problem in Prolog,
- To evaluate different Knowledge Representation schemes for typical AI problems,
- To design and implement a typical AI problem to be solved Using Machine LearningTechniques, design and implement a futuristic AI application

COURSE OUTCOMES :

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Apply artificial intelligence techniques, including search heuristics, knowledge representation, planning and reasoning	L2
CO2	Apply basic principles of AI in solutions that require problem solving, inference, perception, intelligent agents &differentiate the key aspects of evolutionary computation, including genetic algorithms and genetic programming	L3
CO3	Apply search strategies, probability theorem and Bayesian networks and solve problems by applying a suitable searchmethod	L4

CO4	Describe and list the key aspects of planning in artificial intelligence to analyze and apply knowledge representation	L3
CO5	Demonstrate an ability to share in discussions of AI, its current scope and limitations, and societal implications, design and implement appropriate solutions for search problems and for planning problems	L5

COURSE CONTENT:	
MODULE 1	**08Hrs**
INTRODUCTION: What is intelligence? Foundations of artificial intelligence (AI). History of AI; Knowledge based Agents, Problem Solving Formulating problems, problem types, states and operators, state space, search strategies. INFORMED SEARCH STRATEGIES: Best first search, A* algorithm, heuristic functions, Iterative deepening A*(IDA), small memory A*(SMA); Game playing - Perfect decision game, imperfect decision game, evaluation function, alpha-beta pruning	
MODULE 2	**08Hrs**
PROBLEM SOLVING METHODS: Search Strategies- Uninformed - Informed – Heuristics- Local Search Algorithms and Optimization Problems - Searching with Partial ObservationsConstraint Satisfaction Problems – Constraint Propagation - Backtracking Search-Game Playing -Optimal Decisions in Games -Alpha--Beta Pruning -Stochastic Games	
MODULE 3	**08Hrs**
UNCERTAINTY: Overview of Probability and Baye's rule, Belief networks, Defaultreasoning, Fuzzy sets and fuzzy logic; Decision making- Utility theory, utility functions, Decision theoretic expert systems.	
MODULE 4	**08Hrs**
KNOWLEDGE REPRESENTATION: First Order Predicate Logic – Prolog Programming - Unification Forward Chaining -Backward Chaining - Resolution – Knowledge Representation Ontological Engineering - Categories and Objects- Events - Mental Events and Mental Objects	

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MODULE 5	**08Hrs**
REASONING: Representation, Inference, Propositional Logic, predicate logic (firstorder logic), logical reasoning, forward chaining, backward chaining; AI languagesand tools - Lisp, Prolog, CLIPS. PLANNING: Basic representation of plans, partial order planning, planning in the blocks world, hierarchical planning, conditional planning, representation of resource constraints, measures, temporal constraints.	

TEXT BOOKS:

1. Stuart Russell and Peter Norvig. Artificial Intelligence – A Modern Approach, Pearson Education Press, 2001.
2. Kevin Knight, Elaine Rich, B. Nair, Artificial Intelligence, McGraw Hill, 2008.

REFERENCE BOOKS:

1. George F. Luger, Artificial Intelligence, Pearson Education, 2001.
2. Nils J. Nilsson, Artificial Intelligence: A New Synthesis, Morgan Kauffman, 2002.

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SEMESTER	**IV**					
YEAR	**II**					
COURSE CODE	**20CS2407**					
TITLE OF THE COURSE	**OBJECT ORIENTED PROGRAMMING LAB**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	PracticalHours	Seminar/ProjectsHours	Total Hours	Credits
	-	**-**	**2**	**-**	**30**	**1**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	**	**	****

COURSE OBJECTIVES :

- To learn an object oriented way of solving problems using java.
- To write Java programs using multithreading concepts and handle exceptions
- To write Java programs that connects to a database and be able to perform variousoperations.
- To create the Graphical User Interface using AWT Components & Swing Components.

COURSE OUTCOMES :

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Develop simple java programs that make use of classes and objects	L3
CO2	Write Java application programs using OOP principles and proper program structuring.	L3
CO3	Make use of inheritance and interfaces to develop java application	L3
CO4	Model exception handling, multi threading concepts in java	L3
CO5	Create the Graphical User Interface based application programs by utilizing event handling features and Swing in Java	L3
CO6	Develop Java program that connects to a database and be able to perform various operations.	L3

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List of Laboratory/Practical Experiments activities to be conducted
1. Basic programs using data types, operators, and control statements in Java.
2. Basic programs using Arrays, , Strings in java
3. Object Oriented Programming Concepts: Problem on the use of constructors, inheritance, method overloading & overriding, polymorphism and garbage collection
4. Programs involving: Exception handling, Multi-threading in Java
5. Programs involving: Packages, Interfaces in Java
6. Programs involving: Input and Output in Java
7. GUI Programming in Java
8. Programs involving : Database connectivity in Java
9. Mini Project

TEXT BOOKS :

1. Bahrami A.; Object Oriented Systems Development using the Unified Modeling Language;McGraw Hill; 1999.
2. Schildt; Herbert. Java The Complete Reference; 8th Edition. US: McGraw-Hill Osborne Media;2011.
3. Jim Keogh; J2EE: The Complete Reference; McGraw Hill Education in 2002.

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SEMESTER	**IV**					
YEAR	**II**					
COURSE CODE	**20CS2408**					
TITLE OF THE COURSE	**MICROPROCESSORS LAB**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	PracticalHours	Seminar/ProjectsHours	Total Hours	Credits
	-	**-**	**2**	**-**	**30**	**1**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	**	**	****

COURSE OBJECTIVES :

- To develop and execute variety of assembly language programs of Intel 8086 includingarithmetic and logical, sorting, searching, and string manipulation operations
- To develop and execute the assembly language programs for interfacing Intel 8086 withperipheral devices.

COURSE OUTCOMES :

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Implement 8086 assembly language programs for microprocessorapplication using 8086 training boards	L3
CO2	Implement 8086 assembly language programs for microprocessorapplication using assembler and debuggers	L3
CO3	Design interfacing of various peripherals with 8086 microprocessorfor simple applications	L3
CO4	Use Macros and Procedures in 8086 Programs	L3
CO5	Use assembly language and debugging tools when writing programs for a microprocessor	L3
CO6	Communicate effectively on the work done in the laboratory usingformal report	L3

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List of Laboratory/Practical Experiments activities to be conducted
Part-A: Software Programs Using Microprocessor Trainer Kit i) Programs involving : arithmetic operations, sorting ii) Programs on : code conversion (BCD TO HEX, Binary to ASCII, Binary to Gray) iii) Programs involving - Bit manipulation like checking: 1. Whether given data is positive or negative 2. Whether given data is odd or even
3. Logical 1‟s and 0‟s in a given data
Part- B: Software Programs Using MASM/TASM software i) Programs on : searching and sorting ii) Programs on : palindrome, string comparison iii) Programs on : current time display, Decimal up-counter display
Part-C: Hardware Programs to interface microprocessor with various peripherals UsingMicroprocessor Trainer Kit i) DC Motor Interface ii) Stepper Motor Interface iii) Matrix Keypad Interface iv) 7 Segment Display Interface

TEXT BOOKS :

1. Microprocessor and Interfacing - Douglas V Hall, SSSP Rao, 3rd edition TMH, 2012.
2. The Intel Microprocessor, Architecture, Programming and Interfacing - Barry B. Brey, 6e,Pearson Education / PHI, 2003.

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SEMESTER	**V**					
YEAR	**III**					
COURSE CODE	**20CS3501**					
TITLE OF THE COURSE	**COMPUTER NETWORKS**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	PracticalHours	Seminar/ProjectsHours	Total Hours	Credits
	3	-	2	-	39+26	4

Pre-requisite Courses (if any)			
#	Sem /Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- To introduce the fundamental aspects of various types of computer networks.
- To demonstrate the TCP/IP and OSI models with merits and demerits.
- To Understand the working principle of layering structure and basic network components
- To explore the features of each layer by various approaches and methods

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's TaxonomyLevel
CO1	Understand and explore the basics of Computer Networks andphysical layer	L2
CO2	Understand about data link layer and its protocols	L2
CO3	Understand about routing mechanisms and different routingProtocols	L2
CO4	Identify the issues of Transport layer to analyse the congestioncontrol mechanism	L2
CO5	Explain principles of application layer protocols	L2

COURSE CONTENT	
MODULE 1: Overview of Networks	**9 Hrs**

Network Components- Network Physical Structure, Classification of networks (LAN-MAN-WAN),Protocols and Standards, Data representation and data flow, Layered Architecture – Comparison of the OSI and TCP/IP reference model. Physical Layer: Introduction to wired and wireless transmission media. Transmission mode (Serial/Parallel signals, Analog/Digital Signals and Periodic/Aperiodic Signals), Line coding Schemes.
MODULE 2: Data Link Layer — 9 **Hrs**
Data Link Layer – MAC (Media Access Control) and LLC (Logical Link Control) sublayer Functionalities– Design Issues: Framing – Flow control (Simplest protocol, Stop and wait, sliding window) – Error control (CRC, Hamming code) –– Ethernet Basics-Multi Access Protocols: ALOHA, CSMA/CD, Connecting Devices: Hubs, Bridges, Switches, Routers, and Gateways
MODULE 3: Network Layer — **8 Hrs**
Network Layer Design issues, Routing Protocol Basics, Routing Algorithm (Distance Vector Routing, Link State Routing and Hierarchical Routing). IP addressing, IP Packet format IPV4, IPV6 and IP Tunneling. Congestion control algorithms, QoS (Traffic Shaping, Packet Scheduling).
MODULE 4: Transport Layer — 7 **Hrs**
Transport Layer functions- Multiplexing and Demultiplexing. Introduction to TCP and UDP, TheTCP Service Model, The TCP Segment Header, The TCP Connection Management, TCP Flow Control- Sliding Window, TCP Congestion Control, User Datagram Protocol
MODULE 5: Application Layer — 6 **Hrs**
Principles of Network Applications, WEB and HTTP, FTP, E-MAIL(SMTP, POP3), TELNET,DNS, SNMP

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List of Laboratory/Practical Experiments activities to be conducted

PART A

1. Implement three nodes point – to – point network with duplex links between them. Setthe queue size, vary the bandwidth and find the number of packets dropped.
2. Implement transmission of ping messages/trace route over a network topology consisting of6 nodes and find the number of packets dropped due to congestion.
3. Implement an Ethernet LAN using n nodes and set multiple traffic nodes and plotcongestion window for different source / destination.
4. Implement simple ESS and with transmitting nodes in wire-less LAN by simulationand determine the performance with respect to transmission of packets.
5. Implement and study the performance of GSM on NS2/NS3 (Using MAC layer) orequivalent Environment.
6. Implement and study the performance of CDMA on NS2/NS3 (Using stack called Call net)or equivalent environment.

PART B

Implement the following in Java:

7. Write a program for error detecting code using CRC.
8. Write a program to find the shortest path between vertices using bellman-ford algorithm.
9. Using TCP/IP sockets, write a client – server program to make the client send the file name and to make the server send back the contents of the requested file if present. Implement the above program using as message queues or FIFOs as IPC channels.
10. Write a program on datagram socket for client/server to display the messages on client side, typed at the server side.
11. Write a program for simple RSA algorithm to encrypt and decrypt the data.
12. Write a program for congestion control using a leaky bucket algorithm.

TEXT BOOKS:

1. Behrouz A. Forouzan, Data Communications and Networking, Fifth Edition TMH,2013.
2. Computer Networks - Andrew S Tanenbaum, 5th Edition, Pearson Education.

REFERENCES:

1. James F. Kurose, Keith W. Ross, "Computer Networking: A Top-Down Approach",Seventh Edition,
Pearson Education, 2017.
2. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach",Fifth Edition, Morgan
Kaufmann Publishers Inc., 2011.
3. William Stallings, "Data and Computer Communications", Tenth Edition, PearsonEducation, 2014.

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SEMESTER	**V**					
YEAR	**III**					
COURSE CODE	**20CS3502**					
TITLE OF THE COURSE	**DESIGN AND ANALYSIS OF ALGORITHMS**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	-	-	-	39	3

Perquisite Courses (if any)			
#	**Sem/Year**	**Course Code**	**Title of the Course**
*	**	***	***

COURSE OBJECTIVES:

- To introduce and implement various techniques for designing algorithms and advanceddata structures.
- To learn space and time complexity analysis of algorithms.
- To understand the Divide and conquer design strategy and the Greedy Technique
- To understand the concepts of Dynamic Programming Applications
- Synthesize efficient algorithms in common engineering design situations

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Outline the overview of Data structures and Algorithms	L1
CO2	Understand the different Algorithmic Design strategies	L2
CO3	Apply the Design principles and concepts to Algorithmic design	L3
CO4	Describe the DAA paradigms and when an Algorithmic Design situationcalls for it.	L6
CO5	Analyse the efficiency of Algorithms using Time and Space complexity theory	L4
CO6	Implement an existing algorithm to improve the run time efficiency	L3

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MODULE 1: INTRODUCTION	**8 Hrs**
The role of Algorithms in Computing, Running time analysis -- recall of asymptotic notation, big-oh, theta, big-omega, and introduce little-oh and little-omega. Worst case and average case complexity	
MODULE 2: DIVIDE AND CONQUER	**9 Hrs**
Recursive algorithms, Divide-and-Conquer recurrences, Methods for solving recurrences:substitution method, recursion tree method and the Master method. Examples-Binary search, Quick sort, Merge sort, Strassen's Matrix Multiplication. GREEDY METHOD Minimum cost spanning tree, Knapsack problem, Fractional knapsack	
MODULE 3: DYNAMIC PROGRAMMING	**9 Hrs**
Integral knapsack (contrasted with the fractional variant: 0/1 knapsack), longest increasing subsequence, All pair shortest path in graph, Matrix chain multiplication, Travelling salesman Problem	
MODULE 4: APPLICATION OF GRAPH TRAVERSAL TECHNIQUES	**7 Hrs**
Recall representation of graphs, BFS, DFS, connected components, Strongly-connected componentsof DAGs, Kosaraju's algorithm 1 and 2, Applications.	
MODULE 5: REASONING ABOUT ALGORITHMS	**6 Hrs**
Complexity Analysis (Polynomial vs Non-Polynomial time complexity), P, NP-hard and NP-Completeness, Reductions.	

TEXT BOOK:

T. H. Cormen, Leiserson, Rivest and Stein, "Introduction of Computer algorithm," , 3rd Edition,The MIT Press, 2015

REFERENCES:

1. Anany Levitin, —Introduction to the Design and Analysis of Algorithms, Third Edition, PearsonEducation, 2012
2. Sara Basse, A. V. Gelder, "Computer Algorithms : Introduction Design & Analysis", 3rd Edition,Addison Wesley.
3. J.E Hopcroft, J.D Ullman, "Design and analysis of Computer algorithms", PearsonEducation, 2009.
4. Steven S. Skiena, "The Algorithm Design Manual", Second Edition, Springer, 2008

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SEMESTER	**V**					
YEAR	**III**					
COURSE CODE	**20CS3503**					
TITLE OF THE COURSE	**OPERATING SYSTEMS**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	1	-	-	52	4

Perquisite Courses (if any)			
#	**Sem/Year**	**Course Code**	**Title of the Course**
*	***	***	****

COURSE OBJECTIVES:

- To understand the basic concepts and functions of operating systems.
- To understand Processes and Threads
- To analyze Scheduling algorithms.
- To understand the concept of Deadlocks.
- To analyze various Memory and Virtual memory management, File system andstorage techniques.
- To discuss the goals and principles of protection in a modern computersystem.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Demonstrate need for OS and different types of OS	L2
CO2	Analyze the performance of scheduling algorithms for the given problems	L4
CO3	Demonstrate Process Coordination and synchronization techniques.	L2
CO4	Apply the deadlock handling mechanisms to solve the given problem	L3
CO5	Apply suitable techniques for management of different Resources	L3
CO6	Understand the principles of protection and security Mechanisms	L2

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MODULE 1: OS Overview and System Structure	**10 Hrs**
Introduction to operating systems, System structures: What operating systems do; Computer System organization; Computer System architecture; Operating System structure; Operating System operations; Process management; Memory management; Storage management; Protectionand Security; Distributed system; Computing environments. Operating System Services: User - Operating System interface; System calls; Types of system calls;	
System programs; Operating system design and implementation; Operating System structure; Virtual machines;	
MODULE 2: Process Management	**12 Hrs**
Process Management: Process concept; Process scheduling; Operations on processes. Multi-threaded Programming: Overview; Multithreading models; Threading issues. Process Scheduling: Basic concepts; Scheduling Criteria; Scheduling Algorithms.	
MODULE 3: Process Coordination	**10 Hrs**
Process Synchronization: The critical section problem; Peterson's solution; Synchronization hardware; Semaphores; Classical problems of synchronization; Monitors Deadlocks: Deadlocks;System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock.	
MODULE 4: Memory Management	**10Hrs**
Memory Management Strategies: Background; Swapping; Contiguous memory allocation; Paging;Structure of page table; Segmentation. Virtual Memory Management: Background; Demand paging; Copy-on-write; Page replacement;Allocation of frames; Thrashing.	
MODULE 5: File System and Secondary Storage Structure	**10 Hrs**
File System, Implementation of File System**:** File system: File concept; Access methods; Directory structure; File system mounting; File sharing. Protection: Implementing File system: File system structure; File system implementation; Directory implementation; Allocation methods; Free space management. Mass storage structures; Disk structure; Disk attachment; Disk scheduling; Disk management; Swap space management. Protection and Security: Protection: Goals of protection, Principles of protection, System Security: The Security Problem, Program Threats, System and Network Threats.	

TEXT BOOKS:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles 8thedition, Wiley-India, 2010

REFERENCES:

- Operating Systems-Internals and Design Principles, William Stallings, 6thEdition, Pearson Education, 2009.
- Operating Systems: A Modern Perspective, Gary J. Nutt, Addison-Wesley,1997

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Artificial Intelligence & Machine Learning)

SEMESTER	**V**					
YEAR	**III**					
COURSE CODE	**20CS3504**					
TITLE OF THE COURSE	**MACHINE LEARNING**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	PracticalHours	Seminar/ Projects Hours	Total Hours	Credits
	3	-	2	-	39+26	4

Perquisite Courses (if any)			
#	**Sem/Year**	**Course Code**	**Title of the Course**
*	***	***	****

COURSE OBJECTIVES:

- Define machine learning and understand the basic theory underlying machine learning.
- To understand the working principle of Machine Learning Algorithms
- To apply various techniques of Machine Learning Algorithms
- Perform statistical analysis of machine learning techniques.

COURSE OUTCOMES:

CO No.	Outcomes	Taxonomy Level
CO1	Describe the basic concepts and different types of Machine Learning	L2
CO2	Explore and analyse the mathematics behind Machine Learning algorithms	L2
CO3	Apply the design principles and concepts of Machine Learning Algorithms	L3

CO4	Apply effectively Unsupervised Machine Learning algorithms and various learning techniques for appropriate applications.	L3
CO5	Explore, analyse and validate the different Machine Learning algorithms	L3

COURSE CONTENT:

MODULE 1: Introduction to Machine Learning	**7Hrs**

Well posed learning problems, Designing a Learning system. Introduction to AI, Machine learningand Deep learning with applications. Types of learning: supervised, unsupervised and reinforcement
learning. Perspective and Issues in Machine Learning.

Classical paradigm of solving learning problems, The learning problems--classes and types oflearning, fundamental of statistical learning and its framework. Introduction to feature representation and extraction.

MODULE 2: Mathematics for Machine Learning	**8Hrs**

Introduction to Statics Probability (joint probability, conditional probability, Bayes theorem, different distributions, univariate and multivariate Gaussian distribution, PDF, MLE, Motivation, estimating hypothesis accuracy, Basics of sampling theorem, General approach for deriving confidence intervals, Difference in error of two hypothesis, Comparing learning algorithms.

MODULE 3: Supervised Learning	**9Hrs**

Introduction to Supervised Learning, Introduction to Perceptron model and its adaptive learning algorithms (gradient Decent and Stochastic Gradient Decent), Introduction to classification, NaiveBayes classification Binary and multi class Classification, decision trees and random forest, Regression (methods of function estimation) --Linear regression and Non-linear regression, logistic regression, Introduction To Kernel Based Methods of machine learning: K-Nearest neighbourhood
, kernel functions, SVM, Introduction to ensemble based learning methods

MODULE 4: Unsupervised Learning	**8 Hrs**

Introduction to Unsupervised Learning, Clustering (hard and soft clustering) Hierarchal clustering:K-means, Fuzzy C-Means (FCM) algorithm, Gaussian mixture models (GMM), Expectation
Maximization algorithm, feature Engineering in Machine Learning, Dimensionality reduction,Linear Discriminant Analysis and Principle Component Analysis.

MODULE 5: Model Selection	**7Hrs**

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Machine Learning model validation - Confusion Matrix, Accuracy, Precision, F score, Cost function, Machine Learning Optimization algorithms: Gradient descent, stochastic GD. Regularization: Normalization and Standardization overfitting, underfitting, optimal fit, bias, variance, cross-validation.

List of Laboratory/Practical Experiments activities to be conducted

1. Implementation of linear and logistic regression
2. Implementation of SVM, KNN, Naïve Bayes ML algorithms
3. Implementation of Decision trees, Random Forest classifiers
4. Implement ensemble algorithms.
5. Implementation of different clustering algorithms and PCA Implementation of differentneural networks

Capstone project in specific domains (Health care, Transportation, Telecom etc.)

TEXT BOOKS;

1. Thomas M. Mitchell, Machine Learning, McGraw- Hill, Inc. New York, ISBN: 0070428077978007042807 8072.
2. Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville. "Deep learning." An MIT Pressbook in preparation. (2015).

REFERENCE BOOKS:

1. Ethem Alpaydin, Introduction to Machine Learning (Adaptive Computation and MachineLearning series), The MIT Press; second edition, 2009.
2. V. N. Vapnik " The Nature of statistical Learning"

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SEMESTER	**V**					
YEAR	**III**					
COURSE CODE	**20CS3505**					
TITLE OF THE COURSE	**DESIGN AND ANALYSIS OF ALGORITHMS LABORATORY**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	-	-	2	-	26	1

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	****	****	****

COURSE OBJECTIVES:

- To learn mathematical background for analysis of algorithm
- To understand the concept of designing an algorithm.
- To analyze the algorithms using space and time complexity.
- To learn dynamic programming and greedy method.
- To acquire knowledge of various applied algorithms.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Design and develop the Algorithms to understand the differentconcepts.	L3
CO2	Apply the Design principles and concepts to Algorithmic design	L3
CO3	Describe the DAA paradigms and when an Algorithmic Designsituation calls for it.	L6
CO4	Analyse worst-case and best – case running times of algorithmsusing asymptotic analysis.	L4

CO5	Implement an existing algorithm to improve the run time efficiency	L3

List of Laboratory/Practical Experiments activities to be conducted
1. Design a C program to solve the Tower of Hanoi. Compute the time complexity. 2. Apply divide and conquer method and Design a C program to search an element in a givenarray and Compute the time complexity. Binary search - recursive method 3. Apply Divide and Conquer method Design a C program to sort an array using Merge sortalgorithm and compute its time complexity 4. Apply Divide and Conquer method Design a C program to sort an array using Quick sortalgorithm and compute its time complexity. 5. Apply Greedy method and Design a C program to find the minimum cost spanning tree usingPrim's and Kruskal's Algorithm and compute its complexity 6. Apply Dynamic Programming Technique and Design a C program to find the all pairsshortest path using Dijkstra's Algorithm and computes its complexity 7. Design a C program to find the optimal solution of 0-1 knapsack problem using dynamicprogramming and Compute the time complexity 8. Design a C program to solve the Travelling Salesman Problem using dynamic programmingand compute its time complexity. 9. Design a C program to find the longest common subsequence using dynamic programmingand compute its time complexity 10. Mini project proposal should be submitted and Implementation should be done based on the problem stated in the proposal

TEXT BOOK:

1. Levitin A, "Introduction to the Design And Analysis of Algorithms", PearsonEducation, 2008.
2. T. H. Cormen, Leiserson, Rivest and Stein, "Introduction of Computer algorithm," ,3rd Edition, The MIT Press, 2015

REFERENCES:

1. E. Horowitz, S. Sahni, and S. Rajsekaran, "Fundamentals of Computer Algorithms,"Galgotia Publication, 2015.
2. Goodrich M.T., R Tomassia, "Algorithm Design foundations Analysis and InternetExamples", John Wiley and Sons, 2006.
3. Sara Basse, A. V. Gelder, "Computer Algorithms : Introduction Design & Analysis",3rd Edition, Addison Wesley.

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(Artificial Intelligence & Machine Learning)

SEMESTER	**V**					
YEAR	**III**					
COURSE CODE	**20CS3506**					
TITLE OF THE COURSE	**OPERATING SYSTEMS LAB**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	-	-	2	-	26	1

Perquisite Courses (if any)			
#	**Sem/Year**	**Course Code**	**Title of the Course**
*	**	***	****

COURSE OBJECTIVES:

- To learn creating process and Threads
- To implement various CPU Scheduling Algorithms
- To implement Process Creation and Inter Process Communication.
- To implement Deadlock Avoidance and Deadlock Detection Algorithms
- To implement Page Replacement Algorithms
- To implement File Organization and File Allocation Strategies

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxon Level**
CO1	Implement System Calls	L2
CO2	Compare the performance of various CPU SchedulingAlgorithms	L3
CO3	Analyze Deadlock avoidance and Detection Algorithms	L3
CO4	Implement Semaphores	L2

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CO5	Analyze the performance of the various Page ReplacementAlgorithms	L3
CO6	Implement File Organization and File Allocation Strategies	L2

List of Laboratory/Practical Experiments activities to be conducted		
Exp. No	Division of Experiments	List of Experiments
1	System Calls	Write a C program to create a new process that exec a new program using system calls fork(), execlp() & wait()
2		Write a C program to display PID and PPID using system calls getpid () & getppid ()
3		Write a C program using I/O system calls open(), read() & write()to copy contents of one file to another file
4	Process Management	Write a C program to implement multithreaded program using pthreads
5		Write C program to simulate the following CPU schedulingalgorithms a) FCFS b) SJF c) Priority d) Round Robin
6	Process synchronization	Write a C program to simulate producer-consumer problem usingsemaphores
7	Deadlock	Write a C program to simulate Bankers algorithm for the purpose ofdeadlock avoidance.
8		Write a C program to simulate deadlock detection.
9	Memory Management	Write a C program to simulate paging technique of memorymanagement
10		Write a C program to simulate page replacement algorithms a) FIFO b) LRU c) LFU
11	I/O System	Write a C program to simulate the following file organizationtechniques a) Single level directory b) Two level directory
12		Write a C program to simulate the following file allocationstrategies. a) Sequential b) Indexed

TEXT BOOKS:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles 8thedition, Wiley-India, 2010

REFERENCES:

1. Operating Systems-Internals and Design Principles, William Stallings, 6th Edition,Pearson Education, 2009.

2. Operating Systems: A Modern Perspective, Gary J. Nutt, Addison-Wesley,1997

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PROFESSIONAL ELECTIVES-I (V SEM)

SEMESTER	**V**					
YEAR	**III**					
COURSE CODE	**20AM3501**					
TITLE OF THE COURSE	**Machine learning for Pattern Recognition**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	PracticalHours	Seminar/ProjectsHours	Total Hours	Credits
	3	-	-	-	39	3

NO-Prerequisite Courses (if any)			
#	**Sem/Year**	**Course Code**	**Title of the Course**
***	***	***	***

COURSE OBJECTIVES :

- Understand the concept of a pattern and the basic approach to the development of patternrecognition and machine intelligence algorithms.
- Understand the concept of Digital image fundamentals.
- Apply the knowledge of feature extraction methods, feature evaluation, and data miningin real life
- Apply both supervised and unsupervised classification methods to detect and characterizepatterns in real-world data.

COURSE OUTCOMES :

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Understand the need and significance of mathematicalfundamentals in pattern recognition to solve real-time problems.	L2
CO2	Explore supervised learning and Unsupervised learning algorithms and to apply them for solving problems.	L3
CO3	Design pattern recognition models to extract interesting patterns from structured data like graph, syntactic description	L6

	etc.	
CO4	Apply various machine learning techniques like artificial neural networks and etc to solve real-world problems.	L3
CO5	Develop prototype pattern recognition algorithms that can beused to study algorithm behavior and performance against real-world multivariate data.	L6

COURSE CONTENT:

MODULE 1: Introduction to Pattern Recognition	**8Hrs**

Introduction to Pattern Recognition, Introduction to Pattern, Pattern Class, pattern recognition examples, Main classification approaches, Machine perception.

The Sub-problems of Pattern Classification Systems: Feature Extraction, cost of miss classification, Multiple Features, Model complexity, Missing Features, Segmentation and Pattern recognition systems-Two Phases.
Learning and Adaptation: Supervised Learning, Unsupervised Learning, Reinforcement Learning.

(Text-1-Chapter 1)

MODULE 2: Feature Extraction and Pattern Classification	**10Hrs**

Introduction to Digital Image Fundamentals, image acquisition and display using digital devices - Human visual perception, properties – Image Formation -Basic relationship between pixels.

Feature Extraction from the pattern: Shape Feature Extraction: chain code, Differential chain code, Splitting technique, criteria function. Region Feature Extraction: Texture feature-Spatial domain Feature and Transformed domain feature.
Bayes Decision Theory: Decision rule, Class-conditional probability density function, Bayes' formula, Generalization of Bayes Theory. Minimum error rate Classification: Minimum Risk Classifier.
Maximum Likelihood Estimation.
(Text 1: Chapter 2 and 3 and Text 2:Chapter 3)

MODULE 3: Unsupervised Classification	**7Hrs**

Clustering for unsupervised learning and classification-Clustering concept, Agglomerative clustering, Different algorithms to find the distance between clusters: Single linkage algorithm(Nearest neighborhood algorithm), -k-means algorithm.
(Text -1-CH:10)

MODULE 4: Neural Network for pattern Recognition	**6Hrs**

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Introduction to Neural Network, Multilayer Neural Network: Feedforward Operation and classification, Backpropagation algorithm. Introduction to Convolutional Neural Networks(CNNs)(Text1: Chapter 6 ,Text2:Chapter 5)	
MODULE 5: Pattern recognition applications	**8Hrs**
Image and Speech Based Machine Learning for pattern recognition applications: (Eg. Approaches like Speech Recognition, Fingerprint Recognition, character recognition,Pattern Recognition approaches used in AI etc will be used). (Case Study).	

TEXT BOOKS:	
1.	Richard O. Duda, peter E. Hart and David G. Stork" Pattern Classification", 2000 2ND Edition.
2.	Christopher M. Bishop, "Pattern Recognition and Machine Learning", 2006 Springer Science+ Business Media, LLC .

	REFERENCES:	
	1	Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", Pearson Education, Fourth Edition, 2018.
	2.	Tom Mitchell, Machine Learning, McGraw-Hill, 1997
	3.	Robert J.Schalkoff, Pattern Recognition: Statistical, Structural and Neural Approaches,JohnWiley& Sons Inc., New York, 2007.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

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Semester	**V**					
Year	**III**					
Course Code	**20AM3502**					
Title	**Principles of Robotics**					
Scheme of Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	-	-	-	39	3

Prerequisite Courses (if any)-Any one of the below			
#	Sem/Year	Course Code	Title of the Course
1	IV/II	20AM2401	Artificial Intelligence I
2	IV/II	20CS2401	Probability and Statistics

COURSE OBJECTIVES :

- Understand the concepts and importance of Robotics
- Summarize various industrial and non-industrial applications of robots.
- Identify robots and its peripherals for satisfactory operation
- Understand Computational Motion Planning and Mobility
- Understand Geometry of Image Formation, Estimation and Learning

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Apply a wealth of techniques and algorithms for theanalysis of robots.	L3
CO2	Identify factors that influence the robustness of robots in real-world situations	L2

CO3	Development of necessary technical foundations for studies inadvanced robotics.	L4

COURSE CONTENT:	
MODULE 1	**8Hrs**
Robotics: Introduction- System Design, Geometry and Mechanics-Quadrotor Kinematics-Quadrotor Kinematics - Supplementary Material-Quadrotor Dynamics, Planning and Control: Control-Planning, On-Board Estimation, Nonlinear Control, Swarms.	
MODULE 2	**8Hrs**
Computational Motion Planning: Graph-based Plan Methods, Configuration Space-Configuration Space Applications-Path Planning in Configuration Space, Sampling-based Planning Methods, Probabilistic Road Maps, Rapidly Exploring Random Trees, Artificial Potential Field Methods.	
MODULE 3	**8Hrs**
Mobility: Introduction - Motivation and Background, Mechanical Dynamical Systems, Behavioral & Physical-Templates-Components - Materials-Structures-Power-Information, Anchors - Embodied Behaviors, Review - Core, Limbs & Appendages in Motion and at Work, Design - By Animals; by Engineers, Composition: Dynamical Composition-Parallel Composition-Horizons of Research.	
MODULE 4	**7Hrs**
Perception: Geometry of Image Formation, Projective Transformations, Pose Estimation, Multi-View Geometry	
MODULE 5	**8Hrs**
Estimation and Learning: Gaussian Model Learning: Introduction-Single Dimensional Gaussian-Multivariate Gaussian-Mixture of Gaussians, Bayesian Estimation - Target Tracking-Motivation-Kalman Filter Model-MAP Estimate of KF-Non-Linear Variations, Mapping- Robotic Mapping-Occupancy Grid Mapping-Mapping, Bayesian Estimation - Localization- Belief state in 2D-Map Registration-Particle Filters-ICP.	

Text Books:

- Sebastian Thrun, Wolfram Burgard, and Dieter Fox., (2006). Probabilistic Robotics, MITPress. ISBN:978-0-262-20162-9
- Robin R. Murphy. 2014. Disaster Robotics. The MIT Press. ISBN:978-0-262-02735-9.

Reference Books:

- Sebbane, Y.B. (2022). A First Course in Aerial Robots and Drones (1st ed.). Chapmanand Hall/CRC, ISBN 978-1-003-12178-7

- Peter cork,Robotics, 2017,Vision and Control (2nd ed.),springer tracts in advancedRobotics.
- Simon J.D. Prince,Computer Vision: Models, Learning, and Inference,CambridgeUniversity press
- Robin R. Murphy. 2019. Introduction to AI Robotics (Second Edition). MIT Press,Cambridge, MA, USA. ISBN: 978-0-262-03848-5
- Kevin M. Lynch and Frank C. Park. 2017. Modern Robotics: Mechanics, Planning, andControl., Cambridge University Press, USA. ISBN:978-1-107-15630-2.

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SEMESTER	**VI**					
YEAR	**III**					
COURSE CODE	**20CS3601**					
TITLE OF THE COURSE	**COMPILER DESIGN AND SYSTEMS SOFTWARE**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**1**	**-**	**-**	**52**	**4**

Perquisite Courses (if any)			
#	Sem/Year	CourseCode	Title of the Course
*	**	**	***

COURSE OBJECTIVES:

1. To explain the basic system software components such as assembler, loader, linkers,compilers.
2. Provide an understanding of the fundamental principles in compiler design
3. To discuss the techniques of scanning, parsing & semantic elaboration well enoughto build or modify front end.
4. To illustrate the various optimization techniques for designing various optimizingcompilers.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Understand the architecture of a hypotheticalmachine, structure and design of assembler.	L2
CO2	Analyse how linker and loader create anexecutable program from an object module created by assembler	L4
CO3	Describe the major phases of compilation and to apply the knowledge of Lex tool & YAACtool	L2

CO4	Explain the syntax analysis phase and identifythe similarities and differences among various parsing techniques and grammar transformationmethods	L2
CO5	Use formal attributed grammars for specifyingthe syntax and semantics of programming	L3
	languages.	
CO6	Summarize various optimization techniques used for dataflow analysis and generate machine code from the source code of a novel language.	L2

COURSE CONTENT:	
MODULE 1: Introduction to System Software,ASSEMBLERS	**10Hrs**
Introduction to System Software, Machine Architecture of SIC and SIC/XE. ASSEMBLERS: Basic assembler functions: A simple assembler, Assembler algorithm anddata structures, Machine dependent assembler features: Instruction formats and addressingmodes – Program relocation, Machine independent assembler features: Literals, Symbol- defining statements, Expressions, Program blocks	
MODULE 2 : LOADERS AND LINKERS:	**9Hrs**
Basic loader functions: Design of an Absolute Loader, A Simple Bootstrap Loader, Machine dependent loader features: Relocation, Program Linking, Algorithm and Data Structures for Linking Loader, Machine-independent loader features: Automatic Library Search, LoaderOptions, Loader design options: Linkage Editors, Dynamic Linking	
MODULE 3: COMPILERS	**11Hrs**
Introduction: Language Processors, Structure of compiler, The science of building a compiler,Applications of compiler technology. LEXICAL AND SYNTAX ANALYSIS: Role of lexical Analyzer, Specification of Tokens,Lexical Analyzer generator Lex. SYNTAX ANALYSIS I: Role of Parser, Syntax error handling, Error recovery strategies,Writing a grammar: Lexical vs Syntactic Analysis, Eliminating ambiguity, Left recursion, Left factoring.	
MODULE 4: SYNTAX ANALYSIS II	**12Hrs**

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Top down parsing: Recursive Descent Parsing, First and follow, LL (1), –Bottom up parsing: Shift Reduce Parsing, Introduction to LR parsing Simple LR: Why LR Parsers, Items and LR0 Automaton, The LR Parsing Algorithm.
SYNTAX-DIRECTED TRANSLATION: Syntax-Directed Definitions: Inherited and Synthesized Attributes, Evaluation orders for SDDs: Dependency graphs, Ordering the evaluation of Attributes, S-Attributed Definition, L-Attributed Definition, Application: Construction of Syntax Trees.

MODULE 5: INTERMEDIATE CODE GENERATION	**10Hrs**

Three Address Code: Addresses and Instructions, Quadruples, Triples, indirect triples.
CODE GENERATION: Issues in the design of code generator, Basic Blocks, Optimization of Basic Blocks, The Code Generation Algorithm, Peephole optimization.
MACHINE INDEPENDENT OPTIMIZATION: The Principal Sources of Optimization

TEXT BOOKS:

1. Leland L. Beck, “System Software – An Introduction to Systems Programming”, 3rdEdition,
Pearson Education Asia, 2006.
2. Alfred V Aho, Monica S. Lam, Ravi Sethi and Jeffrey D Ullman, “Compilers – Principles,
Techniques and Tools”, 2nd Edition, Pearson Education, 2007.

REFERENCES:

1. V. Raghavan, Principles of Compiler Design||, Tata McGraw Hill EducationPublishers, 2010.
2. Keith D Cooper and Linda Torczon, Engineering a Compiler, Morgan KaufmannPublishers
Elsevier Science, 2004.
3. D.M.Dhamdhere, Systems Programming and operating systems, Second Revisededition, Tata McGraw Hill.

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SEMESTER	**VI**					
YEAR	**III**					
COURSE CODE	**20AM3601**					
TITLE OF THE COURSE	**DEEP LEARNING**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	PracticalHours	Seminar/ProjectsHours	Total Hours	Credits
	3	**-**	**-**	**-**	**39**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	IV/II	20CS2401	Probability and Statistics

COURSE OBJECTIVES :

- To understand the basic building blocks and general principles that allows oneto design Deep learning algorithms
- To become familiar with specific, widely used Deep learning networks
- To introduce building blocks of Convolution neural network architecture
- To learn to use deep learning tools and framework for solving real-life problems

COURSE OUTCOMES :

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO 1	Understand Building blocks of deep networksand Neuralnetworks	L2
CO 2	Understand the need and significance of mathematicalfundamentals in Deep Learning to solve real-time problems.	L2

CO 3	Identify and Apply the deep learning algorithms which are more appropriate for various types of learning tasks in variousdomains	L3
CO 4	Develop deep learning algorithms and solve real- world problems deep learning tools and framework	L6

COURSE CONTENT:	
MODULE 1:Introduction to Deep Learning	**8Hrs**
Introduction to Neural Networks:Single layer and Multilayer NN, training neural networks,activation functions, loss functions, Model Selection. Introduction to Deep Learning, Principles of Deep Networks and Building blocks of deepnetworks. (Text 2: Chapter 2&3)	
MODULE 2	**7Hrs**
Mathematical background for Deep learning- Data Manipulation and Data Preprocessing, LinearAlgebra, Calculus, Probability. (Text 1: Chapter 2)	
MODULE 3	8**Hrs**
Forward Propagation, Backward Propagation, and Computational Graphs Layers and Blocks,shallow neural network, deep neural network, Optimization for Training Deep Models. (Text 1: Chapter 4)	
MODULE 4	**8Hrs**
Convolutional Neural Networks (CNNs) - Biological inspiration, Mapping of Human Visual System and CNN. Convolution operation, Convolutional Layers, Padding and Stride, Batch normalization and layers, Subsampling, Pooling. (Text2: Chapter 4)	
MODULE 5 Unsupervised Pretrained Networks (UPNs)- Autoencoders, Deep Belief Networks(DBNs) ,Introduction to Generative Adversarial Networks (GANs). Deep Learning Applications in Healthcare and other areas(Case study)	**8Hrs**
List of Laboratory/Practical Experiments activities to be conducted:	
1 Using an Algorithm and supporting flow chart elaborate and implement the handwrittendigital classifier using Deep Learning network.	

2	A hospital consists of patients with heart diseases, their ECGs are stored in a repository. Basedon the n ECG of a new patient, conclude whether r patient has heart disease or not using an appropriate Deep Learning network, and so give suggestiforimprove decisionision- makingmaking using an algorithm.
3	Our health as individual human beings is influenced by global health issues. We have experienced the same for the past two years during the COVID 19 pandemic. Suggest an appropriate Deep Learning model to predict the COVID positive or Not using X-rayImages.
4	

TEXT BOOKS :	
1.	Aston Zhang, Zack C. Lipton, Mu Li, Alex J. Smola, "Dive into Deep Learning", Amazon Science, 2020
2.	Josh Patterson and Adan Gibson, "Deep Learning a Practitioners Approach", July, 2018.
3	"Neural Networks: A Comprehensive Foundation,"S. Haykin, 2nd Ed, Prentice Hall of India, 2003.

REFERENCES :	
1	Tom Mitchell, Machine Learning, McGraw-Hill, 1997
2.	Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", The MIT Press, 2016
3.	François Chollet, "Deep Learning Python", Manning Publications, 2018
4.	Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems", O'Reilly Media; 1 edition(April 9, 2017)

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

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SEMESTER	**VI**					
YEAR	**III**					
COURSE CODE	**20AM3602**					
TITLE OF THE COURSE	**ARTIFICIAL INTELLIGENCE-II**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**-**	**-**	**39**	**3**

Perquisite Courses (if any)			
#	Sem/Year	CourseCode	Title of the Course
* * *	VI/III	* * *	Artificial Intelligence-I

COURSE OBJECTIVES :

- Gain a perspective of state space search in AI
- Investigate applications of AI techniques in intelligent agents, expert systems,
- Understanding Natural language and its importance in AI

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COURSE OUTCOMES :

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Demonstrate awareness and a fundamental understanding of various applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.	L5
CO2	Demonstrate proficiency in applying scientific method tomodels using PROLOG and LISP	L4
CO3	Apply AI techniques to real-world problems to developintelligent systems	L4
CO4	Design, analyse and demonstrate AI applications or systems thatapply to real life problems.	L5

COURSE CONTENT:	
MODULE 1	**10Hrs**
AI as Representation and Search: The predicate Calculus, Using Inference Rules to produce Predicate Calculus Expressions, Structures and Strategies for State Space Search: Graph Theory,Strategies for State Space Search, using state space to represent Reasoning with predicate calculus Recursion-based search, production systems, Predicate Calculus and Planning	
MODULE 2	**8Hrs**
Programming Languages for AI An Introduction to PROLOG: Syntax for predicate Calculus programming, ADTs in PROLOG, A production system example in PROLOG. An Introduction to LISP: LISP - A brief overview, Search in LISP, Pattern matching in LISP	
MODULE 3	**8Hrs**

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Expert Systems: Introduction to AI agents, Overview of expert system Technology, Rule Based expert systems, Model based reasoning, Case-based Reasoning, knowledge-Representation problem, An Expert system Shell in LISP.
MODULE 4 **7Hrs**
Understanding Natural Language: Role of knowledge in Language Understanding, Language Understanding: A symbolic approach, Syntax, Combining Syntax and semantic in ATN parsers, Stochastic Tool for language Analysis, Natural Language Applications: Story Understanding and Question Answering
MODULE 5 **8Hrs**
Pattern Recognition: Introduction, Recognition and classification process, learning Classification patterns, Recognizing and Understanding Speech **Computer Vision** Overview and State-of-the-art, Fundamentals of Image Formation, Transformation: Orthogonal,Euclidean, Affine, Projective, etc; Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing

TEXT BOOKS :	
1.	George F Luger, William A Stubblefield. Artificial Intelligence: Structures and Strategies for Complex Problem Solving, 3rd Edition, Addison Wesley Longman, Inc
2	Introduction to Artificial Intelligence and Expert Systems by Dan W. Patterson, PearsonEducation
3.	Forsyth and Ponce, "Computer Vision – A Modern Approach", Second Edition, Prentice Hall, 2011.

REFERENCES :	
1.	Daniel Jurafsky, James H. Martin. Speech and Language processing: An Introduction toNatural Language processing, computational Linuistics and Speech, Pearson Publication, 2014
2.	Artificial Intelligence: Concepts and Applications, Wiley (1 January 2021); ISBN-10 :8126519932.

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SEMESTER	**VI**					
YEAR	**III**					
COURSE CODE	**20CS3604**					
TITLE OF THE COURSE	**COMPILER DESIGN AND SYSTEM SOFTWARE LAB**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	-	-	2	-	26	1

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

• Experiment on the basic techniques of compiler construction and tools that can used to performsyntax-
directed translation of a high-level programming language into an executable code.
• Know the implementation of assemblers, loaders and various parsing techniques.
• Learn how to optimize and effectively generate machine codes.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Identify patterns, tokens & regular expressions for lexical analysis.	L2
CO2	Develop LEX and YACC programs for lexical and syntax analysis phases of Compiler.	L3
CO3	Implement the pass 1 of two pass assembler and absolute loader algorithm	L3

CO4	Analyze and Implement the bottom up parsing technique	L4
CO5	Implement front end of the compiler by means of generating intermediate codes.	L3

List of Laboratory/Practical Experiments activities to be conducted
1a. Program to count the number of characters, words, spaces and lines in a given input file.
1b. Program to recognize and count the number of identifiers in a file.
2a. Program to count the numbers of comment lines in a given C program. Also eliminate them and copy the resulting program into separate file.
2b. Program to recognize whether a given sentence is simple or compound.
3a. Program to count no of:i.+ve and –ve integers ii. +ve and –ve fractions
3b. Program to count the no of „scanf‟ and „printf‟ statements in a C program. Replace themwith “readf‟ and “writef‟ statements respectively.
4.Program to evaluate arithmetic expression involving operators +,-,*,/
5. Program to recognize a valid variable which starts with a letter, followed by any number of letters or digits.
6. Program to recognize the strings using the grammar ($a^n b^n$;n>=0)
7. C Program to implement Pass1 of Assembler
8. C Program to implement Absolute Loader
9. C program to find the FIRST in context free grammar.
10.C Program to implement Shift Reduce Parser for the given grammarE →E+E E→E*E E→(E) E → id
11. C Program to implement intermediate code generation for simple expression

TEXT BOOKS:

1. Leland L. Beck, “System Software – An Introduction to Systems Programming”, 3rdEdition, Pearson Education Asia, 2006.

2. Alfred V Aho, Monica S. Lam, Ravi Sethi and Jeffrey D Ullman, “Compilers – Principles, Techniques and Tools”, 2nd Edition, Pearson Education, 2007.

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SEMESTER	**VI**					
YEAR	**III**					
COURSE CODE	**20AM3603**					
TITLE OF THE COURSE	**ARTIFICIAL INTELLIGENCE-LAB**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/ Projects Hours	Total Hours	Credits
		-	**2**	**-**	**26**	**1**

Prerequisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	III/II	***	CTPY

COURSE OBJECTIVES:

- To provide skills for designing and analyzing AI-based algorithms.
- To familiarize students with skills to work in various sub-areas of AI, such as expertsystems, natural language processing, and machine learning.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
1	Demonstrate awareness and a fundamental understandingof applying AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.	L6
3	Select and apply appropriate algorithms and AI techniques	L6

	to solve complex problems.	

COURSE CONTENT:	
List of Laboratory/Practical Experiments activities to be conducted:	
1	Design & analyze the application of Artificial Intelligence for Graph Theory concept.
2	Write a Program to find the factorial & Fibonacci series of a given number
3	Write a Program to find the solution for Travelling Salesman Problem with Prolog.
4	LISP with Hello World Example & to check given word is equal or not
5	Relation identification program using Lisp
6	For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent.
7	Write a python program to remove punctuations from the given string?
8	Implement part of speech (POS) tagging using an HMM model.
9	Implement naïve bayes theorem to classify the English text
10	Implement the finite words classification system using backpropagation algorithm
11	To implement the model to correctly identify the sentiments of the users by reviews which is an English paragraph and the result will be in positive or negative only. “NLP - Sentiment Analysis - Restaurant Reviews”.
12	MINI Project (Graph Theory / Prolog /LISP / CNN /NLP) Each batch (Consisting of not more than 3 members need to submit the mini project report & demonstration on the said topics)

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PROFESSIONAL ELECTIVES- II & III(VI SEM)

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SEMESTER	**VI**					
YEAR	**III**					
COURSE CODE	**20AM3604**					
TITLE OF THE COURSE	**INTRODUCTION TO COMPUTER VISION**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	PracticalHours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**-**	**-**	**39**	**3**

No- Perquisite Courses Required			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES :

- To learn the fundamentals of computer vision systems.
- To understand the image recognition and retrieval algorithms
- To learn the concepts of object recognition and applications of computer vision systems.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Understand and explore the basics of Computer Vision andVarious Models.	L2
CO2	Understand the geometric relationships between 2D images andthe 3D world;	L2
CO3	Developed the practical skills necessary to build computervision applications.	L2

COURSE CONTENT:	
MODULE 1	**8Hrs**
Image Formation: Geometric image formation, Photometric image formation - Camera Models and Calibration: Camera Projection Models – Orthographic, Affine, Perspective, Projective models. Projective Geometry,	
MODULE 2	**8Hrs**

Transformation of 2D and 3D, Internal Parameters, Lens Distortion Models- Local Feature Detectorsand Descriptors: Hessian corner detector, Harris Corner Detector, LOG detector, DOG detector.	
MODULE 3	**8Hrs**
SIFT, PCA-SIFT, GLOH, SURF, HOG, Pyramidal HOG, PHOW, Calibration Methods: Linear, Direct, Indirect and Multiplane methods, Pose Estimation. Stereo.	
MODULE 4	**7Hrs**
Multi-view Geometry: Epipolar Geometry, Rectification and Issues related to Stereo, General Stereowith E Matrix Estimation.	
MODULE 5	**8Hrs**
Stratification for 2 Cameras, Extensions to Multiple Cameras, Self-Calibration with MultipleCameras, 3D reconstruction of cameras and structures, Three View Geometry.	

TEXT BOOKS :

1. Forsyth and Ponce, "*Computer Vision – A Modern Approach*", Second Edition, Prentice Hall, 2011.
2. Emanuele Trucco and Alessandro Verri, "*Introductory Techniques for 3-D Computer Vision*", Prentice Hall, 1998.

REFERENCES:

1. Olivier Faugeras, "*Three Dimensional Computer Vision*", MIT Press, 1993.
2. Richard Szeliski, "*Computer Vision: Algorithms and Applications*", Springer, 2011.
3. Milan Sonka, Vaclav Hlavac and Roger Boyle, "*Image Processing, Analysis and Machine Vision*", Third Edition, CL Engineering, 2013.

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SEMESTER	**VI**					
YEAR	**III**					
COURSE CODE	**20AM3605**					
TITLE OF THE COURSE	**REINFORCEMENT LEARNING**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Hands on Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**-**	**-**	**39**	**3**

Perquisite Courses (if any)			
#	Sem/ Year	Course Code	Title of the Course
1	IV/II	20CS2401	Probability and Statistics

COURSE OBJECTIVES:

- Use Reinforcement Learning Methods for the agents to learn an optimal, or nearly-optimal, policy that maximizes the "reward function" or other user-provided reinforcement signal .
- Apply such Reinforcement Learning mechanisms to various learning problems.
- Learn about several algorithms that can learn near optimal policies based on trial and error interaction with the environment---learning from the agent's own experience

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Understand Temporal-Difference learning and Monte Carlo as two strategies for estimating value functions from sampled experience	L2
CO2	Understand the importance of dynamic programming in amodel	L2

CO3	Implement and apply the TD algorithm, for estimating valuefunctions	L3
CO4	Understand the connections between Monte Carlo andDynamic Programming and TD.	L2

COURSE CONTENT:	
MODULE 1	**8Hrs**
Introduction: Reinforcement Learning, Elements of Reinforcement Learning, Limitations and Scope, History of Reinforcement Learning, Probability concepts - Axioms of probability, Notion of random variables, PMF, PDFs, CDFs. Two Random Variables, Pairs of Discrete Random Variables, The Joint cdf of X and Y, The Joint pdf of two continuous random variables, Independence of two Random variables **Textbook 1: Ch 1.1 to 1.4; Textbook 2: 2.2,3.1,3.2,4.1 to 4.2, 5.1 to 5.5RBT: L1, L2**	
MODULE 2	**8 Hrs**
Finite Markov Decision Processes: The Agent-Environment Interface, Goals and Rewards, Returns, Unified Notation for Episodic and Continuing Tasks, The Markov Property, MarkovDecision Processes, Value Functions, Optimal Value Functions, Optimality and Approximation **Textbook 1: Ch 3.1 to 3.9** **RBT: L1, L2, L3**	
MODULE 3	**7Hrs**
Dynamic Programming : Policy Evaluation, Policy Improvement, Policy Iteration, Value Iteration, Asynchronous Dynamic Programming, Generalized Policy Iteration, Efficiency of Dynamic Programming **Textbook 1: Ch 4.1 to 4.8RBT: L1, L2, L3**	
MODULE 4	**8Hrs**
Monte Carlo Methods : Monte Carlo Prediction, Monte Carlo Estimation of Action Values, MonteCarlo Control, Monte Carlo Control without Exploring Starts, O-policy Prediction via Importance Sampling, Incremental Implementation, O-Policy Monte Carlo Control, Importance Sampling on Truncated Returns **Textbook 1: Ch 5.1 to 5.8RBT: L1, L2, L3**	
MODULE 5	**8Hrs**

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Temporal Difference Learning : TD Prediction , Advantages of TD Prediction Methods , Optimalityof TD(0) , Sarsa: On-Policy TD Control , Q-Learning: Off-Policy TD Control, n-Step TD Prediction
, The Forward View of TD(λ) ,The Backward View of TD(λ) , Equivalences of Forward andBackward Views.
Textbook 1: Ch 6.1 to 6.5 , 7.1 to 7.4RBT: L1, L2, L3

TEXT BOOKS:

1. Richard S. Sutton and Andrew G. Barto, Reinforcement Learning: An Introduction, 2nd Edition
2. Alberto Leon-Garcia, Probability, Statistics, and Random Processes for Electrical Engineering,3rd Edition

REFERENCE BOOKS:

1. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective ,The MIT Press, 2012
2. Kyriakos G. Vamvoudakis, Yan Wan, Frank L. Lewis, Derya Cansever, Handbook ofReinforcement Learning and Control,1st ed. 2021 Edition, ISBN-13: 978-3030609894

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Semester	**VI**					
Year	**III**					
Course Code	**20AM3606**					
Title	**Industrial Robotics**					
Scheme of Instruction	Lecture Hours	Tutorial Hours	PracticalHours	Seminar/ProjectsHours	Total Hours	Credits
	3	**-**	**-**	**-**	**39**	**3**
Perquisite Courses (if any):						

#	Sem / Year	Course Code	Title of the Course
	IV/II	20CS2401	Probability and Statistics

Course Objectives

- Understand the configuration space with specific reference to robotic motion
- Understand different types of kinematics used in industrial robotics.
- To understand motion planning in industrial robotics.
- Understand Computational Motion Planning and Mobility
- Understand the concept of grasping and manipulation.

	CO No.	Outcomes	Bloom's Taxonomy Level
	CO 1	Physics-based modeling of robots.	L4
	CO 2	Ability to design path planning algorithms	L4
	CO 3	Development of necessary technical foundations for studiesof advanced robots like soft robots, spherical robots etc..	L3

COURSE CONTENT:

MODULE 1	**8Hrs**

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Introduction Configuration Space: Foundations of Robot Motion-Degrees of Freedom of a Rigid Body-Degrees of Freedom of a Robot-Configuration Space Topology-Configuration Space Representation- Configuration and Velocity Constraints-Task Space and Workspace. Rigid-Body Motions: Introduction to Rigid-Body Motions-Rotation Matrices-Angular Velocities-Exponential Coordinates of Rotation-Homogeneous Transformation Matrices-Twists-Exponential Coordinates of Rigid-Body Motion-Wrenches.	
MODULE 2	**8Hrs**
Forward Kinematics: Product of Exponentials Formula in the Space Frame-Product of Exponentials Formula in the End-Effector Frame-Forward Kinematics Example-Velocity Kinematics and Statics:Introduction to Velocity Kinematics and Statics-Space Jacobian-Body Jacobian-Statics of Open Chains-Singularities-Manipulability. Inverse Kinematics: Inverse Kinematics of Open Chains- Numerical Inverse Kinematics.	
MODULE 3	**8Hrs**
Kinematics of Closed Chains-Kinematics of Closed Chains, Dynamics of Open Chains-Lagrangian Formulation of Dynamics-Understanding the Mass Matrix-Dynamics of a Single Rigid Body- Newton-Euler Inverse Dynamics-Forward Dynamics of Open Chains-Dynamics in the Task Space-Constrained Dynamics-Actuation, Gearing, and Friction. Trajectory Generation: Point-to-Point Trajectories-Polynomial Via Point Trajectories-Time-Optimal Time Scaling.	
MODULE 4	**7Hrs**
Motion Planning: Overview of Motion Planning-C-Space Obstacles-Graphs and Trees-Graph Search-Complete Path Planners-Grid Methods for Motion Planning-Sampling Methods for Motion Planning-Virtual Potential Fields-Nonlinear Optimization. Robot Control: Control System Overview-Error Response-Linear Error Dynamics-First-Order Error Dynamics-Second-Order Error Dynamics-Motion Control with Velocity Inputs - Motion Control with Torque or Force Inputs-ForceControl-Hybrid Motion-Force Control.	
MODULE 5	**8 Hrs**
Grasping and Manipulation: Grasping and Manipulation: First-Order Analysis of a Single Contact- Contact Types: Rolling, Sliding, and Breaking-Multiple Contacts-Planar Graphical Methods-Form Closure-Friction-Planar Graphical Methods-Force Closure-Duality of Force and Motion Freedoms-Manipulation and the Meter-Stick Trick-Transport of an Assembly. Wheeled Mobile Robots: Wheeled Mobile Robots-Omnidirectional Wheeled Mobile Robots-Controllability of WheeledMobile Robots-Motion Planning for Nonholonomic Mobile Robots-Odometry-Mobile Manipulation	

Text Books:

1. Kevin M. Lynch and Frank C. Park. 2017. Modern Robotics: Mechanics, Planning, andControl., Cambridge University Press, USA. ISBN:978-1-107-15630-2.

Reference Books:

1. Spong, M. W., Hutchinson, S., & Vidyasagar, M. (2020). Robot Modeling and Control, 2ndEdition. Wiley, ISBN: 978-1-119-52404-5.
2. Peter cork,Robotics, 2017,Vision and Control (2nd ed.),springer tracts in advanced Robotics.
3. Simon J.D. Prince,Computer Vision: Models, Learning, and Inference,Cambridge Universitypress
4. Ghosal, A. (2015). Robotics: Fundamental concepts and analysis. Oxford: Oxford UniversityPress.ISBN: 978-0-195-67391-3.

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SEMESTER	**VI**					
YEAR	**III**					
COURSE CODE	**20AM3607**					
TITLEOFTHECOURSE	**EXPLAINABLE ARTIFICIAL INTELLIGENCE**					
SCHEMEOFInstruction	Lecture Hours	Tutorial Hours	PracticalHours	Seminar/ProjectsHours	Total Hours	Credits
	3	**-**	**-**	**-**	**39**	**3**

PerquisiteCourses(ifany)			
#	Sem/Year	Course Code	Title of the Course
1	V/III	20CSXXXX	Machine Learning
2	IV/II	20CS2401	Probability and Statistics

COURSE OBJECTIVES:

- To understand the basic building block of Explainable AI and interpretablemachine learning
- To understand the inner workings of AI and consequent outcomes .
- To bring transparency to AI systems by translating, simplifying, and visualizingits decisions.
- To discover unknown correlations with causal relationships in data

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Show familiarity with concepts within Explainable AI andinterpretable machine learning	L3
CO2	Demonstrate comprehension of current techniques for generating explanations from black-box machine learning methods	L3
CO3	Implement explainable deep learning algorithmsand solve real-world problems	L4

COURSECONTENT:

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MODULE1: Introduction to Interpretability and Explainability	**7Hrs**
Black-Box problem, Goals, Porphyrian Tree , Expert Systems , Case-Based Reasoning, BayesianNetworks , Types of Explanations, Trade-offs, Taxonomy, Flowchart for Interpretable and Explainable Techniques **TextBook 1: 1.1 to 1.9**	
MODULE2: Pre-model Interpretability and Explainability	**8Hrs**
Data Science Process and EDA, Exploratory Data Analysis, Feature Engineering-Feature Engineering and Explainability , Feature Engineering Taxonomy and Tools. **TextBook 1: 2.1 to 2.3**	
MODULE3: Model Visualization Techniques and Traditional InterpretableAlgorithms	**8Hrs**
Model Validation, Evaluation, and Hyperparameters, Model Selection and Visualization, Classification Model Visualization, Regression Model Visualization, Clustering Model Visualization, Interpretable Machine Learning Properties, Traditional Interpretable Algorithms-Linear Regression. **TextBook- 3.1 to 3.6, 3.7.2**	
MODULE4: Model Interpretability: Advances in Interpretable Machine Learning	**8Hrs**
Interpretable vs. Explainable Algorithms, Ensemble-Based-Boosted Rulesets, Explainable Boosting Machines (EBM), RuleFit, Skope-Rules, Iterative Random Forests (iRF), Decision Tree-Based-Optimal Classification Trees, Optimal Decision Trees, Scoring System **TextBook 1: 4.1-4.4,4.6**	
MODULE 5:Explainable Deep Learning	**8Hrs**
Applications, Tools and Libraries, Intrinsic, Perturbation- LIME, Occlusion, RISE, Prediction Difference Analysis, Meaningful Perturbation, Gradient/Backpropagation- Activation Maximization, Class Model Visualization, Saliency Maps, DeepLIFT, DeepSHAP, Deconvolution, Guided Backpropagation, Integrated Gradients, Layer-WiseRelevance Propagation, Excitation Backpropagation, CAM **Textbook 1: 6.1 to 6.4 , 6.5.1 to 6.5.11**	

TEXTBOOKS :	
1.	Uday Kamath , John Liu, "Explainable Artificial Intelligence: An Introduction to Interpretable Machine Learning", Springer, 2021.

REFERENCES :	
1	Christoph Molnar , "Interpretable Machine Learning: A Guide for Making Black Box Models Explainable", Second Edition
2.	Leonida Gianfagna, Antonio Di Cecco, "Explainable AI with Python" , 2021

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SEMESTER	**VI**					
YEAR	**III**					
COURSE CODE	**20AM3608**					
TITLE OF THE COURSE	**Natural language Models**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**-**	**-**	**39**	**3**

Prerequisite Courses (if any)			
#	Sem/Year	Course Code	Title of theCourse
*	IV/II	20CS2401	Probability and Statistics

COURSE OBJECTIVES:

- To understand the algorithms available for the processing of linguistic information andcomputational properties of natural languages
- To conceive basic knowledge on various morphological, syntactic and semantic NLP task
- To understand machine learning techniques used in NLP,
- To write programs in Python to carry out natural language processing

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Extract information from text automatically using concepts and methods from natural language processing (NLP) including stemming, n-grams	L2
CO2	Categorizing words in the text using n-grams, Part-of-speech tagging,information extraction	L3
CO3	Apply Machine learning Algorithms to Character-level LanguageModeling	L4
CO4	Apply machine learning algorithms for text data processing.	L4
CO5	Create scripts and applications in Python to carry out natural languageprocessing	L5

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COURSE CONTENT:	
MODULE 1	**8 Hrs.**
Introduction Past, present, and future of NLP; Classical problems on text processing; Necessary Math concepts forNLP; Regular expressions in NLP. Parts of Speech and Morphology, Phrase Structure, Semantics and Pragmatics, Corpus-Based Work:Getting Set Up, Looking at Text, Marked-up Data Text processing: lemmatization, stop word, tokenization, stemming, Spelling errors corrections–Minimum edit distance, Bayesian method	
MODULE 2	**8Hrs**
Words & Sentences N-grams: Simple unsmoothed n-grams; smoothing, backoff, spelling correction using N-grams,Metrics to evaluate N-grams. Parts of Speech tagging: Word classes, POST using Brill's Tagger and HMMs; Information Extraction: Introduction to Named Entity Recognition and Relation Extraction WordNet and WordNet-based similarity measures, Concept Mining using Latent Semantic Analysis	
MODULE 3	**7Hrs**
Sequence to sequence & Language Modelling Word embedding: skip-gram model, CBOW, GloVe, BERT; Sequence to sequence theory and applications, Attention theory and teacher forcing; Language Modelling: Basic ideas, smoothing techniques, Language modeling with RNN and LSTM	
MODULE 4	**8Hrs**
ML for NLP Classification- binary and multiclass, clustering, regression for text data processing; Machine translation: rule-based techniques, Statistical Machine Translation (SMT); Hidden Markov Models: HMMs: Implementation, Properties, and Variants, Markov Model Taggers	
MODULE 5	**8 Hrs**
Advanced Topics and Hands-on Practices Python libraries supporting NLP; Hands-on Data collection - from social network platforms, pdfs,word files, JSON, HTML Parsing text using regular expression; scraping data from web; Text processing: convert to lowercase,remove punctuation, remove stop words, standardizing text, tokenising, stemming, lemmatising. ***Applications:*** Spam detection, consumer complaint classification, Semantic Analyser, Dialogueprocessing (Chatbots), Text summarization, Text Categorization	

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TEXTBOOKS:

1. Daniel Jurafsky and James H. Martin. 2009. Speech and Language Processing: An Introduction to Natural Language Processing, Speech Recognition, and Computational Linguistics. 2nd edition. Prentice-Hall.
2. Christopher D. Manning and Hinrich Schütze. 1999. Foundations of Statistical Natural LanguageProcessing. MIT Press.
3. Tiwary, U. S., & Siddiqui, T. (2008). Natural language processing and information retrieval. Oxford University Press, Inc.
4. Kao, Anne, and Steve R. Poteet, eds. Natural language processing and text mining. Springer Science & Business Media, 2007.

REFERENCES:

1. Akshay Kulkarni, Adarsha Shivananda, "Natural Language processing Recipes - Unlocking Text
Data with Machine Learning and Deep Learning using Python". ISBN-13 (pbk): 978-1-4842-4266-7ISBN-13 (electronic): 978-1-4842-4267-4 https://doi.org/10.1007/978-1-4842-4267-4

2. Palash Goyal, Sumit Pandey, Karan Jain, Deep Learning for Natural Language Processing - Creating Neural Networks with Python. ISBN-13 (pbk): 978-1-4842- 3684-0 ISBN-13 (electronic): 978-1-4842-3685-7, https://doi.org/10.1007/978-1-4842-3685-7

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SEMESTER	**VI**					
YEAR	**III**					
COURSE CODE	**20AM3609**					
TITLE OF THE COURSE	**DATA SCIENCE**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**-**	**-**	**39**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
	IV/II	20CS2401	Probability and Statistics

COURSE OBJECTIVES:

- Impart necessary knowledge of the mathematical foundations needed for data science
- Develop programming skills required to build data science applications

COURSE OUTCOMES:

CO No.	Outcomes	**Bloom's Taxonomy** Level
CO1	Demonstrate understanding of the mathematical foundationsneeded for data science.	**L1**
CO2	Collect, explore, clean, munge and manipulate data.	**L3**
CO3	Implement models such as k-nearest Neighbors, Naive Bayes, linear and logistic regression, decisiontrees, neural networks and clustering.	**L4**
CO4	Build data science applications using Python basedtoolkits.	**L3**

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Kudlu Gate, Hosur Road, Bengaluru 560068

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Artificial Intelligence & Machine Learning)

COURSE CONTENT:	
MODULE 1: Introduction to Data Science & Programming Tools for DataScience	**8 Hrs**
Concept of Data Science, Traits of Big data, Analysis vs Reporting, Toolkits using Python:, NumPy,Pandas, Scikit-learn, Matplotlib, Visualizing Data: Bar Charts, Line Charts, Scatterplot. Working with data: Reading Files, Scraping the Web, Using APIs (Example: Using the Twitter APIs), Cleaning and Munging, Manipulating Data, Rescaling, Dimensionality Reduction, PrincipalComponent Analysis, Feature extraction	
MODULE 2: Mathematical Foundations	**8 Hrs**
Review of Probability theory, Correlation, Dependence and Independence, Conditional Probability,Baye's Theorem, The Normal Distribution, The Central Limit Theorem, Hypothesis and Inference: Statistical Hypothesis Testing, Confidence Intervals, P-hacking, Bayesian Inference	
MODULE 3 : Machine Learning	**8 Hrs**
Overview of Machine learning concepts – Over fitting and under fitting, feature selection, train/testsplits, Types of Machine learning – Supervised, Unsupervised, Reinforced learning, Linear Regression- regularization (lasso, ridge, elastic net), Clustering algorithms, K-Means Clustering,Classification versus Regression	
MODULE 4 : Popular Machine Learning algorithms	**8 Hrs**
Naive Bayes, K-Nearest Neighbors, logistic regression, support vector machines (SVM), decisiontrees, and random forest, Classification performance metrics, Analysis of Time Series, Neural Networks- Learning and Generalization, Overview of Deep Learning.	
MODULE 5 : Case Studies of Data Science Application	**7 Hrs**
Weather forecasting, Stock market prediction, Object recognition, Real Time Sentiment Analysis.	

TEXT BOOK:

1. Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media
2. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn and Tensor Flow: Concepts,Tools, and Techniques to Build Intelligent Systems", 1st Edition, O'Reilly Media

REFERENCES:

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Presshttp://www.deeplearningbook.org
2. Jiawei Han and Jian Pei, "Data Mining Concepts and Techniques", Third Edition, MorganKaufmann Publishers
3. Jain V.K., "Data Sciences", Khanna Publishing House, Delhi.

4. Jain V.K., "Big Data and Hadoop", Khanna Publishing House, Delhi.
5. Jeeva Jose, "Machine Learning", Khanna Publishing House, Delhi.
6. Chopra Rajiv, "Machine Learning", Khanna Publishing House, Delhi

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Artificial Intelligence & Machine Learning)

SEMESTER	**VI**					
YEAR	**III**					
COURSE CODE	**20AM3610**					
TITLEOFTHECOURSE	**Introduction to IoT and Embedded Computing**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	PracticalHours	Seminar/ProjectsHours	Total Hours	Credits
	3	**-**	**-**	**-**	**39**	**3**

	PerquisiteCourses(ifany)			
	#	Sem/Year	CourseCode	Title of the Course
	1	III/II	20CS2303	Digital Electronics and Logic Design

COURSE OBJECTIVES:

- To understand the fundamental of IoT and appreciate the importance of communication between machines with referen to IoT.
- To understand the embedded systems including design techniques, control-driven architectures, and use of Internet for communication.
- See the mechanism of controls and sensing and use of Internet to take globaldecisions using IoT technology and see how it works.
- To understand, appreciate and develop ability to use various contemporaryIOT communication protocols for transport, discovery and routing.
- To understand the methodologies to implement the software systems forembedded computing and methods of programming them.
- To appreciate the utilities of IoT through case studies.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom'sTaxonomy Level**
CO1	Program an embedded computing device such asArduino and Raspberry Pi.	L2
CO2	Build an IoT system for sensing and decision making.	L3
CO3	Implement standard communication protocols for IoT tobuild large systems	L4

CO3	Appreciate and understand the use of IoT in systems such as home automation, smart lighting, smart parkingetc	L4

COURSECONTENT:	
MODULE1: Introduction to IoT	**7 Hrs**
Introduction: Definition, Characteristics and Architecture of IOT Devices, Trends in the Adoptionof IoT in modern applicants, Risks, Privacy, and Security.	
MODULE2: IoT Enabling Technologies	**8 Hrs**
Sensor Networks, Sensors and actuators, Analog/Digital Conversion, Communication Protocols, Embedded Computing Systems, Cloud Computing.	
MODULE3: IoT Communication Protocols	**8 Hrs**
Communication stack for IoT, Machine to machine communication (M2M), Introduction to various protocols such as Message Queue Telemetry Transport (MQTT), ConstrainedApplication Protocol (CoAP), 6LoPAN	
MODULE4: Applications of IoT	**8 Hrs**
Routing protocols, autonomous routing, hierarchical architectures and routing protocols to connectwith infrastructure networks. Applications of IoT, case studies. Software development systems, embedded software, programming environments for IoT softwaredevelopment.	
MODULE 5: IoT Practicals using Raspberry Pi and Arduino	**8Hrs**
Introduction to Raspberry Pi and Arduino Kits, Programming Raspberry Pi with Python, Arduino Programming IDE, Use Cases: Home Automation (e.g., Smart Lighting), City Applications (e.g., Smart Parking Smart Lighting), Environment (e.g., Pollution Monitoring, Weather Monitoring), Agriculture (e.g., Smart Irrigation) etc.	

Text Books:

1. Jeeva Jose, “Internet of Things”, Khanna Book Publishing Company, 2021.
2. Samuel Greengard, “The Internet of Things”, 1st Edition, MIT Press, 2015.
3. Peter Waher, Pradeeka Seneviratne, Brian Russell, Drew Van Duren, “IoT: Building Arduino-Based Projects”, 1st Edition, Packt Publishing Ltd, 2016.

REFERENCES :	
1	Peter Waher, "Mastering Internet of Things: Design and create your own IoTapplications using Raspberry Pi 3", 1st Edition, Packt Publishing Ltd, 2018.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Artificial Intelligence & Machine Learning)

OPEN ELECTIVE (VI SEM)

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Artificial Intelligence & Machine Learning)

Semester	**VI**					
Year	**III**					
Course Code	**20OE0030**					
Title	**Industrial Robotics (Open Elective)**					
Scheme of Instruction	Lecture Hours	Tutorial Hours	PracticalHours	Seminar/ProjectsHours	Total Hours	Credits
	3	**-**	**-**	**-**	**39**	**3**
Perquisite Courses (if any):						

#	Sem / Year	Course Code	Title of the Course
1.	IV/II	20CS2401	Probability and Statistics

Course Objectives

- Understand the configuration space with specific reference to robotic motion
- Understand different types of kinematics used in industrial robotics.
- To understand motion planning in industrial robotics.
- Understand Computational Motion Planning and Mobility
- Understand the concept of grasping and manipulation.

CO No.	Outcomes	Bloom's Taxonomy Level
CO 1	Physics-based modeling of robots.	L4
CO2	Ability to design path planning algorithms	L4
CO3	Development of necessary technical foundations for studiesof advanced robots like soft robots, spherical robots etc..	L3
8Hrs		

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MODULE 2	**8Hrs**
Forward Kinematics: Product of Exponentials Formula in the Space Frame-Product of Exponentials Formula in the End-Effector Frame-Forward Kinematics Example-Velocity Kinematics and Statics:Introduction to Velocity Kinematics and Statics-Space Jacobian-Body Jacobian-Statics of Open Chains-Singularities-Manipulability. Inverse Kinematics: Inverse Kinematics of Open Chains- Numerical Inverse Kinematics.	
MODULE 3	**8Hrs**
Kinematics of Closed Chains-Kinematics of Closed Chains, Dynamics of Open Chains-Lagrangian Formulation of Dynamics-Understanding the Mass Matrix-Dynamics of a Single Rigid Body- Newton-Euler Inverse Dynamics-Forward Dynamics of Open Chains-Dynamics in the Task Space-Constrained Dynamics-Actuation, Gearing, and Friction. Trajectory Generation: Point-to-Point Trajectories-Polynomial Via Point Trajectories-Time-Optimal Time Scaling.	
MODULE 4	**7Hrs**
Motion Planning: Overview of Motion Planning-C-Space Obstacles-Graphs and Trees-Graph Search-Complete Path Planners-Grid Methods for Motion Planning-Sampling Methods for Motion Planning-Virtual Potential Fields-Nonlinear Optimization. Robot Control: Control System Overview-Error Response-Linear Error Dynamics-First-Order Error Dynamics-Second-Order Error Dynamics-Motion Control with Velocity Inputs - Motion Control with Torque or Force Inputs-ForceControl-Hybrid Motion-Force Control.	
MODULE 5	**8 Hrs**
Grasping and Manipulation: Grasping and Manipulation: First-Order Analysis of a Single Contact- Contact Types: Rolling, Sliding, and Breaking-Multiple Contacts-Planar Graphical Methods-Form Closure-Friction-Planar Graphical Methods-Force Closure-Duality of Force and Motion Freedoms-Manipulation and the Meter-Stick Trick-Transport of an Assembly. Wheeled Mobile Robots: Wheeled Mobile Robots-Omnidirectional Wheeled Mobile Robots-Controllability of WheeledMobile Robots-Motion Planning for Nonholonomic Mobile Robots-Odometry-Mobile Manipulation	

Text Books:

1. Kevin M. Lynch and Frank C. Park. 2017. Modern Robotics: Mechanics, Planning, andControl., Cambridge University Press, USA. ISBN:978-1-107-15630-2.

Reference Books:

1. Spong, M. W., Hutchinson, S., & Vidyasagar, M. (2020). Robot Modeling and Control, 2ndEdition. Wiley, ISBN: 978-1-119-52404-5.
2. Peter cork,Robotics, 2017,Vision and Control (2nd ed.),springer tracts in advanced Robotics.
3. Simon J.D. Prince,Computer Vision: Models, Learning, and Inference,Cambridge Universitypress
4. Ghosal, A. (2015). Robotics: Fundamental concepts and analysis. Oxford: Oxford UniversityPress.ISBN: 978-0-195-67391-3.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Artificial Intelligence & Machine Learning)

SCHEME - B.TECH – 2020-21 ONWARDS

VII SEM - COMPUTER SCIENCE & ENGINEERING (ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	CR/ AU	SCHEME OF TEACHING					PRE-REQUISITE	
					L	T	P	S/P	C	SEM	COURSE CODE
1	121	20AM47XX	PROFESSIONAL ELECTIVE – 4	CR	3	-	-	-	3	*	AS INDICATED IN THE ELECTIVE LIST
2	121	20AM47XX	PROFESSIONAL ELECTIVE – 5	CR	3	-	-	-	3	*	
3	121	20OEXXXX	OPEN ELECTIVE-3	CR	3	-	-	-	3	*	***
4	121	20AM4701	MAJOR PROJECT PHASE – I	CR	-	-	-	4	2	*	***
					09			**04**	**11**		

CR – CREDIT, AU – AUDIT, L – LECTURE, T – TUTORIAL, P – PRACTICAL, S/P – SEMINAR/PROJECT, C – NO. OF CREDITS

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Artificial Intelligence & Machine Learning)

VII SEM-PROFESSIONAL ELECTIVE – IV&V

SL	COURSE CODE	COURSETITLE	SCHEME OF TEACHING					PRE-REQUISITE	
			L	T	P	S/ P	C	SEM	COURSE CODE
1	20AM4702	MACHINE LEARNING FOR HEALTHCARE	3			-	03	V	20CS3504
2	20AM4703	SPEECH AND NLP	3			-	03	-	-
3	20AM4704	ADVANCED DEEP LEARNING	3				03	VI	20AM3601
4	20AM4705	CLOUD COMPUTING	3				03		
5	20AM4706	GPU ARCHITECTURE AND PROGRAMMING	3				03	-	-
6	20AM4707	UG RESEARCH PROJECT-I	-			06	03	-	-

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Artificial Intelligence & Machine Learning)

SCHEME - B.TECH – 2020-21 ONWARDS

VIII SEM - COMPUTER SCIENCE & ENGINEERING (ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	CR/ AU	SCHEME OF TEACHING					PRE-REQUISITE	
					L	T	P	S/ P	C	SEM	COURSE CODE
1	121	20AM48XX	PROFESSIONAL ELECTIVE – 6	CR	3	-	-	-	3	*	AS INDICATED IN THE ELECTIVE LIST
2	121	20AM4801	MAJOR PROJECT PHASE – I	CR	-	-	-	12	6	*	***
3	121	20AM4802	INTERNSHIP	CR	-	-	-	6	3		
					03	**-**	**-**	**18**	**12**		

CR – Credit, AU – Audit, L – Lecture, T – Tutorial, P – Practical, S/P – Seminar/Project, C – No. of Credits

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VIII SEM-PROFESSIONAL ELECTIVE – VI

SL	COURSE CODE	COURSE TITLE	SCHEME OF TEACHING					PREREQUISITE	
			L	T	P	S/P	C	SEM	COURSE CODE
1	20AM4803	MOBILE COMPUTING AND ANDROID APPLICATION DEVELOPMENT	3			-	03	VI	20AM3604
2	20AM4804	RESPONSIBLE AI AND ETHICS	3			-	03	-	-
3	20AM4805	HUMAN-COMPUTER INTERFACE	3			-	03	-	-
4	20AM4806	UG RESEARCH PROJECT-II	-			06	03	-	-

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Artificial Intelligence & Machine Learning)

MACHINE LEARNING FOR HEALTHCARE

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VII

Subject Code	:	**20AM4702**	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:

This course will enable students to:

1. **Summarize** the different types of medical data and its Medical Standards, Challenges.
2. **Explain** the different techniques to handle the image and clinical data.
3. **Apply** Modelling techniques, Reinforcement Learning and Natural LanguageProcessing for healthcare data.
4. **Utilize** the suitable Machine Learning and Deep Learning algorithms for various typesof healthcare applications.
5. **Get the idea** to build a chatbot and develop a project using the appropriate case study in the healthcare.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainmentof the various course outcomes.

1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. Discuss how every ***concept can be applied to the real world*** - and when that's possible,it helps improve the student's understanding.

UNIT – I	**08 Hours**

Knowing Healthcare Industry: Introduction to healthcare informatics, Introduction to Machine Learning and Deep Learning in Healthcare, Medical Standards and Coding Types, Health LevelSeven (HL7;) Global Healthcare Challenges and Trends; Past-Present-Future of AI&ML in Healthcare, Electronic Medical Records (EMR), Electronic Health Records (EHR) - Dataflow of EHR, Difference between EHR and EMR.

UNIT – II	**08 Hours**

Advanced Analytics in Health Care: Overview of Clinical Data, Data Types; Data handling techniques – Imputation technique for handling missing data; Synthetic Minority Oversampling Technique for handling imbalanced data, Different types of Data Analysis techniques, Risk Stratification; Survival Modelling; Disease progression Modelling.

UNIT – III	**08 Hours**

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Medical Image Diagnostics and its Preprocessing: Biomedical Imaging Modalities - Computed Tomography, Magnetic Resonance Imaging, Positron Emission Tomography; Biomedical Signal: Electrocardiogram (ECG), Electroencephalogram (EEG), Segmentation – Thresholding and Region based Segmentation, Image Registration; ML applications in medical Ology space (Cardiology, oncology).
UNIT – IV **08 Hours**
AI/ML and NLP for healthcare: Automating clinical workflow, Regulation of AI/ML, Challenges in deploying ML model, NLP for Healthcare, Re-enforcement learning in healthcare applications, Wearable devices and Medical Bots.
UNIT – V **07 Hours**
Applications of Machine learning models (Linear regression, SVM, Random Forest) and Deeplearning models (CNN, RNN….) for the Healthcare area (Case study)
Course Outcomes: At the end of the course the student will be able to: 1. **Explain** the different types of medical data and its Medical Standards, Challenges. 2. **Utilize** the appropriate techniques to handle the image and clinical data. 3. **Make use of the** Modelling techniques, Reinforcement Learning and Natural Language Processing for various healthcare applications 4. **Apply** the suitable Machine Learning and Deep Learning algorithms for various typesof healthcare applications. 5. **Build** a chatbot and develop a project using the appropriate case study in thehealthcare.

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	Engineering knowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer and society	Environment and sustainability	Ethics	team work	Communication	Life-long learning	Project management and finance	Apply the principal concepts of AI	Apply the knowledge gained pertaining to data storage, data analytics and AI concepts	develop, and test principles of AI concepts on Intelligent Systems
CO1	2	1	-	-	-	-	-	-	2	2	-	-	2	2	2
CO2	3	2	-	-	1	-	-	-	2	2	-	-	2	2	2
CO3	3	2	-	-	1	-	-	-	2	2	-	-	2	2	2
CO4	3	2	-	-	1	-	-	-	2	2	-	-	2	2	2
CO5	3	3	2	-	1	-	-	-	2	2	-	-	2	2	2

CO5	3	3	2	-	1	-	-	-	2	2	-	-	2	2	2

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. SumeetDua, U. RajendraAcharya, PrernaDua , Machine Learning in Healthcare nformatics,Intelligent Systems Reference Library 56, Springer Nature 2014.
2. Sergio Consoli, Diego ReforgiatoRecupero, Milan Petkovic, Data Science for Healthcare Methodologies and Applications, 2019.

REFERENCE BOOKS:

1. Thomas M. Deserno, Fundamentals of Bio-Medical Image processing, Biological and Medical Physics, Biomedical Engineering, Springer, ISBN 978-3-642-15816-2, 2011.

E-Resources:

1. https://stellar.mit.edu/S/course/HST/sp19/HST.956/
2. https://www.coursera.org/learn/fundamental-machine-learning-healthcare.
3. https://www.coursera.org/learn/introduction-clinical-data

Activity Based Learning (Suggested Activities in Class)

1. Group discussion on different Health Care Problems.
2. Collaborative Activity is minor project development with a team of 4 students.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Artificial Intelligence & Machine Learning)

SPEECH PROCESSING AND NATURAL LANGUAGE PROCESSING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VII

Subject Code	: **20AM4703**	**Credits**	: 03
Hours / Week	: 03 Hours	**Total Hours**	: 39 Hours
L–T–P–S	: 3–0–0–0		

Course Learning Objectives:

This course will enable students to:

1. Overview and language modeling.
2. Word level and syntactic analysis
3. Extracting Relations from Text: From Word Sequences to Dependency Paths, Semantic Role Labeling
4. Evaluating Self-Explanations in iSTART: Word Matching, Latent Semantic Analysis,and Topic Models
5. Information Retrieval and Lexical Resources

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainmentof the various course outcomes.

1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. Discuss how every ***concept can be applied to the real world*** - and when that's possible,it helps improve the student's understanding.

UNIT – I	**08 Hours**

Overview: Past present and future of NLP, Classical problems on text processing; Necessary Math concepts for NLP; Words & Sentences, N- grams, Part of Speech tagging and challenges of Language and Grammar- Processing Indian Languages- NLP Applications, Information Retrieval. Language Modeling: Various Grammar- based Language Models, Statistical Language Model.

TEXT BOOK 1, TEXT BOOK 2 (CHAPTER 4, CHAPTER 5)

UNIT – II	**08 Hours**

Extracting Relations from Text: From Word Sequences to Dependency Paths: Introduction, Subsequence Kernels for Relation Extraction, A Dependency-Path Kernel for Relation Extraction and Experimental Evaluation, Word Matching, Latent Semantic Analysis, and Topic Models.

Mining Diagnostic Text Reports by Learning to Annotate Knowledge Roles: Introduction, Domain Knowledge and Knowledge Roles, Frame Semantics and Semantic Role Labeling.

TEXT BOOK 2

CHAPTER 2 AND CHAPTER 4

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UNIT – III	08 Hours
Speech production process - speech sounds and features - Phonetic Representation of Speech – representing-speech in time and frequency domains - Short-Time Analysis of Speech - Short- Time Energy and Zero-Crossing Rate - Short-Time Autocorrelation Function - Short-Time Fourier Transform (STFT)- Speech Spectrum - Cepstrum - Mel-Frequency Cepstrum Coefficients - Hearing and Auditory Perception - Perception of Loudness - Critical Bands - Pitch Perception **TEXT BOOK 3 : CHAPTER 9**	
UNIT – IV	**08 Hours**
Pulse Code Modulation (PCM), Sampling and Quantization of Speech - Adaptive differential PCM - Delta Modulation - Vector Quantization- Introduction to Linear predictive coding (LPC) of Speech – Parameter Estimation- LP Formulation using Generalized Inverse of Matrices – Sample Selective Linear Prediction. **TEXT BOOK 3**	
UNIT – V	**07 Hours**
Case study to illustrate classical Linear Predictive Coding (LPC) method of speech compression used to reduce the bit rate in digital speech transmission systems. **TEXT BOOK 5**	

Course Outcomes:

At the end of the course the student will be able to:

1. **Apply** Boolean, Vector-space, and Probabilistic models to retrieve information from a giventext.
2. From a given text, **distinguish** relations among the sentences and words. **examine** dependency path from Word Sequences.
3. From a given text, **interpret** the semantic texts and **examine** the meaning of the text.
4. **Formulate** correlation between a given speech at a given time applying Short-Time Autocorrelation Function - Short-Time Fourier Transform (STFT).
5. **Construct** NLP model for speech compression using LPC.

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Table: Mapping Levels of COs to POs / PSOs															
Cos	**Program Outcomes (POs)**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
	Engineering knowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer and society	Environment and sustainability	Ethics	team work	Communication	Life-long learning	Project management and finance	develop ,deploy and prototype AI Subsystems	AI concepts to solve real world business	AI concepts on Intelligent Systems
CO1	3	2	2	-	-	-	-	-	2	2	-	-	2	2	2
CO2	3	3	2	2	3	-	-	-	2	2	-	-	2	2	2
CO3	3	3	2	2	2	-	-	-	2	2	-	-	2	2	2
CO4	3	3	2	2	3	-	-	-	2	2	-	-	3	2	2
CO5	3	3	3	3	3	2	-	-	2	2	-	-	3	2	2

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Tanveer Siddiqui, U.S. Tiwary, “Natural Language Processing and Information Retrieval,” Oxford University Press, 2008.
2. Anne Kao and Stephen R. Poteet (Eds), “Natural Language Processing and Text Mining”, Springer Verlag London Limited 2007.
3. Daniel Jurafsky and James H Martin, “Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition”, 2nd Edition, Prentice Hall, 2008.
4. James Allen, “Natural Language Understanding”, 2nd edition, Benjamin/Cummings publishing company, 1995.
5. Author(s): R. E. Stone Source: Digital Signal Processing: principles, devices and applications,1990, Publication date January 1990.
6. Elsa Harrington, Speech and Language Processing: Computational Linguistics and Natural Language Processing, 2022

REFERENCE BOOKS:

1. Raju, Kavitha. (2014). Speech Based Voice Recognition System for Natural Language Processing. International Journal of Computer Science and Information Technology.
2. Reshamwala, Alpa & Mishra, Dhirendra & Pawar, Prajakta. (2013). REVIEW ON NATURAL LANGUAGE PROCESSING. IRACST – Engineering Science and Technology: An International Journal (ESTIJ). 3. 113-116.
3. A. Celesti, M. Fazio, L. Carnevale and M. Villari, "A NLP-based Approach to Improve Speech Recognition Services for People with Speech Disorders," 2022 IEEE Symposium on Computers and Communications (ISCC), Rhodes, Greece, 2022, pp. 1-6, doi: 10.1109/ISCC55528.2022.9912940.

4. Santosh Kumar Behera, Mitali M Nayak, Natural Language Processing for Text and Speech Processing: A Review Paper, International Journal of Advanced Research in Engineering and Technology, 11(11), 2020, pp. 1947-1952.

E-Resources:

1. https://onlinecourses.nptel.ac.in/noc23_cs45/preview

Activity-Based Learning (Suggested Activities in Class)

1. Better Understanding the concept of Sampling and Semantic Role Labeling Quantization of Speech and using group discussion.
2. Collaborative Activity is minor project development with a team of 4 students.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Artificial Intelligence & Machine Learning)

ADVANCED DEEP LEARNING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VII

Subject Code	:	**20AM4704**	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:

This course will enable students to:

1. **Understand** the building blocks and working principles of advanced Deep learning models
2. **Design** deep learning models to address novel challenges in practical applications.
3. **Make use of** regularization, training optimization, and hyperparameter selection on deep learning models.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainmentof the various course outcomes.

1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher-order Thinking questions in the class.
6. Discuss how every ***concept can be applied to the real world*** - and when that's possible,it helps improve the student's understanding.

UNIT – I	**08 Hours**

INTRODUCTION TO RNN: Basics of RNN, RNN's Computational Graph across Time, RNN's For Sequence Modeling- Language Modeling, Back Propagation Through Time, Standard RNN Gradient Flow, LSTM Network

UNIT – II	**08 Hours**

REGULARIZATION AND OPTIMIZATION OF DEEP NEURAL NETWORKS:

Hyperparameter Tuning of RNN, Regularization- Different types of regulations, Regularization techniques- Lasso Regularization, Ridge Regularization, Elastic Net Regularization, Optimization, optimization techniques- Batch and Minibatch Algorithms. Adam, Challenges in Neural Network Optimization

UNIT – III	**08 Hours**

DEEP LEARNING MODELS:

RESNET- Types, YOLO-object detection with YOLO, Fast R-CNN-components and classification, Faster R-CNN-components, and classification, RCNN vs Fast R-CNN vs Faster R-CNN

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UNIT – IV	**08 Hours**

GENERATIVE MODELS:
Generative Modelling-Hidden Markov Models (HMMs), Gaussian mixture model, Autoencoders, Variational Autoencoders, Latent Perturbations, Variational autoencoders vs Generative modeling

UNIT – V	**07 Hours**

SUCCESS STORIES AND LIMITATIONS OF USING DL:
Limitations and New Frontiers, Bias and Fairness, Taming Dataset Bias, Success Storiesfrom Industry Domains

APPLICATIONS OF RNN:
Music Generation, Sentiment Classification, Machine Translation, EnvironmentModeling, Stock Market Prediction, Next Word Prediction.

Course Outcomes:

At the end of the course, the student will be able to:

1. Identify and **apply** the learnt deep learning algorithms on specific tasks in various domains
2. **Implement** deep learning algorithms and solve real-world problems in various domains
3. To **use** learnt models for solving a few real-life problems.
4. **Understand** and **analyze** the Applications of Deep Learning Work in teams to implement/simulate applications of CNN and RNN
5. **Apply** new deep learning models to address novel challenges in practical applications

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs		
	Engineering knowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer and society	Environment and sustainability	Ethics	teamwork	Communication	Life-long learning	Project management and finance	Apply the principal concepts of AI Engineering	Apply the knowledge gained pertaining to data storage, data analytics, and AI concepts	develop, and test principles of AI concepts on Intelligent Systems
CO1	3	1	2	-	3	1	-		3	2	-	2	3	-	1
CO2	3	2	2	2	3	1	-	2	3	2	2	2	3	2	2
CO3	3	3	3	-	3	1	-	-	3	2	-	2	3	-	2
CO4	3	3		-	3	2	-	-	3	2	-	2	3	2	2
CO5	3	1	2	-	3	1	-	-	3	2	-	2	3	-	2

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Aston Zhang, Zachary C. Lipton, Mu Li, And Alexander J. Smola, "Dive Into DeepLearning", April 2021
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", The MIT Press,2016.

REFERENCE BOOKS:

1. Palash Goyal Sumit Pandey Karan Jain, "Deep Learning For Natural Language Processing : Creating Neural Networks With Python", Apress, 2018
2. UmbertoMichelucci, "Applied Deep Learning A Case-Based Approach To Understanding Deep Neural Networks", 2018
3. Aureilien Geron, Hands-On Machine Learning With Scikit-Learn & Tensorflow:Concepts, Tools, And Techniques To Build Intelligent Systems, O'Reilly, 2017
4. Josh Patterson, "Deep Learning: A Practitioner's Approach", O'Reilly Media; 1 Edition(August 19, 2017)

E-Resources:

1. Deep Learning A-Z™: Hands-On Artificial Neural Networks | Udemy
2. Deep Learning by deeplearning.ai | Coursera

Activity Based Learning (Suggested Activities in Class)

1. The Applications of Deep Learning using group discussion.
2. Collaborative Activity is minor project development with a team of 4 students.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
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CLOUD COMPUTING
[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VII

Subject Code	:	**20AM4705**	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:
This course will enable students to:
1. **Understand** various basic concepts related to cloud computing technologies.
2. **Contrast** various programming models used in cloud computing.
3. **Choose** appropriate cloud model for a given application.

Teaching-Learning Process (General Instructions)
These are sample new pedagogical methods that teachers can use to accelerate the attainmentof the various course outcomes.
1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and role-playing.
3. Show ***Video/animation*** films to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. Discuss how every ***concept can be applied to the real world*** - and when that's possible,it helps improve the student's understanding.

UNIT – I	**08 Hours**

INTRODUCTION TO CLOUD COMPUTING

Introduction, Cloud Computing at a Glance, The Vision of Cloud Computing, Defining a Cloud, A Closer Look, Cloud Computing Reference Model, Characteristics and Benefits, Challenges Ahead, Historical Developments, Distributed Systems, Virtualization, Web 2.0, Service- Oriented Computing, Utility-Oriented Computing

Text Book 1: Chapter 1

UNIT – II	**08 Hours**

TYPES OF CLOUDS

Types of Clouds, Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds, Economicsof the Cloud, Open Challenges.

Cloud Definition, Cloud Interoperability and Standards Scalability and Fault ToleranceSecurity, Trust, and Privacy Organizational Aspects.

Text Book 1: Chapter 4

UNIT – III	08 Hours

CLOUD SERVICES AND PLATFORMS

Building Cloud Computing Environments, Application Development, Infrastructure and System Development. Computing Platforms and Technologies, Amazon Web Services (AWS), Google AppEngine, Microsoft Azure, Hadoop, Force.com and Salesforce.com, Manjrasoft Aneka.
Cloud Computing Architecture-Introduction, Cloud Reference Model- Architecture, Infrastructure / Hardware as a Service, Platform as a Service, Software as a Service.

Text Book 1: Chapter 1, Chapter 4

UNIT – IV	08 Hours

CLOUD APPLICATION PLATFORM-ANEKA

Aneka: Cloud Application Platform, Framework Overview, Anatomy of the Aneka Container, From the Ground Up: Platform Abstraction Layer, Fabric Services, foundation Services, Application Services, Building Aneka Clouds, Infrastructure Organization, Logical Organization, Private Cloud Deployment Mode, Public Cloud Deployment Mode, Hybrid CloudDeployment Mode, Cloud Programming and Management, Aneka SDK, Management Tools.

Text Book 1: Chapter 5

UNIT – V	07 Hours

CLOUD PLATFORMS IN INDUSTRY

Concurrent Computing: Thread Programming, Introducing Parallelism for Single MachineComputation.

Cloud Platforms in Industry, Amazon Web Services, Compute Services, Storage Services, Communication Services, Additional Services, Google AppEngine, Architecture and Core Concepts, Application Life-Cycle, Cost Model, Observations, Microsoft Azure, Azure CoreConcepts, SQL Azure, Windows Azure Platform Appliance.

Text Book 1: Chapter 9

Course Outcomes:

At the end of the course the student will be able to:

1. **Discuss** the reference models, characteristics, and benefits of cloud computing.
2. **Compare and contrast** cloud architecture, computing platforms, and technologies.
3. **Illustrate** different types of clouds.
4. **Describe** the framework, cloud deployment mode and services in Aneka.
5. **Apply** the web services and search engines in industry.

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Table: Mapping Levels of COs to POs / PSOs															
Cos	**Program Outcomes (POs)**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
	Engineering knowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer and society	Environment and sustainability	Ethics	team work	Communication	Life-long learning	Project management and finance			
CO1	3	1	-	-	-	-	-	-	-	-	-	1		1	-
CO2	3	1	-	-	-	-	-	-	-	-	-	1		1	-
CO3	2	1	-	-	-	-	-	-	-	-	-	1		1	-
CO4	3	1	-	-	-	-	-	-	-	-	-	1		1	-
CO5	2	2	-	-	-	-	-	-	-	-	-	1		1	-

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi Mastering Cloud. ComputingMcGraw Hill Education, 2013.

REFERENCE BOOKS:

1. Cloud Computing, Dr. Kumar Saurabh, Wiley Publications, 2012
2. Guide to Cloud Computing, Richard hill, Springer Publications, 2013
3. Cloud Computing A Practical Approach, Anthony T Velte et.al, MC Graw Hillpublications, 2014
4. Cloud Computing Principles and Paradigms, Rajkumar Buyya et.al, WileyPublications, 2015
5. Cloud Computing Technologies and Strategies of the Ubiquitous data center, Brain J.S et.al, CRC Press

Activity Based Learning (Suggestion Activities in Class)

- Presentation
- Collaborative Activity is minor project development with a group of 4 students.

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GPU ARCHITECTURE AND PROGRAMMING
[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VII

Subject Code	:	**20AM4706**	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:
This course will enable students to:
1. To understand the basics of GPU architectures
2. To write programs for massively parallel processors
3. To understand the issues in mapping algorithms for GPUs
4. To introduce different GPU programming models

Teaching-Learning Process (General Instructions)
These are sample new pedagogical methods that teachers can use to accelerate the attainment of the variouscourse outcomes.
1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type ofteaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work,focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helpsimprove the student's understanding.

UNIT – I	**08 Hours**
Evolution of GPU architectures – Understanding Parallelism with GPU –Typical GPU Architecture – CUDAHardware Overview – Threads, Blocks, Grids, Warps, Scheduling – Memory Handling with CUDA: Shared Memory, Global Memory, Constant Memory and Texture Memory. ***(Text Book-1: Chapter 1: 1.1 to 1.4, 1.6, Chapter 2: 2.1,2.2, 2.4)***	

UNIT – II	**08 Hours**
CUDA PROGRAMMING Using CUDA – Multi GPU – Multi GPU Solutions – Optimizing CUDA Applications: Problem Decomposition, Memory Considerations, Transfers, Thread Usage, Resource Contentions. ***(Text Book-1: Chapter 3: 3.1 to 3.3).***	

UNIT – III	**08 Hours**
PROGRAMMING ISSUES Common Problems: CUDA Error Handling, Parallel Programming Issues, Synchronization, Algorithmic Issues, Finding and Avoiding Errors. ***(Text Book-1: Chapter 5: 5.2,5.3)(Text Book-2 Chapter 1: 1.1 to 1.5***)	

UNIT – IV	**08 Hours**
OPENCL BASICS OpenCL Standard – Kernels – Host Device Interaction – Execution Environment –Memory Model – Basic OpenCL Examples. ***(Text Book-1: Chapter 14: 14.1 to 14.5).***	

UNIT – V	**07 Hours**
ALGORITHMS ON GPU Parallel Patterns: Convolution, Prefix Sum, Sparse Matrix – Matrix Multiplication – Programming Heterogeneous Cluster. ***(Text Book-2: Chapter 20: 20.1 to 20.5, Chapter 21: 21.1 to 21.3, Chapter 22: 22.1 to 22.4***)	

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Course Outcomes:

At the end of the course the student will be able to:

1. Outline GPU computing architecture.
2. Make use of parallel programming to decompose a problem
3. Demonstrate GPU programming environments.
4. Design programs that make efficient use of the GPU processing power.
5. Experiment with GPU to provide massive acceleration for specialized tasks such as AI.

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	Engineering knowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer and society	Environment and sustainability	Ethics	team work	Communication	Life-long learning	Project management and finance	Apply the principal concepts of AI Engineering	Apply the knowledge gained pertaining to data storage, data analytics and AI concepts	develop, and test principles of AI concepts on Intelligent Systems
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	3	2	-	-	-	-	-	-		-	-	-	-	-
CO 2	3	3	2	-	-	-	-	-	2	2	-	-	-	-	-
CO 3	3	2	1	-	1	-	-	-	2	2	-	-	-	2	-
CO 4	3	1	-	-	1	-	-	-	2	2	-	-	2	2	-
CO 5	3	2	2	-	2	-	-	-	2	2	-	-	3	2	-

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Shane Cook, CUDA Programming: —A Developer's Guide to Parallel Computing with GPUs(Applications of GPU Computing), First Edition, Morgan Kaufmann, 2012
2. David R. Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang, —Heterogeneous computing with OpenCL, 3rd Edition, Morgan Kauffman, 2015.

REFERENCE BOOKS:

1. Learn CUDA Programming - Jaegeun Han, Bharatkumar Sharma Packt Publishing, 27-Sept-2019 - 508 pages.
2. Parallel Computing for Data Science (Chapman & Hall/CRC The R Series) 1st Edition

E-Resources:

https://developer.nvidia.com/cuda-toolkit
https://developer.nvidia.com/opencl
https://leonardoaraujosantos.gitbook.io/opencl/chapter1
https://github.com/topics/opencl
https://github.com/mikeroyal/OpenCL-Guide

Activity Based Learning (Suggested Activities in Class)

1. Group discussion on how to optimize the machine learning algorithms or a whole neural network using CUDA.
2. Collaborative Activity is minor project development with a team of 4 students.

Prerequisites:

- Basic understanding of CPU scheduling, process and threading and memory handling.

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UG RESEARCH PROJECT-I
[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VII

Subject Code	:	20AM4707	**Credits**	:	03
Hours / Week	:	0	**Total Hours**	:	Hours
L–T–P–S	:	0–0–0–6			

Course Learning Objectives:
This course will enable students to:

1. **To identify** key research questions within a field to carry out research in a team.
2. **To identify** and summarize the literature review of the relevant field.
3. **To demonstrate** relevant referencing and inculcate new skills in various aspects of academic writing.
4. **To demonstrate** the knowledge and understanding of writing the publication/report.
5. **To showcase** the strong evidence on the clarity of the argument, understanding of theselected domain area and presentation of its technical information.
6. **To detail description** of the process of carrying out the independent research in written document along with results and conclusions with reference to the existing literature.
7. **To analyze** and synthesize the new research findings.

Teaching-Learning Process (General Instructions)
These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. Lecture method means it includes not only the traditional lecture method but a different type of teaching method that may be adopted to develop the course outcomes.
2. Interactive Teaching: Adopt Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show Video/animation films to explain the functioning of various concepts.
4. Encourage Collaborative (Group Learning) Learning in the class.
5. To make Critical thinking, ask at least three Higher-order Thinking questions in the class.
6. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the student's understanding.

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COURSE CONTENT:

The research topic proposed by both the guide and the student team should be approved by the department chairman to proceed further. A degree of industrial inputand involvement will be encouraged, and can be facilitated through existing academic-industrial collaborations or by addressing specific topics that are of interest to industrial partners.
All projects will be closely supervised by the Project Guide with ongoing feedback and guidance at all stages of the project from conception to completion.
The following criteria will be checked by the department chairman to approve for theresearch proposal:

a. Department staff as course guide
   1. Abilityto provide research direction to the student in the chosen field of interest
   2. Ability to design an appropriate research strategy and methodology tocarry out the research by student
   3. Ability to provide and evaluate the strong literature review document forthe chosen research topic
   4. Ability to train students on research paper / technical writing skills
   5. Conduct reviews in regular time period and submit the evaluation to department chairman

b. Student Team
   1. To be dedicated and committed to work on a new research topic bylearning new technical skills
   2. To have fair knowledge on what is product development or research topic
   3. To have constant interaction with allocated guide by providing weekly updates
   4. To be committed to complete the project and submitting the technical paperwithin the stipulated time framed by the university

Evaluation:
There will be CIA evaluation as well as the Semester end evaluation of the work done. Itwill be done by a committee of senior researchers of the Department.

Course Outcomes:

At the end of the course the student will be able to:

1. Develop the research project by selecting an appropriate research problem.
2. Compare the papers relevant to the selected problem domain.
3. Construct the model and perform the model evaluation and analysis.
4. Draft of the Publication or Demonstration of the Proof-of- concept product, Draft of patent application.

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Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	Engineering knowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer and society	Environment and sustainability	Ethics	team work	Communication	Life-long learning	Project management and finance	Apply the principal concepts of AI Engineering	Apply the knowledge gained pertaining to data storage, data analytics and AI concepts	develop, and test principles of AI concepts on Intelligent Systems
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	2	2	-	2	-	-	2	-	3	2	2	3	3	2
CO 2	2	1	-	-	-	-	-	2	-	3	2	2	1	1	1
CO 3	3	3	3	2	3	1	-	2	-	3	2	2	3	3	3
CO 4	3	3	3	2	1	-	-	2	-	3	2	1	2	2	2

3: Substantial (High) 2: Moderate (Medium) 1: Poor (Low)

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Artificial Intelligence & Machine Learning)

MOBILE COMPUTING AND ANDROID APPLICATION DEVELOPMENT

[As per Choice Based Credit System (CBCS) Scheme]

SEMESTER – VIII

Subject Code	:	**20AM4803**	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:

This course will enable students to:

1. Understand the basic concepts of mobile computing
2. Learn the setup of the Android development environment
3. Illustrate the interaction of the app with the user interface and handling variousactivities
4. Identify the options for saving the persistent application data
5. Gain knowledge about different mobile platforms and application development

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainmentof the various course outcomes.

1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. Discuss how every ***concept can be applied to the real world*** - and when that's possible,it helps improve the student's understanding.

UNIT – I	**08 Hours**
INTRODUCTION TO MOBILE COMPUTING Introduction to mobile computing, Architecture of mobile network, Generations of mobile communication, mobile operating systems, Application of mobile communication, Challenges of mobile communication.	

UNIT – II	**08 Hours**
Introduction, trends, platforms, Android Development Setup like, Android Studio, Eclipse,Android SDK, tools. Emulator setup. App behavior on the Android Runtime (ART). Platform Architecture. Application framework and basic App Components resources. HelloWorld program in Android Studio.	

UNIT – III	**08 Hours**
MOBILE APP DEVELOPMENT USING ANDROID:	

Android user Interface – Layouts (Linear, Absolute, Table, Relative, Frame and Scroll), values, asset XML representation, generate R.Java file, Android manifest file. Activities, Intent and UI Design - activities life-cycle. Android Components – layouts, fragments, basic views (Button, Edit Text, Check box, Toggle Button, Radio Button), list views, picker views, adapter views, Spinner views, Menu, Action Bar and Managing data using SQLite database (Database create, Read, Update and delete).

UNIT – IV	**08 Hours**

MESSAGING AND LOCATION BASED SERVICES
Sending SMS and mail, Google Maps – Displaying Google Maps in Andriod application, Networking – How to connect to Web using HTTP, Publishing Android Applications – how to prepare applicationfor deployment, exporting application as an APK file and signing it with new certificate, Introduction to new android application and publish the android application on market place

UNIT – V	**07 Hours**

DATA PERSISTENCE AND GOOGLE APIS FOR ANDROID:
Introduction of Google APIs for Android. SQLite Databases. CROSS-PLATFORM APP DEVELOPMENT - Introduction to Cross platform App Development - Difference to native apps, Pros and cons, Development tools.

Course Outcomes:

At the end of the course, the student will be able to:

1. **Create**, test, and debug Android applications by setting up the Android development environment.
2. **Implement** adaptive and responsive user interfaces that work across various devices.
3. **Demonstrate** the techniques involved to store, share, and retrieve data in Android applications.
4. **Acquire** technical competency and skills in developing applications using Android andcross-platform.

Table: Mapping Levels of COs to POs / PSOs

COs	**Program Outcomes (POs)**											**PSOs**		
	Engineering knowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer and society	Environment and sustainability	Ethics	team work	Communication	Life-long learning	Project management and finance	Apply the principal concepts of AI Engineering	Apply the knowledge gained pertaining to data storage, data analytics and	develop, and test principles of AI concepts on Intelligent Systems
CO1	3	1	-	-	1	-	-	-	2	2	-	-	2	2	2
CO2	3	2	-	-	1	-	-	-	2	2	-	-	2	2	2
CO3	3	2	-	-	1	-	-	-	2	2	-	-	2	2	2
CO4	3	2	-	-	1	-	-	-	2	2	-	-	2	2	2

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Mobile Cloud Computing by Debashis De, CRC Press, Taylor & Francis Group, 2016.
2. Head First Android Development by Jonathan Simon O'reilly Publication, 2021.

REFERENCE BOOKS:

1. Learning Android by Marko Gargenta O'reilly Publications, 2011.
2. Jochen H. Schller, "Mobile Communications", Second Edition, Pearson Education, New Delhi, 2007.
3. Uwe Hansmann, LotharMerk, Martin S. Nicklons and Thomas Stober, "Principles ofMobile Computing", Springer, 2003.
4. Erik Hellman, "Android Programming – Pushing the Limits", 1st Edition, Wiley India PvtLtd, 2014.
5. F DiMarzio, "Beginning Android Programming with Android Studio", 4th Edition, Wiley India Pvt Ltd, 2016

E-Resources:

1. https://stellar.mit.edu/S/course/HST/sp19/HST.956/
2. https://www.coursera.org/learn/fundamental-machine-learning-healthcare.
3. https://www.coursera.org/learn/introduction-clinical-data

Activity Based Learning (Suggested Activities in Class)

1. Group discussion on skills in developing applications using Android and cross-platform.
2. Collaborative Activity is minor project development with a team of 4 students.

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RESPONSIBLE AI AND ETHICS
[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VIII

Subject Code	:	**20AM4804**	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:
This course will enable students to:
1. **Understand** the impact of analytics and AI/ML on individuals and society.
2. **Identify** the problems associated with Big Data using the appropriate technique.
3. **Apply** AI/ML techniques on identifying fairness and bias issues.
4. **Use** Tools and methods to quantify bias.
5. **Develop** the project using the case study.

Teaching-Learning Process (General Instructions)
These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

7. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
8. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
9. Show ***Video/animation*** films to explain the functioning of various concepts.
10. Encourage ***Collaborative*** (Group Learning) Learning in the class.
11. To make ***Critical thinking***, ask at least three Higher-order Thinking questions in the class.
12. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the student's understanding.

UNIT – I	**08 Hours**
Data, Individuals, and Society: The power and impact that analytics and AI/ML have on individuals and society, especially concerning issues such as fairness and bias, ethics, legality, data collection and public use.	

UNIT – II	**09 Hours**
Big Data: Components of big data, basic statistical techniques to data scenarios, and understand the issues faced when learning from big data, ranging from data biases, overfitting, causation vs correlation, etc.	

UNIT – III	**10 Hours**
Privacy and Fairness in AI/ML: Use of AI/ML techniques to data scenarios, with a focus on identifying fairness and bias issues found in the design of decision-making systems. Technical approaches to current AI/ML applications such as facial recognition, natural language processing, and predictive algorithms, all while being mindful of its social and legal context.	

UNIT – IV	**12 Hours**
Tools and methods to quantify bias and examine ways to use algorithmic fairness to mitigate this bias, taking into consideration ethical and legal issues associated with it. Knowledge of analytics and AI/ML to transform a current biased data-set into a more objective solution.	

UNIT – V	**07 Hours**
Case Studies :	

1. Robustness and beneficial AI
2. Benefits and dangers of super-intelligence
3. Rationality in Advanced Artificial Agents
4. Artificial Morality

Course Outcomes:

At the end of the course the student will be able to:

1. **Explain** impact of analytics and AI/ML on individuals and society.
2. **Analyse** the problems associated with Big Data using the appropriate technique.
3. **Apply** AI/ML techniques on identifying fairness and bias issues.
4. **Apply** Tools and methods to quantify bias.
5. **Develop** the project using the case study.

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	Engineering knowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer and society	Environment and sustainability	Ethics	team work	Communication	Life-long learning	Project management and finance	Apply the principal concepts of AI	Apply the knowledge gained pertaining to data storage, data analytics and AI concepts	develop, and test principles of AI concepts on Intelligent Systems
CO1	1	-	-	-	-	-	-	-	2	2	-	-	2	2	2
CO2	3	2	-	-	1	-	-	-	2	2	-	-	2	2	2
CO3	3	2	-	-	1	-	-	-	2	2	-	-	2	2	2
CO4	3	2	-	-	1	-	-	-	2	2	-	-	2	2	2
CO5	3	3	2	-	1	-	-	-	2	2	-	-	2	2	2

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. O'neil, Cathy. Weapons of math destruction: How big data increases inequality and threatens democracy. Broadway Books, 2016.
2. Kearns, Michael, and Aaron Roth. The ethical algorithm: The science of socially aware algorithm design. Oxford University Press, 2019.

REFERENCE BOOKS:

1. S. J. Russell, D. Dewey, and M. Tegmark, 'Research priorities for robust and beneficial artificial intelligence', AI Magazine, 2015.
2. Bostrom, N. (2014), Superintelligence: Paths, Dangers, Strategies, Oxford University Press, Chapters 2-6.
3. Bostrom, N. (2012). The Superintelligent Will: Motivation and Instrumental Rationality in Advanced Artificial Agents. Minds & Machines 22: 71-85.
4. Allen, C., Smit, I.,Wallach,W. (2005) 'Artificial morality: Top-down, bottom-up, and hybrid approaches', Ethics and Information Technology ; 7, 149-155

5. Lake, B. M., Ullman, T. D., Tenenbaum, J. B., Gershman, S. J. (2017) 'Building machines that learn and think like people', Behavioral and Brain Sciences, e253.

E-Resources:

1. https://onlinecourses.nptel.ac.in/noc19_ee56/
2. https://nptel.ac.in/courses/106106046

Activity Based Learning (Suggested Activities in Class)

1. Group Discussion.
2. Collaborative Activity on case studies with a team of 4 students.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Artificial Intelligence & Machine Learning)

HUMAN-COMPUTER INERACTION

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VIII

Subject Code	:	**20AM4805**	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:

This course will enable students to:

1. **Describe** effective and usable graphical computer interfaces.
2. **Describe and apply** core theories, models, and methodologies from the field of HCI.
3. **Choose** an appropriate approach for interface designing.
4. **Make use of** the components to build new and navigation schemes in windows.
5. **Build** the model in the field of HCI.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the student's understanding.

UNIT – I	**08 Hours**
Introduction: Introduction: Importance of user Interface – definition, the importance of 8 good designs. Benefits of good design. A brief history of Screen design. The graphical user interface – the popularity of graphics, the concept of direct manipulation, graphical system, Characteristics, Web user – Interface popularity, characteristics- Principles of user interface.	

UNIT – II	**09 Hours**
Design Process: Human interaction with computers, the importance of 8 human characteristics human consideration, Human interaction speeds, and understanding of business junctions. III Screen Designing: Design goals – Score.	

UNIT – III	**10 Hours**
Screen Designing: Design goals – Screen planning and purpose, 8 organizing screen elements, ordering of screen data and content – screen navigation and flow – visually pleasing composition – the amount of information – focus and emphasis – presentation of information simply and meaningfully – information retrieval on the web – statistical graphics – Technological consideration in interface design.	

UNIT – IV	**12 Hours**
Windows: New and Navigation schemes selection of window, 8 selection of devices based and screen-based controls. Components – text and messages, Icons and increases – Multimedia, colors, uses problems, choosing colors.	

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UNIT – V	**07 Hours**
Software Tools Specification methods, interface – Building Tools. 8 Interaction Devices – Keyboard and function keys – pointing devices – speech recognition digitization and generation – image and video displays – drivers.	

Course Outcomes:

At the end of the course the student will be able to:

1. **Describe** effective and usable graphical computer interfaces**.**
2. **Design** effective HCI for individuals and persons with disabilities**.**
3. **Choose** an appropriate approach for interface designing and **assess the importance of user feedback.**
4. **Make use of** the components to build new and navigation schemes in windows.
5. **Demonstrate** the HCI implications for designing multimedia/eCommerce/e-learning websites.

Table: Mapping Levels of COs to POs / PSOs

COs	**Program Outcomes (POs)**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
	Engineering knowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer and society	Environment and sustainability	Ethics	team work	Communication	Life-long learning	Project management and finance	Apply the principal concepts of AI	Apply the knowledge gained pertaining to data storage, data analytics and AI concepts	develop, and test principles of AI concepts on Intelligent Systems
CO1	1	-	-	-	-	-	-	-	2	2	-	-	2	2	2
CO2	3	2	2	-	1	-	-	-	2	2	-	-	2	2	2
CO3	3	2	-	-	1	-	-	-	2	2	-	-	2	2	2
CO4	3	2	-	-	1	-	-	-	2	2	-	-	2	2	2
CO5	3	3	2	-	1	-	-	-	2	2	-	-	2	2	2

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale Human Computer Interaction, 3rd Edition rentice Hall, 2004.
2. Jonathan Lazar Jinjuan Heidi Feng, Harry Hochheiser, Research Methods in HumanComputer nteraction, Wiley, 2010.
3. Samit Bhattacharya. (2019). Human-Computer Interaction: User-Centric Computing for Design, McGraw Hill Education (1st ed).
4. Bruce R Maxim & Roger S Pressman (2019). Software Engineering: A Practitioner's Approach. (8th ed). McGraw Hill Education.

REFERENCE BOOKS:

1. Ben Shneiderman and Catherine Plaisant Designing the User Interface: Strategies for Effective Human-Computer

E-Resources:

1. https://archive.nptel.ac.in/courses/106/106/106106177/
2. https://onlinecourses.nptel.ac.in/noc22_cs125/

Activity Based Learning (Suggested Activities in Class)

1. Quiz.
2. Collaborative Activity is minor project development with a team of 4 students.

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UG RESEARCH PROJECT-II

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VII

Subject Code	:	20AM4806	**Credits**	:	03
Hours / Week	:	0	**Total Hours**	:	Hours
L–T–P–S	:	0–0–0–6			

Course Learning Objectives:

This course will enable students to:

1. **To identify** key research questions within a field to carry out research in a team.
2. **To identify** and summarize the literature review of the relevant field.
3. **To demonstrate** relevant referencing and inculcate new skills in various aspects of academic writing.
4. **To demonstrate** the knowledge and understanding of writing the publication/report.
5. **To showcase** the strong evidence on the clarity of the argument, understanding of theselected domain area and presentation of its technical information.
6. **To detail description** of the process of carrying out the independent research in written document along with results and conclusions with reference to the existing literature.
7. **To analyze** and synthesize the new research findings.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

13. Lecture method means it includes not only the traditional lecture method but a different type of teaching method that may be adopted to develop the course outcomes.
14. Interactive Teaching: Adopt Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
15. Show Video/animation films to explain the functioning of various concepts.
16. Encourage Collaborative (Group Learning) Learning in the class.
17. To make Critical thinking, ask at least three Higher-order Thinking questions in the class.
18. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the student's understanding.

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COURSE CONTENT:

The research topic proposed by both the guide and the student team should be approved by the department chairman to proceed further. A degree of industrial input and involvement will be encouraged, and can be facilitated through existing academic- industrial collaborations or by addressing specific topics that are of interest to industrial partners.

All projects will be closely supervised by the Project Guide with ongoing feedback and guidance at all stages of the project from conception to completion.

The following criteria will be checked by the department chairman to approve for the research proposal:

a. Department staff as course guide
   1. Ability to provide research direction to the student in the chosen field of interest
   2. Ability to design an appropriate research strategy and methodology tocarry out the research by student
   3. Ability to provide and evaluate the strong literature review document forthe chosen research topic
   4. Ability to train students on research paper / technical writing skills
   5. Conduct reviews in regular time period and submit the evaluation to department chairman

b. Student Team
   1. To be dedicated and committed to work on a new research topic bylearning new technical skills
   2. To have fair knowledge on what is product development or research topic
   3. To have constant interaction with allocated guide by providing weekly updates
   4. To be committed to complete the project and submitting the technical paperwithin the stipulated time framed by the university

Evaluation:

There will be CIA evaluation as well as the Semester end evaluation of the work done. Itwill be done by a committee of senior researchers of the Department.

Course Outcomes:

the end of the course the student will be able to:

1. Develop the research project by selecting an appropriate research problem.
2. Compare the papers relevant to the selected problem domain.
3. Construct the model and perform the model evaluation and analysis.
4. Draft of the Publication or Demonstration of the Proof-of- concept product, Draft of patent application.

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	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	2	2	-	2	-	-	2	-	3	2	2	3	3	2
CO 2	2	1	-	-	-	-	-	2	-	3	2	2	1	1	1
CO 3	3	3	3	2	3	1	-	2	-	3	2	2	3	3	3
CO 4	3	3	3	2	1	-	-	2	-	3	2	1	2	2	2

Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

3:

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