DAYANANDA SAGAR UNIVERSITY

Dayananda Sagar University

School of Engineering

Main Campus, Devarakaggalahalli Campus, Harohalli-562112, Ramanagara, Karnataka

Department of

Computer Science and Engineering

(Cyber Security)

SCHEME AND SYLLABUS

B.Tech. PROGRAMME– 2023-27 BATCH

(With effective from - 2023-24)

DAYANANDA SAGAR UNIVERSITY

(A State Private University under the Karnataka Act No. 20 of 2013)

Approved By UGC & AICTE, New Delhi.

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.

SCHOOL OF ENGINEERING

SCHOOL OF ENGINEERING

(Hosur Main Road, Kudlu Gate, Bengaluru-560 068)

Approved By UGC & AICTE, New Delhi.

VISION

To transform life through Excellence and Innovation in Engineering Education and Research with an emphasis on Sustainable, Inclusive Technology and Global needs.

MISSION

To Develop School of Engineering at Dayananda Sagar University, as Center of Excellence by imparting Quality Education and Research to generate highly Competent, Skilled and Humane manpower to face emerging Technological, Scientific and Social challenges with Ethics, Integrity, Credibility and Social concern.

LEADERSHIPS

Sl. No	Name	Position
1	Dr. D. Hemachandra Sagar	Chancellor, DSU
2	Dr. D. Premachandra Sagar	Pro Chancellor, DSU
3	Mr. Galiswamy	Secretory
4	Dr. Amith R Bhatt	Vice Chancellor, DSU
5	Prof. Janardhan R	Pro Vice Chancellor, DSU
6	Dr. Puttamadappa C	Registrar, DSU
7	Dr. Uday Kumar Reddy	Dean, SOE, DSU
8	Dr. Kousalya Govardhanan	Dean, Research, DSU
9	Dr. Ramesh R. Galigekere	Dean, Academics
10	Dr. S Senthil	Professor & Dean, School of Computer Applications
11	Dr. Nagaraja S R	Professor and Chairman Department of Aerospace Engineering
12	Dr. Jayavrinda Vrindavanam	Professor and Chairman, Department of CSE (Artificial Intelligence and Machine Learning)
13	Dr. Girisha G S	Professor and Chairman, Department of Computer Science and Engineering
14	Dr. Durbadal Chattaraj	Associate Professor and Chairman, Department of CSE (Cyber Security)
15	Dr. Shaila S G	Professor and Chairman, Department of CSE (Data Science)
16	Dr. M Shahina Parveen	Professor and Chairperson Department of Computer Science & Technology
17	Dr. Arun Balodi	Professor and Chairman, Department of ECE
18	Dr. Vinayak B Hemadri	Professor and Chairman Department of Mechanical Engineering
19	Dr. Pramod Kumar Naik	Associate Professor and Chairman, Department of AI & Robotics

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-basedcourse 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 Graduatelevel, 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

UG 4.4. Admission to II year /III Semester Bachelor of Technology under Lateral entry shall be open to the candidates who have passed diploma or equivalent

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 semestersof 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.

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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 fulfil 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, mini-projects, 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. A and SEE shall respectively have 60:40 percent weightage. The Vice-Chancellor, 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 up the Semester End Examination or else 'NE' grade shall be awarded. However, the Vice-Chancellor, under exceptional circumstances on the recommendations of Dean of Faculty and Department Chair, may exempt a student from participation 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, CumulativeGrade 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.

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

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. 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 11.1.5. 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 under graduate 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 Vice-Chancellor 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 14.1.1. 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

Department of Computer Science and Engineering (Cyber Security)

VISION

Ignite and nurture young learners to provide a sustainable, humane, and research-centric educational platform in the domain of cybersecurity for building a robust, resilient, and attack-free digital universe.

MISSION

1. Provide committed and competent faculty and educational infrastructure to impart the theoretical and practical foundation of cybersecurity in the emanating youth.
2. Establish MoUs and Centre of Excellences (CoEs) with Information Technology Sector to provide industry-ready cybersecurity graduates with research instinct imbibed for the sustainable development of young learners
3. Build collaborative and teamwork-centric project-oriented learning environment, to address global challenges whilst preserving human and ethical values.
4. Encourage young minds to educate society to restore nationwide human safety and security in digital world.

FACULTY LIST

Sl No	Name of the Faculty	Designation
1	Dr. Durbadal Chattaraj	Associate Professor and Chairperson CSE (Cyber Security)
2	Dr. Dilip Kumar Jang Bahadur Saini	Associate Professor
3	Naveen Kulkarni	Assistant Professor
4	Sharanabasappa Tadkal	Assistant Professor
5	Ranjima P	Assistant Professor
6	Vinitha V	Assistant Professor
7	Dr. Prajwalasimha S N	Assistant Professor
8	Deepthika Karuppusamy	Assistant Professor
9	Dr. Indushree M	Assistant Professor
10	Dr. Mubeen Ahmed Khan	Assistant Professor
11	Prof. G N V Prasad	Professor of Practice

PROGRAM OUTCOMES (PO'S):

A graduate of Computer Science and Engineering (Cyber Security) program will demonstrate:

- **PO1. Engineering knowledge:** Apply the information of arithmetic, science, engineering fundamentals, associate degreed an engineering specialization to the answer of advanced engineering issues.
- **PO2. Problem analysis:** Identify, formulate, review analysis literature, and analyse complicated engineering issues reaching corroborated conclusions mistreatment initial principles of arithmetic, natural sciences, and engineering sciences.
- **PO3. Design/development of solutions:** Design solutions for advanced engineering issues and style system elements or processes that meet the required wants with applicable thought for the general public health and safety, and therefore the cultural, societal, and environmental concerns.
- **PO4. Conduct investigations of complex problems:** Use analysis-based information and research ways as well as style of experiments, analysis and interpretation of information, and synthesis of the knowledge to supply valid conclusions.
- **PO5. Modern tool usage:** Create, select, and apply acceptable techniques, resources, associate degreed fashionable engineering and IT tools as well as prediction and modelling to advanced engineering activities with an understanding of the restrictions.
- **PO6. The engineer and society:** Apply reasoning familiar by the discourse information to assess social group, health, safety, legal and cultural problems and therefore the resulting responsibilities relevant to the skilled engineering apply.
- **PO7. Environment and sustainability:** Understand the impact of the skilled engineering solutions in social and environmental contexts, and demonstrate the information of, and want for property development.

- **PO8. Ethics:** Apply moral principles and decide to skilled ethics and responsibilities and norms of the engineering follow.
- **PO9. Individual and team work:** Function effectively as a private, and as a member or leader in numerous groups, and in multidisciplinary settings.
- **PO10. Communication:** Communicate effectively on advanced engineering activities with the engineering community and with society at giant, such as, having the ability to grasp and write effective reports and style documentation, build effective shows, and provides and receive clear directions.
- **PO11. Project management and finance:** Demonstrate information and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in an passing team, to manage comes and in multidisciplinary environments.
- **PO12. Life-long learning:** Recognize the necessity for, and have the preparation and talent to interact in freelance and life - long learning within the broadest context of technological amendment.

PSOs

1. Ability to understand, analyse and develop computer programs in the areas related to networking, cryptography, web development and database management by adhering software development life cycle.

2. Graduate students will be able to develop data, resource, and asset protection strategies for organizations, processes, peoples, and individuals through Cybersecurity-centric skills.

SCHEME - B.TECH – 2023-24 ONWARDS

I SEM - CHEMISTRY CYCLE

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	SCHEME OF TEACHING					Duration in Hrs Exam	Examination (Maximum Marks)		
				L	T	P	J	C		CIE	SEE	TM
1	101-105, 121-123 & 141	23EN1101	LINEAR ALGEBRA AND DIFFERENTIAL EQUATIONS	3	0	0	0	3	3	60	40	100
2	101-105, 121-123 & 141	23EN1102	ENGINEERING CHEMISTRY	2	0	2	0	3	3	60	40	100
3	101-105, 121-123 & 141	23EN1103	INTRODUCTION TO MECHANICAL ENGINEERING	2	0	2	0	3	3	60	40	100
4	101-105, 121-123 & 141	23EN1104	INTRODUCTION TO ELECTRICAL ENGINEERING	2	0	0	0	2	3	60	40	100
5	101-105, 121-123 & 141	23EN1105	C PROGRAMMING FOR PROBLEM SOLVING	2	1	2	0	4	3	60	40	100
6	101-105, 121-123 & 141	23EN1106	ENGINEERING MECHANICS	2	0	0	0	2	3	60	40	100
7	101-105, 121-123 & 141	23EN1107	TECHNICAL ENGLISH	2	0	0	0	2	1	100	-	100
8	101-105, 121-123 & 141	23EN1108	ENVIRONMENTAL SCIENCE	1	0	0	0	1	1	50	-	50
9	101-105, 121-123 & 141	23EN1109	KANNADA KALI / MANASU	1	0	0	0	0	1	50	-	50
			TOTAL	17	1	6	0	20		560	240	800

L – Lecture, T – Tutorial, P – Practical, J – Project, C – No. of Credits, CIE – Continuous Internal Evaluation, SEE- Semester End Examinations, TM – Total Marks.

SCHEME - B.TECH – 2023-24 ONWARDS

I SEM - PHYSICS CYCLE

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	SCHEME OF TEACHING					Duration in Hrs Exam	Examination (Maximum Marks)		
				L	T	P	J	C		CIE	SEE	TM
1	101-105, 121-123 & 141	23EN1101	LINEAR ALGEBRA AND DIFFERENTIAL EQUATIONS	3	0	0	0	3	3	60	40	100
2	101-105, 121-123 & 141	23EN1110	ENGINEERING PHYSICS	3	0	2	0	4	3	60	40	100
3	101-105, 121-123 & 141	23EN1111	INTRODUCTION TO ELECTRONICS ENGINEERING	3	0	0	0	3	3	60	40	100
4	101-105, 121-123 & 141	23EN1112	C PROGRAMMING FOR PROBLEM SOLVING	2	1	2	0	4	3	60	40	100
5	101-105, 121-123 & 141	23EN1113	ENGINEERING GRAPHICS AND DESIGN THINKING	2	0	2	0	3	3	60	40	100
6	101-105, 121-123 & 141	23EN1114	BIOLOGY FOR ENGINEERS	2	0	0	0	2	1	100	-	100
7	101-105, 121-123 & 141	23EN1115	CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS	1	0	0	0	1	1	50	-	50
			TOTAL	16	1	6	0	20	17	450	200	650

L – Lecture, T – Tutorial, P – Practical, J – Project, C – No. of Credits, CIE – Continuous Internal Evaluation,
SEE- Semester End Examinations, TM – Total Marks.

SCHEME - B.TECH – 2023-24 ONWARDS

II SEM - CHEMISTRY CYCLE

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	SCHEME OF TEACHING					Duration in Hrs Exam	Examination (Maximum Marks)		
				L	T	P	J	C		CIE	SEE	TM
1	101-105, 121-123 & 141	23EN1201	SINGLE AND MULTIVARIATE CALCULUS	3	0	0	0	3	3	60	40	100
2	101-105, 121-123 & 141	23EN1202	OBJECT ORIENTED PROGRAMMING	2	1	2	0	4	3	60	40	100
3	101-105, 121-123 & 141	23EN1102	ENGINEERING CHEMISTRY	2	0	2	0	3	3	60	40	100
4	101-105, 121-123 & 141	23EN1103	INTRODUCTION TO MECHANICAL ENGINEERING	2	0	2	0	3	3	60	40	100
5	101-105, 121-123 & 141	23EN1104	INTRODUCTION TO ELECTRICAL ENGINEERING	2	0	0	0	2	3	60	40	100
6	101-105, 121-123 & 141	23EN1106	ENGINEERING MECHANICS	2	0	0	0	2	3	60	40	100
7	101-105, 121-123 & 141	23EN1107	TECHNICAL ENGLISH	2	0	0	0	2	1	100	-	100
8	101-105, 121-123 & 141	23EN1108	ENVIRONMENTAL SCIENCE	1	0	0	0	1	1	50	-	50
9	101-105, 121-123 & 141	23EN1109	KANNADA KALI / MANASU	1	0	0	0	0	1	50	-	50
			TOTAL	17	1	6	0	20		560	240	800

L – Lecture, T – Tutorial, P – Practical, J – Project, C – No. of Credits, CIE – Continuous Internal Evaluation,
SEE- Semester End Examinations, TM – Total Marks.

SCHEME - B.TECH – 2023-24 ONWARDS

II SEM - PHYSICS CYCLE

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	SCHEME OF TEACHING					Contact Hours /Week	Examination (Maximum Marks)		
				L	T	P	J	C		CIE	SEE	TM
1	101-105, 121-123 & 141	23EN1201	SINGLE AND MULTIVARIATE CALCULUS	3	0	0	0	3	3	60	40	100
2	101-105, 121-123 & 141	23EN1202	OBJECT ORIENTED PROGRAMMING	2	1	2	0	4	3	60	40	100
3	101-105, 121-123 & 141	23EN1110	ENGINEERING PHYSICS	3	0	2	0	4	3	60	40	100
4	101-105, 121-123 & 141	23EN1111	INTRODUCTION TO ELECTRONICS ENGINEERING	3	0	0	0	3	3	60	40	100
5	101-105, 121-123 & 141	23EN1113	ENGINEERING GRAPHICSAND DESIGN THINKING	2	0	2	0	3	3	60	40	100
6	101-105, 121-123 & 141	23EN1114	BIOLOGY FORENGINEERS	2	0	0	0	2	01	100	-	100
7	101-105, 121-123 & 141	23EN1115	CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS	1	0	0	0	1	01	50	-	
			TOTAL	16	1	6	0	20	17	450	200	650

L – Lecture, T – Tutorial, P – Practical, J – Project, C – No. of Credits, CIE – Continuous Internal Evaluation, SEE- Semester End Examinations, TM – Total Marks.

Definitions / Descriptions

Definition of Credit:	
1 Hour Lecture (L) Per Week	01 Credit
1 Hour Tutorial (T) Per Week	01 Credit
1 Hour Practical (P) Per Week	0.5 Credit
1 Hour Project (J) Per Week	0.5 Credit

Course code and Definition:	
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management Courses
IPCC	Integrated Professional Core Course
PCC	Professional Core Courses
PEC	Professional Elective Courses
OEC	Open Elective Courses
SEC	Skill Enhancement Courses
UHV	Universal Human Value Course
PROJ	Project Work
INT	Internship

Implementation of National Education Policy (NEP) 2020 for the B.Tech students of Batch 2023-2027

The implementation of Curriculum follows NEP 2020 and addresses the following features and categories of courses:

1. Student Centric flexible curriculum.
2. Inter-disciplinary Courses,
3. Multi-disciplinary Courses,
4. Ability Enhancement Courses,
5. Skill Enhancement Courses,
6. Value Added Courses,
7. Product Design and Development,
8. Internship (Rural Internship, Industry Internship, Research/Development Internship), and
9. Multiple Exit and Multiple Entry
    - Certificate in Engineering after completion of first year.
    - Diploma in Engineering after completion of second year.
    - Advanced Diploma in Engineering after completion of third year.
    - Degree in Engineering after completion of fourth year.

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III SEMESTER													
S.N.	Course Type	CourseCode	Course Name	Teaching Department	Teaching Hours / Week				Examination				Credits
					Lecture	Tutorial	Practical	Project	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	J					
1	BSC	23CY2301	Transforms and Numerical Techniques	MAT	3	0	0	0	03	60	40	100	**3**
2	IPCC	23CY2302	Data Structures	CSE(CY)	3	0	2	0	03	60	40	100	**4**
3	IPCC	23CY2303	Digital Logic Design	ECE	3	0	2	0	03	60	40	100	**4**
4	PCC	23CY2304	Discrete Mathematics and Graph Theory	CSE(CY)	3	0	0	0	03	60	40	100	**3**
5	PCC	23CY2305	Introduction to Computer Networks	CSE(CY)	3	0	2	0	03	60	40	100	**4**
6	AEC	23LSXXXX	Liberal Studies	Any Dept.	1	0	0	0	01	50	--	50	**1**
7	TPC	23CY2306	Cognitive and Technical Skills-I	TPO	2	0	0	0	01	100	--	100	**2**
			Total		**18**	**0**	**06**	**0**		**450**	**200**	**650**	**21**

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Liberal Studies	
Course Code	**Course Name**
23LS0001	Drama
23LS0002	Dance
23LS0003	Music
23LS0004	Photography
23LS0005	Introduction to Japanese language
23LS0006	Law for Engineers
23LS0007	Canvas Painting
23LS0008	Communication in Sanskrit
23LS0009	Vedic Mathematics
23LS0010	Critical Thinking
23LS0011	Introduction to Film Studies
23LS0012	Yoga & Meditation
23LS0013	Cyber Crimes, Policies & Laws
23LS0014	Holistic Medicine
23LS0015	3-D Modelling using Tinkercad
23LS0016	Brief Introduction to Psychology **
23LS0017	Innovation to Design**
23LS0018	Introduction to Indian Art- An Appreciation **
23LS0019	Body Language: Key to Professional Success **
23LS0020	Stress Management **
23LS0021	Water, Society and Sustainability **
23LS0022	Business Fundamentals for Entrepreneurs (Part 1: Internal Operation) **
23LS0023	Moral Thinking: An Introduction to VALUES and Ethics**
23LS0024	Gender Justice and Workplace Security**

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IV SEMESTER													
S.N.	Course Type	Course Code	Course Name	Teaching Department	Teaching Hours / Week			Examination					Credits
					Lecture	Tutorial	Practical	Project	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	J					
1	BSC	23CY2401	Probability & Statistics	MAT	3	0	0	0	03	60	40	100	**3**
2	IPCC	23CY2402	Design and Analysis of Algorithms	CSE(CY)	3	0	2	0	03	60	40	100	**4**
3	IPCC	23CY2403	Database Management System	CSE(CY)	3	0	2	0	03	60	40	100	**4**
4	IPCC	23CY2404	Introduction to Cyber Security	CSE(CY)	3	0	0	0	03	60	40	100	**3**
5	PCC	23CY2405	Cyber Forensics and Cyber Law	CSE(CY)	3	0	0	0	03	60	40	100	**3**
6	PCC	23CY2406	Computer Organization and Architecture	CSE(CY)	3	0	0	0	03	60	40	100	**3**
7	TPC	23CY2407	Cognitive and Technical Skills-II	TPO	2	0	0	0	01	100	--	100	2
			Total		**20**	**0**	**04**	**0**		**460**	**240**	**700**	**22**

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LINEAR ALGEBRA & DIFFERENTIAL EQUATIONS

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

SEMESTER – I

Course Code	:	23EN1101	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–J	:	3–0–0–0			

Course Learning Objectives:

This Course will enable students to:

1. **Apply** the method of Gauss elimination to solve systems of linear equations and determine the row echelon form of a matrix
2. **Analyze** vector spaces, subspaces, and their properties to identify linear independence, span, and bases in the context of finite-dimensional vector spaces.
3. **Evaluate** and compute the dimensions of vector spaces by understanding the concepts of rank and nullity
4. **Analyze** the properties and characteristics of linear transformations and theircorresponding matrices to gain a deeper understanding of their behaviour and applications.
5. **Utilize** the concepts of eigenvalues and eigenvectors, employing diagonalization techniques to determine the diagonal form of a matrix and its implications in various contexts.

Teaching-Learning Process (General Instructions)

These are sample newpedagogical methods, where teacher can use to accelerate the attainmentof the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *typeof teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating,and roleplaying.
3. Show ***Video/animation*** films to explain 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. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information ratherthan simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to comeup with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible,it helps improve the students' understanding.

UNIT – I	**08 Hours**

INTRODUCTION:

System of Linear equations. ***(Text Book-1: Chapter 1: 1.1)***

Row reduction and echelon form. ***(Text Book-1: Chapter 1: 1.2)***

Rank of a matrix by row echelon form. ***(Text Book-1: Chapter 4: 4.6)***

Gauss elimination, Inverse of a matrix by Gauss Jordan ***(Text Book-5: Chapter 3: 3.7 and 3.11)***

LU decomposition ***(Text Book-1: Chapter 2: 2.5)***,

UNIT – II	08 Hours
Vector spaces – Subspaces ***(Text Book-1: Chapter 4: 4.1)*** Linear independence – Span - Bases and Dimensions -Finite dimensional vector spaces ***(Text Book-1: Chapter 4: 4.3***) Dimensions, finite dimensional vector spaces ***(Text Book-1: Chapter 4: 4.5)***	
UNIT – III	**09 Hours**
Linear transformation - Matrices of linear transformations ***(Text Book-1: Chapter 1: 1.7 and 1.8)*** Vector space of linear transformations – Inner Product, Orthogonal Vectors - Projections ***(Text Book-1: Chapter 6: 6.1, 6.2 and 6.3)*** Gram- Schmidt Orthogonalization process ***(Text Book-1: Chapter 6: 6.4)***	
UNIT – IV	**07 Hours**
Introduction to Eigenvalues and Eigenvectors ***(Text Book-1: Chapter 5: 5.1)*** Diagonalization of a Matrix ***(Text Book-1: Chapter 5: 5.3)***	
UNIT – V	**07 Hours**
Linear second order ordinary differential equation with constant coefficients (***Text Book-5: Chapter 2***) Solutions of homogenous and non-homogenous equations ***(Text Book-5: Chapter 2: 2.2 to 2.7***) Method of variation of parameters ***(Text Book-5: Chapter 2: 2.10***) Solutions of Cauchy-Euler and Cauchy-Legendre differential equations ***(Text Book-5: Chapter2: 2.5***)	

Course Outcomes:

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

1. **Solve** systems of linear equations using Gauss elimination and determine the inverse ofa matrix by applying the Gauss-Jordan method.
2. **Solve** problems involving row reduction and echelon form in linear algebra to demonstrate an understanding of the concepts and their applications in solving systems of linear equations and transforming matrices.
3. **Analyze** matrices and determine their rank by using row echelon form, examining the relationships between rows and columns, and identifying the motives or causes behind the rank.
4. **Apply** LU decomposition techniques to factorize a matrix into lower and upper triangular matrices, illustrating their understanding of the process and its applications.
5. **Apply** the concepts of vector spaces, subspaces, linear independence, span, bases, and dimensions to solve problems related to finite-dimensional vector spaces, applyingacquired knowledge and techniques.

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
CO1	3	2	1						1					
CO2	3	2	1		1				1					
CO3	3	2	1		1				1					
CO4	3	2	1						1					
CO5	3	2	1		1				1					

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

TEXT BOOKS:

1. D C Lay, S R Lay and JJ McDonald, Linear Algebra and its Applications, PearsonIndia, Fifth edition.
2. Linear Algebra and its Applications by Gilbert Strang, 4th Edition, ThomsonBrooks/Cole, Second Indian Reprint 2007.
3. Introductory Linear Algebra- An applied first course, Bernard Kolman and David, R.Hill, 9th Edition, Pearson Education, 2011.
4. Thomas' Calculus, George B. Thomas, D. Weir and J. Hass, 2014, 13th edition,Pearson.
5. Advanced engineering mathematics, Erwin Kreyszig, Wiley, London, 1972.

REFERENCE BOOKS:

1. Introduction to Linear Algebra, Gilbert Strang, 5th Edition, Cengage Learning (2015).
2. Higher Engineering Mathematics by B S Grewal, 42nd 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.
5. Practical Linear Algebra, Farin and Hansford, CRC Press (2013).

E-Resources:

1. https://nptel.ac.in/courses/111101115
2. https://nptel.ac.in/courses/111108066
3. Linear Algebra Basics | Coursera
4. https://nptel.ac.in/courses/111108081
5. https://nptel.ac.in/courses/111106100
6. Differential Equations for Engineers Course (HKUST) | Coursera

Activity Based Learning (Suggested Activities in Class)

1. Introduce the concept of matrix transformations, such as translation, rotation, scaling, and reflection. Provide visual examples and interactive tools that allow students to manipulate shapes and observe the effects of different transformation matrices.
2. Using real-life scenarios or word problems to make the activity of solving linear equations using matrix method.
3. Some real-world scenarios that can be modelled using ODEs, such as population growth, radioactive decay, or chemical reactions that can be discussed and solve using appropriate methods.

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ENGINEERING CHEMISTRY

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

SEMESTER – I/II

Course Code	:	23EN1102	**Credits**	:	03
Hours / Week	:	04 Hours	**Total Hours**	:	26 + 26 Hours
L–T–P–J	:	2–0–2–0			

Course Learning Objectives:

This Course will enable students to:

- **Understand** the principles of chemical fuel towards energy production.
- **Apply** the concept of energy conversion from solar to electric energy in photovoltaic cells.
- **Understand** the basic principles of electrochemistry to measure the potential of redox reactions. **Illustrate** the construction, working, and applications of batteries, and fuel cellsas energy storage devices.
- **Understand** the electrochemical theory of corrosion of metals and its prevention by metal finishing techniques.
- **Understand** the synthesis, structure–property relationship, and the applications of commercial polymers.
- **Understand** the different techniques for the purification of sewage water. **Analyse** the impurities present in waste water systems.

Teaching-Learning Process (General Instructions)

These are some of the innovative pedagogical approaches to accelerate the attainment of the various course outcomes.

1. **Lecture method**: Chalk and talk method, and demonstrations may be adopted to achieve the course outcomes.
2. **Interactive Teaching: Active learning** that includes brainstorming, group work, formulating questions, notetaking, and annotating.
3. Show **Video**s to explain and illustrate the various concepts.
4. Encourage **Collaborative** learning in the class.
5. **Problem Based Learning**, may foster students' analytical skills, ability to evaluate, and process the information.
6. Inculcate the culture of research and encourage students to come up with their own creativity.

UNIT – I Chemical Energy Source	**06 Hours**

Fuels: 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, and Biodiesel. ***(Text Book-1: Module-3)***

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. ***(Text Book-1: Module-3)***

UNIT – II Energy Science and Technology	06 Hours
Electrochemistry and Battery Technology: Single electrode potential - Definition, and sign conventions. Standard electrode potential- Definition. EMF of a cell-Definition, notation and conventions. Reference electrodes– Calomel electrode, Ag/AgCl electrode. Measurement of standard electrode potential. 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. ***(Text Book-2: Module-1)*** **Fuel Cells:** Introduction to fuel cells, types of fuel cells. Construction, working and application of Methanol-Oxygen fuel cell. ***(Text Book-2: Module-1)***	

UNIT – III Corrosion Science and Surface Modification Techniques	06 Hours
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:Metal coatings-Galvanization, Tinning and its disadvantages. Cathodic protection of Corrosion: Sacrificial anode method and current impression method. ***(Text Book-2: Module-2)*** **Surface Modification Techniques:** Definition, Technological importance of metal finishing. Significance of polarization, decomposition potential and over-voltage in electroplating processes. Electroless Plating. Distinction between electroplating and Electroless plating, advantages of electroless plating. Electroless plating of copper. ***(Text Book-2: Module-2)***	

UNIT – IV Polymers	02 Hours
Polymers: Introduction to polymers, Glass transition temperature, structure and property relationship. Synthesis, properties and applications of Teflon. PMMA. Synthesis, properties and application of silicone rubber. ***(Text Book-1: Module-4)***	

UNIT – V Water Technology & Instrumental Methods of Analysis:	06 Hours
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. Alkalinity. 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. ***(Text Book-2: Module-5)*** **Instrumental Methods of Analysis:** Instrumental methods of analysis, Principles of Potentiometry, Conductometry (Strong acid against strong base, weak acid against strong base, mixture of strong acid and a weak acid against strong base).	

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Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Determination** of calorific value of fuels and **apply** the concepts of energy conversion for photovoltaic cells.	L3
2	**Apply** the basic principles of electrochemistry for the construction of energy storage devices.	L3
3	**Implement** the electrochemical theory to **analyze** the concept of corrosion of metals and its prevention by surface modifications.	L3
4	**Apply** the concept of polymerization for the synthesis of polymers and study their structure-property relationship for commercial applications.	L3
5	**Demonstrate** the techniques in the purification of sewage water. **Determine** the hardness and oxygen demand of the provided waste water samples.	L2

Table: Mapping Levels of COs to POs

COs	Program Outcomes (POs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	3	3	0	0	0	0	0	0	0	0	0
CO2	3	2	2	0	0	0	0	0	0	0	0	0
CO3	3	1	1	0	0	0	0	0	0	0	0	0
CO4	3	1	3	0	0	0	0	0	0	0	0	0
CO5	3	1	3	0	0	0	0	0	0	0	0	0

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

Text Books

1. Engineering Chemistry, Edited by Dr. Mahesh B and Dr. Roopashree B, SunstarPublisher, Bengaluru, ISBN 978- 93-85155-70-3, 2022.
2. Engineering Chemistry - by Chandra Shekara B M and Basavaraju B C, Banbayalu(publications), Bengaluru, 2014, 294 pages.

Reference Books

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

2. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", CambridgeUniversity Press, Delhi, 2015.

Wiley's Engineering Chemistry (Wiley India), 2nd Edition, 2013, 1026 pages.

E-Resources

1. https://nptel.ac.in/
2. https://swayam.gov.in/
3. https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Supplemental_Modules_(Analytical_Chemistry)/Electrochemistry/Basics_of_Electrochemistry

Activity Based Learning (Suggested Activities in Class)

1. Analyze research problems by reading research articles, group discussion, andpresentations.
2. Demonstration of solution to a problem through experiential learning.
3. Demonstrations using real objects, taking students on an educational tour.

ENGINEERING CHEMISTRY-LABORATORY

Total: 26 Hrs

Volumetric Analysis and Preparations

1. Evaluation of quality of water in terms of total hardness by complexometric titration.
2. Determination of Chemical Oxygen Demand (COD) of the given industrial wastewater sample.
3. Determination of alkalinity of the given water sample

Instrumental methods of Analysis

1. Potentiometric titration–Estimation of FAS using standard $K_2Cr_2O_7$ solution.
2. Conductometric estimation of a mixture of a weak and strong acid using standardsodium hydroxide solution
3. Determination of viscosity coefficient of a given liquid
4. Colorimetric estimation of copper in a given solution
5. Determination of pKa of given weak acid.

Reference Books

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

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SEMESTER	**I/II**					
COURSE CODE	**23EN1103**					
TITLE OF THE COURSE	**INTRODUCTION TO MECHANICAL ENGINEERING**					
SCHEME OF INSTRUCTION	L	T	P	J	Total Hours	Credits
	2	0	2	0	26(L)+26(P) = 52	3

COURSE OBJECTIVES:

The course will enable the students to

- Acquire a basic understanding of renewable energy resources and basic concepts of hydraulicturbines.
- Acquire knowledge of various engineering materials and metal joining techniques.
- Acquire essential knowledge of modern manufacturing tools and techniques.
- Acquire knowledge on basics of refrigeration and air-conditioning.
- Explain about the cooling of electronic devices.
- Acquire knowledge of basic concepts of mechatronics and robotics.
- Explain about the electric and hybrid vehicles.

COURSE OUTCOMES:

CO No	Outcomes	Bloom's Taxonomy Level
CO1	Describe basic concepts of renewable energy resources andpower generation	L2
CO2	Distinguish various engineering materials and metal joinin techniques	L2
CO3	Demonstrate different modern manufacturing tools andtechniques	L3
CO4	Make use of basic concepts of refrigeration and air-conditioning concepts	L3
CO5	Illustrate essential knowledge of basic concepts c mechatronics and robotics	L2
CO6	Comprehend the important concepts of electric and hybrid vehicles	L2

COURSE CONTENT:

MODULE 1 Energy Sources and Power Generation	**10 Hrs**

Review of energy sources: Construction and working of Hydel power plant, Thermal power plant, Nuclear power plant, Solar power plant, Tidal power plant, Wind power plant. Principle and Operation of Hydraulic turbines, Pelton Wheel, Francis Turbine and Kaplan Turbine. Working of Centrifugal Pump&reciprocating pump.

Thermodynamics: System, boundary, surroundings, types of systems, Zeroth law, First and second lawsof thermodynamics, Efficiency, COP, Carnot theorem

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MODULE 2 Engineering Materials and Metal Joining Processes	**10 Hrs**
Metals-Ferrous: Tool steels and stainless steels. Non-ferrous /metals: aluminum alloys. **Ceramics-** Glass, optical fiber glass, cermets. **Composites-** Fiber reinforced composites, Metal matrixComposites.	
Smart materials- Piezoelectric materials, shape memory alloys, semiconductors, and super-insulators. **Metal Joining Processes:** Fitting, Sheet metal, Soldering, brazing and Welding: Definitions. Classificationand methods of soldering, brazing, and welding. Brief description of arc welding, Oxy-acetylene welding, Introduction to TIG welding and MIG welding.	
MODULE 3 Modern Manufacturing Tools and Techniques	**12 Hrs**
CNC: Introduction, components of CNC, advantages and applications of CNC, CNC Machining centres andTurning Centers Concepts of Smart Manufacturing and Industrial IoT. **Additive Manufacturing:** Introduction to reverse Engineering, Traditional manufacturing vs Additive Manufacturing, Computer aided design (CAD) and Computer aided manufacturing (CAM) and Additive Manufacturing (AM), Different AM processes, Rapid Prototyping, Rapid Tooling, **3D printing:** Introduction, Classification of 3D printing process, Applications to various fields.	
MODULE 4 Thermal Systems and Management	**10 Hrs**
Heat in Electronic Devices: Modes of Heat Transfer, heat generation in electronics, temperaturemeasurement, heat sink, Cooling of electronic devises: Active, Passive, and Hybrid Cooling **Refrigeration:** Principle of refrigeration, Refrigeration effect, Ton of Refrigeration, COP, Refrigerants andtheir desirable properties. Principles and Operation of Vapor Compression and Vapor absorption refrigeration. Applications of Refrigerator. **Air-Conditioning:** Classification and Applications of Air Conditioners. Concept and operation of Centralized air conditioning system.	
MODULE 5 Advanced Technologies	**10 Hrs**
Mechatronics: Introduction, Concept of open-loop and closed-loop systems, Examples of Mechatronicsystems and their working principle. **Robotics:** Introduction, Robot anatomy, Joints & links, common Robot configurations. Applications of Robotics in Material Handling, Processing, Assembly, and Inspection. **Electric and Hybrid Vehicles:** Introduction, Components of Electric and Hybrid Vehicles, Drives andTransmission. Advantages and disadvantages of EVs and Hybrid vehicles.	
List of Laboratory/Practical Experiments activities to be conduct	
- Demonstration on Principle and Operation of any one Turbo machine - Demonstration on pumps - Visit any one Conventional or Renewable Energy Power Plant and prepare acomprehensive report. - One exercises each involving Fitting and Sheet metal.One exercises each involvingwelding and Soldering. - Study oxy-acetylene gas flame structure and its application to gas welding - Demonstration on Principle and Operation of CNC machine. - Demonstration on Principle and Operation of 3D printing process.	

- Demonstration of anyone Heat transfer application device and prepare acomprehensive report.
- Demonstration of anyone air conditioning system.
- Demonstration of the machine consists of Gear Trains.
- Demonstration of various elements of mechatronic system.
- Demonstration of any one model of Robot

TEXT BOOKS:

1. Basic and Applied Thermodynamics, P.K.Nag, Tata McGraw Hill 2nd Ed., 2002
2. Non-Conventional Energy Sources, G.D Rai, Khanna Publishers, 2003
3. Elements of Workshop Technology (Vol. 1 and 2), Hazra Choudhry and Nirzar Roy,Media Promoters and Publishers Pvt. Ltd., 2010
4. Thermal Management in Electronic Equipment, HCL Technologies, 2010
5. Robotics, Appu Kuttan KK K. International Pvt Ltd, volume 1

REFERENCES:

1. An Introduction to Mechanical Engineering, Jonathan Wickert and Kemper Lewis, Third Edition,2012
2. Turbo Machines, M. S. Govindegowda and A. M. Nagaraj, M. M. Publications 7th Ed,2012
3. Manufacturing Technology- Foundry, Forming and Welding, P.N.Rao TataMcGraw Hill 3rd Ed.,2003.
4. Thermal Management of Microelectronic Equipment, L. T. Yeh and R. C.Chu, ASME Press, NewYork, 2002
5. Fundamentals of Robotics: Analysis and Control, Robert J. Schilling, Pearson Education (US).

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INTRODUCTION TO ELECTRICAL ENGINEERING

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

SEMESTER – I/II

Course Code	:	23EN1104	**Credits**	:	02
Hours / Week	:	02 Hours	**Total Hours**	:	26 Hours
L–T–P-J	:	2–0–0-0			

Course Learning Objectives:

This course enables students to:

- **Demonstrate** a foundational understanding of electrical quantities, including current, voltage, power, and energy.
- **Apply** fundamental laws of electric circuits, such as Ohm's law and Kirchhoff's laws to evaluate electrical circuits.
- **Explain** fundamental concepts of electro-magnetic circuits.
- **Demonstrate** a foundational understanding of the working principles, construction, and characteristics of DC machines.
- **Illustrate** the construction, operation, and types of transformers, considering their significance in electrical systems.
- **Explain** the structure and components of electrical power system, highlighting their interconnections.
- **Explain** emerging trends of green energy technologies and smart metering.
- **Explain** the importance of earthing, protective devices, and proper wiring for ensuring electrical safety.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain 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. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I	**10 Hours**

Fundamentals laws of Electrical circuit and elements: Electrical charge, potential; current; power and energy; AC and DC current (mathematical treatment); Ohm's law; KCL and KVL in resistive circuits; series and parallel combination of resistors; voltage and current division rule; V-I relationships for inductor and capacitor under AC voltage; impedance and admittance (series RC and RL); Overview of active power, reactive power and power factor; Introduction to 3 phase systems; Simulation using LTspice software to demonstrate voltage division, current division in resistive circuits. Simulation using LTspice software to show voltage and current waveform for RC and RL circuit.

(TextBook-1: Chapter 1: 1.1 to 1.4, 1.6 to 1.8. Chapter 2: 2.1 to 2.3. Chapter 4: 4.1 to 4.4 Chapter 6: 6.1 to 6.4)

UNIT – II	**10 Hours**

Electromagnetic circuits:

Magnetic circuits: Basics of magnetic circuits (flux, mmf, permeability, reluctance, B and H); Relation between field theory and circuit theory; Faraday's and lenz's laws, Lorentz force; Self and Mutual inductance.

DC machines: Principle of operation of DC generator; generated EMF equation; classification; characteristics and applications. (Introductory treatment only); Principle of operation of DC Motor; back EMF; speed and torque; classification; characteristics and applications. Losses and efficiency in DC machines.

Transformers: Construction, working principle, induced emf equation; step-up and step down; losses and efficiency.

(TextBook-2: Chapter 7: 7.1 to 7.12; Textbook 1: 10.1, 10.2, 10.4, 10.5, 10.8, 10.9, 10.11 and 10.12; Chapter 8: 8.1, 8.2 and 8.9)

UNIT – III	**06 Hours**

Powers system fundamentals: Power system structure; generations sources; green energy; smart meters; power tariff calculations; Electrical safety and standards (IS: 732-2019, IEC: 60446): Colour code of wires for single phase supply, earthing, fuse and MCB.

(Textbook 1: , Chapter 16: 16.1 to 16.5; Textbook 2: Chapter 24: 24.1 to 24.6)

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Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
CO1	**Solve** for voltage, current, power and energy in purely R, series RL and RC circuits under DC and AC voltages.	L3
CO2	**Demonstrate** understanding of principle of operation of DC machines and its applications.	L2
CO3	**Demonstrate** understanding of the working principle of transformers.	L2
CO4	**Demonstrate** understanding of the working principle of transformers, generation sources, the significance of renewable energy sources in electrical engineering, and safety practices.	L2
CO5	Demonstrate proficiency in using simulation software (e.g., LTspice) to simulate and **solve** electrical parametrs.	L3

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
CO1	3	2		1	3						1		1		
CO2	3	2									1		1		
CO3	3	2									1		1		
CO4	3					2	3	2			1		1	1	2
CO5	3	3	2	1	3				1	1	2	2	1	1	

TEXT BOOKS:

1. D.P.Kothari and I.J. Nagrath, "Basic Electrical Engineering", 4th Edition, Tata McGraw Hill, 2019.
2. B.L. Theraja and A.K. Therja, "A textbook of electrical technology, Vol. I (Basicelectrical Engineering)", S. Chand Publishing, 23rd Rev Ed, 2006.

REFERENCE BOOKS:

1. Clayton Paul, Syed A Nasar and Louis Unnewehr, "Introduction to Electrical Engineering", 2nd Edition, McGraw-Hill, 1992.
2. William H Hayt and Jack E Kimberly and Steven M Durbin, "Engineering Circuit Analysis" 8th Edition, McGraw-Hill, 2013.

E-Resources:

1. https://nptel.ac.in/courses/108/108/108108076

Activity Based Learning (Suggested Activities in Class):

1. Real world problem solving using group discussion and hands-on activities. E.g., Interfacing different types of sensors using Arduino.
2. Simulation of different electrical circuits. E.g., RL and RC circuits.

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C PROGRAMMING FOR PROBLEM SOLVING

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

SEMESTER – I

Course Code	:	23EN1112	**Credits**	:	04
Hours/Week	:	05 Hours	**Total Hours**	:	26(L) + 13(T) + 26 (P) Hours
L–T–P–J	:	2–1-2–0			

Course Learning Objectives:

This Course will enable students to:

1. **Elucidate** the basic architecture and functionalities of C programming language.
2. **Apply** programming constructs of C language to solve the complex problems
3. **Explore** data structures like arrays, structures, unions and pointers in implementing solutions to real world problems
4. **Design** and Develop Solutions to problems using structured programming constructs such as functions.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different type of teaching methods may be adopted to develop the course outcomes. 2. ***Interactive Teaching:*** Adopt the Active learning that includes brainstorming,
discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain 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. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that possible, it helps improve the students' understanding.

UNIT – I	**07 Hours**

Basics and overview of C: Introduction to Problem Solving using Algorithms and Flowchart: Key features of Algorithms: Sequence, Decision, Repetition with examples. Background, structure of C program, keywords, Identifiers, Data Types, Variables, Constants, Input / Output statements, Operators (Arithmetic, relational, logical, bitwise etc.), Expressions, Precedence andAssociativity, Expression Evaluation, Type conversions. Conditional Branching Statements-if and switch statements, iterative statements (loops)-while, for, do-while statements, Loop examples, Nested loops, break, continue, go to statement.

(Text Book-1: Chapter 2 & Chapter 3)

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UNIT – II	**05 Hours**
Arrays: Introduction, declaration & initialization of array, reading and writing array elements, Operations on array: Traversal, searching (Linear and Binary search), sorting (Bubble sort and Selection Sort). Declaration and Initialization of two-dimensional arrays. Matrix Operations (addition, subtraction, multiplication, transpose) using two-dimensional array. **Strings:** Definition, declaration, initialization, and representation. String handling functions and character handling functions. ***(Text Book-1: Chapter 5:5.1 to 5.9 & Chapter 6)***	
UNIT – III	**06 Hours**
Pointers: Definition and declaration and initialization of pointers. Accessing values using pointers. Accessing array elements using pointers. **Functions:** Definition and declaration. Built-in functions and User-defined functions. Categories of functions with example. Pointers as function arguments, array as function argument, Call-by-value and call-by-reference. Recursion. ***(Text Book-1: Chapter 7: 7.1 to 7.17 & Chapter 4:4.1 to 4.8, 4.10)***	
UNIT – IV	**04 Hours**
Structures: Purpose and usage of structures. Declaration of structures. Assignment with structures. Structure variables and arrays. Nested structures. Student and employee database implementation using structures. **Unions**: Declaration and initialization of a union. Difference between structures and unions. Example programs. ***(Text Book-1: Chapter 8: 8.1, 8.2,8.6)***	
UNIT – V	**04 Hours**
Memory allocation in C programs: Dynamic memory allocation, memory allocation process, allocating a block of memory, releasing the used space, altering the size of allocated memory. **Files**: Defining, open, read, write, seek and closing of both textual and random files. ***(Text Book-1: Chapter 7: 7.18 to 7.20 & Chapter 9: 9.1 to 9.5, 9.8)***	

Course Outcome	**Description**	**Bloom's Taxonomy Level**
At the end of the course the student will be able to:		
1	**Apply** programming constructs of C language to solve the real-world problem.	L3
2	**Choose** appropriate data type for implementing solutions to solve problems like searching and sorting.	L3
3	**Examine** suitable user-defined data structures in implementing solutions, using modular programming constructs.	L4
4	**Analyze** efficient ways for managing data and storage.	L4
5	**Justify** a solution using a modern IDE and associated tools, conduct a code review and contribute in a small-team.	L5

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
CO1	3													
CO2		2												
CO3			2										1	
CO4				2										
CO5					3				2				1	

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

TEXT BOOKS:

1. Reema Thareja, "Programming in C". Oxford University Press, Second Edition,2016.

REFERENCE BOOKS:

1. Brian W. Kernigham and Dennis M. Ritchie, (2012) "The C Programming Language", 2nd Edition, PHI.
2. Behrouz A. Forouzan, Richard F. Gilberg, "Computer Science - A StructuredApproach Using C", Cengage Learning, 2007.
3. Vikas Gupta, "Computer Concepts and C Programming", Dreamtech Press 2013.

E-Resources:

1. https://nptel.ac.in/courses/106/105/106105171/ MOOC courses can be adopted for more clarity in understanding the topics and verities of problem-solving methods.
2. https://www.w3schools.com/c/index.php
3. https://www.guvi.in/courses/web-development/c-programming/
4. https://www.tutorialspoint.com/cprogramming/index.htm
5. https://pythontutor.com/

Activity Based Learning (Suggested Activities in Class)

- Demonstration of solution to a problem through designing the Flowchart or any design notations using **draw.io** in the group of four and justify using snippets or algorithms.

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C PROGRAMMING FOR PROBLEM SOLVING LABORATORY

Total Contact Hours: 26

List of Laboratory/Practical Experiments activities to be conducted

1. Programming Basics: Swapping Numbers, Simple Interest, and Factorial.
2. Quadratic Equation Solver
3. Number Operations: Palindrome Check and Power Calculation.
4. Fibonacci Series and Greatest Common Divisor (GCD) Calculation.
5. Calculator Emulation
6. String Manipulation
7. Sorting an Array of Integer Elements.
8. Searching an Array of Elements.
9. Pointer Demonstration using Functions.
10. Case Study on Strings and Functions.

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ENGINEERING MECHANICS

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

SEMESTER – I/II

Course Code	:	23EN1106	**Credits**	:	02
Hours / Week	:	02 Hours	**Total Hours**	:	26 Hours
L–T–P–J	:	2–0–0–0			

Course Learning Objectives:

This Course will enable students to:

1. **Illustrate** Couples and equivalent force couple system
2. **Understand the** principles of resolution and composition of forces
3. **Calculate** moment of coplanar concurrent and coplanar non-concurrent forces
4. **Draw** free body diagrams of objects subjected to coplanar concurrent and non-concurrent force systems
5. **Calculate** center of gravity/centroid for various planar figures
6. **Determine** area moment of inertia for various planar geometrical objects and standard symmetrical sections
7. **Explain** Limiting friction and Laws of Friction
8. **Solve numerical on** wedge friction, ladder friction
9. **Explain** assumptions made in analysis of Trusses
10. **Determine** axial forces in members of Planar determinate Truss
11. **Illustrate** rectilinear, plane curvilinear and projectile motions

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain 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. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I Introduction to Engineering Mechanics	**06 Hours**

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INTRODUCTION:

Introduction to Engineering Mechanics, Force Systems Basic concepts, Particle Equilibrium in 2-D; System of Forces, Co-planar Concurrent Forces, Resultant- Moment of Forces and its Application; Couples and Resultant of force System, Equilibrium of System of Forces,

UNIT – II Centroid, Centre and gravity and Moment of inertia	**05 Hours**

Introduction, Centroid of simple figures from first principle, centroid of standar sections Centre of Gravity and its implications; Area moment of inertia Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections

UNIT – III Friction	**05 Hours**

Introduction, Free body diagrams, Equations of Equilibrium. Types of friction, Limiting friction, Cone of Friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, related problems.

UNIT – IV Dynamics	**05 Hours**

Introduction, Rectilinear motion; Plane curvilinear motion (rectangular path, and polar coordinates); Projectile motion, Basic terms, general principles in dynamics; Types of motion, motion and simple problems, Kinetics- Newton's laws of motion and related problems.

UNIT – V Analysis of Trusses	**05 Hours**

Introduction, Classification of trusses, Equilibrium in two and three dimension; Method of Joints; To determine if a member is in tension or compression; Simple Trusses; Zero force members.

Course Outcomes:

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

1. **Compute** Resultant and reactions by principles and resolution of forces in a plane.
2. **Analyse** the objects under the action of applied and frictional forces in a plane by equations of equilibrium.
3. **Determine** the Moment of Inertia of composite geometrical sections in a plane
4. **Analyse** determinate two-dimensional truss by the method of joints and method of section.
5. **Analyze** the motion of objects by equations of motion, equations of equilibrium, and Newton's laws of motion and **calculate** quantities in projectile motion by equations of motion.

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
CO1	3	3	2	2	0	0	1	1	0	0	0	0	1	3	2
CO2	2	2	2	2	0	0	1	0	0	0	0	0	2	2	0
CO3	3	3	2	2	0	0	1	0	1	0	0	0	3	2	0
CO4	3	3	2	2	0	0	1	0	0	0	0	0	3	3	0
CO5	3	2	2	2	0	0	1	0	0	0	0	0	2	2	0

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

TEXT BOOKS:

1. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall publications.
2. A Nelson (2009), Engineering Mechanics: Statics and dynamics, Tata McGraw Hillpublications.

REFERENCE BOOKS:

1. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill publications.
2. R.C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.
3. H.J. Sawant, S.P Nitsure (2018), Elements of Civil Engineering and Engineering Mechanics, Technical Publications.

E-Resources:

1. https://archive.nptel.ac.in/courses/105/105/105105108/
2. https://onlinecourses.nptel.ac.in/noc22_ce46/preview
3. https://www.youtube.com/watch?v=LIZ-PQbGZkA

Activity Based Learning (Suggested Activities in Class)

1. Real world problem solving and puzzles using group discussion.
2. Demonstration of solution to a problem through experiential learning.
3. Demonstrations using real objects, taking students on an educational tour.

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Devarakaggalahalli, Harohalli, Bengaluru – 562 112

TECHNICAL ENGLISH

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

SEMESTER – I / II

Course Code	:	23EN1107	**Credits**	:	02
Hours / Week	:	02 Hours	**Total Hours**	:	26 Hours
L–T–P-J	:	2-0- 0-0			

Objective:

Developing Communicative competence: Enhancing the Language competence in the technical discourse and augmenting the strategic competence in the social and professional environment.

Course Learning Objectives:

This course will enable students to:

a. To enable students to improve their lexical and grammatical competence.
b. To enhance their verbal and nonverbal communication in a professional environment
c. To optimize oral and written communication.
d. To familiarize the students with employability and job search skills.
e. To enhance the students with soft skills
f. To inculcate critical thinking

Teaching-Learning Process (General Instructions)

These are some of the innovative pedagogical approaches to accelerate the attainment of the various course outcomes.

1. ***Lecture method***: Anecdotes, case studies and Examples from real-life situations may be adopted along with the traditional method of chalk and talk to achieve the course outcome.
2. ***Interactive Teaching: Active learning*** may be adopted which includes brainstorming, Teamwork, focused listening, formulating questions, note-taking, and Role play.
3. ***Collaborative*** learning through Debates and Group Discussion
4. ***Activity-based learning*** to inculcate Critical ***thinking*** – conceptualizing, applying, analyzing, synthesizing, and/or evaluating information from observation, perception, and expression. Minimum three higher-order questions from the real-world context
5. ***Problem-Solving method through*** Activities and discussion / Minimum of three situations to inculcate ***Problem-Solving skills*** and encourage the students to come up with creative ways to solve the problem
6. ***Audio-visual methods*** through language Lab in the teaching of LSRW skills.
7. ***Short films/ Ted talks/ Videos/Animation*** films to explain the functioning of various concepts.
8. ***Flipped learning***
9. ***Peer learning / Peer tutoring***

Module – I	**06 Hours**

Grammar and Usage, Language and Communication.

(Branches of Grammar and Vocabulary Word Formation and Types of Word Formation. Communication process diagram. Types of Communication: Managerial, Corporate, Technical and Other Organizational Communication. Barriers to Effective Communication. Listening: Types and their Importance. Difference between hearing and listening. Speaking: Different aspects of Effective Speaking. Oral presentation Pronunciation Guidelines- Common Errors of Pronunciation-Various Techniques for Neutralization of Mother Tongue Influence)

Objective:

- Revising and practicing grammar will help students to optimize their language Competence
- Listening steps up language learning and improves pronunciation
- Speaking improves one's ability to construct phrases naturally and spontaneously in everyday discussions, Clarity and comprehensiveness in speech.

Communicating effectively in the Professional environment, to interact with thecolleagues and to involve in collaborate initiatives

Module – II

Reading: Extensive and Intensive. Technical Paper Writing and Minutes of the Meeting.

Objective:

- Reading provides exposure to the chosen field and helps in the coherence of the thought process
- Technical writing techniques enable the knowledge in the relevant domain and creates better content based on the need of the target group

Meeting minutes allows to access information such as facts, opinions, votes cast,conflicts, attendees, and other crucial elements at the workplace.

Module – III

Memo and E-mail Etiquette. Referencing Skills for Academic Report Writing.

Objective:

- Familiarizing with email etiquettes and correspondence provides learners to form an excellent first impression, establishing trust and confidence.
- Following the Academic conventions helps the students to optimize their reference skills and use references to acknowledge the input of other authors and scholars in their work and avoid plagiarism.
- Writing technical reports develop competence in creating a legally bound account of efforts and choices and engineering technical report propose a solution to a problem inorder to inspire action.

Module – IV

Group Discussion: Definition, How GD Helps in Student Life & Corporate Life.

Objective: GD helps individuals to achieve the skills of organizing and presenting the ideas and concepts in a cohesive manner and to overcome the inhibition of expression incommunication

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Module – V

***Drafting Curriculum Vitae, Resumes, and Cover- Letters. Job Applications*.**
{Types of Resumes, Preparing Resume, CV and Cover- Letter. Filling Job Application. Difference between Curriculum Vitae, Interview techniques: Telephonic interviews, Groupinterviews, face-to-face interviews -Mannerism and etiquette}.
Objective: Learning the specifics of creating a CV or Resume helps in the effective presentation of their achievements and skills, and a cover letter is a chance for them to exhibita few aspects of their personality.

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course, the student will be able to:		
1	Developing language competence **improves** one's ability to construct phrases naturally in everyday discussions and Communication skills and soft skills enhance the self-confidence of students,	L3
2	**Applying** the fundamentals of technical writing techniques provides adequate exposure to the respective domain and creates better content. **Implementing** the technicalities of writing provides better exposure in the domain.	L3
3	**Following** an appropriate style of email reveals the aspect of professionalism. **Develop** technical writing skills to increase the quality of the work and testimony of conduct.	L3
4	**Practicing** communication with greater clarity and ease enable the students to discuss a wide spectrum of topics.	L3
5	Writing resumes or curriculum vitae provides a practice to exhibit their skills and achievements concisely and writing a covering letter enables them to express their personality in the formal context.	L3

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
CO1										2				
CO2										2				
CO3										2				
CO4										2				
CO5										2				

TEXT BOOKS:

1. Dhanavel, S.P. "English and Communication Skills for Students of Science and Engineering". Orient Blackswan Pvt. Ltd., 2009.
2. Meenakshi Raman and Sangeetha Sharma. "Technical Communication- Principles and Practice". 3rd Edition, Oxford University Press, 2009.
3. Murphy R. "English Grammar in Use", Cambridge University Press,2012.
4. N. Krishnaswamy and T. Sri Raman. "Creative English for communication",Macmillan Publication, 2005.

REFERENCE BOOKS:

1. Day. R A. "Scientific English: A Guide for Scientists and Other Professional". 2nd Edition, Hyderabad: Universities Press, 2000.
2. Ashraf Rizvi M. "Effective Technical Communication". McGraw Hill Education, 2017.
3. Eastwood J. "Oxford Practice Grammar". Oxford University Press, 1999.
4. Swan M and Walter C. "Oxford English Grammar Course". Oxford University Press, 2011.
5. Dale, Carnegie. "The Quick and Easy Way to Effective Speaking". JAICO Publishing House, 2019.
6. Chauhan, Gajendra S and Smita, Kashiramka. "Technical Communication". India: Cengage Learning India Private Limited, 2018.
7. Bailey, Stephen. "Academic Writing: A Handbook for International Students". 5th Edition, Routledge, 2017.
8. Kumar, Shiv K and Nagarajan, Hemalatha. "Learn Correct English: Grammar, Composition and Usage". 1st edition, India: Pearson, 2005.
9. Board of Editors. Language and Life: A Skills Approach. Orient BlackSwan, 2018.
10. Sudharshana, NP and C Savitha. English for Engineers. Cambridge University Press, 2018.
11. Kumar, Sanjay and Pushp Lata. English Language and Communication Skills for Engineers. Oxford University Press, 2018.
12. Thomson, A.J. and Martinet, A.V. A Practical English Grammar, OUP, New Delhi: 1986
13. Anne Laws, —Writing Skills||, Orient Black Swan, Hyderabad, 2011
14. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

E-Resources:

1. https://gnindia.dronacharya.info/ME/Common-Subjects/Downloads/Technical-Communication/Books/Technical-Communication-Book-9.pdf. Web.
2. https://projects.iq.harvard.edu/files/hks-communications-program/files/ho_murphy_michael-pp-slides_9_30_14.pdf. Web.
3. https://www.youtube.com/watch?v=TR0JZiapxXM. Web.
4. file:///C:/Users/rochn/Downloads/ManualofEnglishGrammarandComposition_10_012575.pdf. Web.

5. https://www.youtube.com/watch?v=f5Tao6KHV5w. Web.
6. https://www.sastra.edu/nptel/download/Prof%20GPRagini/pdf_New/Unit%20 2 6.pdf. Web.
7. https://www.hansrajcollege.ac.in/hCPanel/uploads/elearning/elearning_docum e nt/English_communication_chapter_13.pdf. Web.
8. https://www.youtube.com/watch?v=voyGGhlpBR8. Web.

Activity Based Learning (Suggested Activities in Class)

1. Observing and responding appropriately to the real-life situations.
2. Encouraging students to participate in Group discussions.
3. Articulating internal observations precisely and confidently through extempore.
4. Producing sentences easily without any grammatical errors in speaking, writing essays, and creative writing.
5. Conducting mock interviews, to refine their expressions, familiarize them with the interview techniques, and provide training for the spontaneous response to tricky questions.
6. Directing students for PowerPoint presentations and orienting them towards the higher order skills of expressing their ideas and concepts with cohesion.

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SCHOOL OF ENGINEERING

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ENVIRONMENTAL SCIENCES

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

SEMESTER – I/II

Course Co e	:	23EN1108	**Credits**	:	01
Hours / Week	:	01 Hour	**Total Hours**	:	13 Hours
L–T–P–J	:	1–0–0–0			

Course Learning Objectives:

This Course will enable students to:

1. Understand the concepts of environment, pollution, energy resources Understand basic engineering principles imminently run physiological processes particularly about engineering designs and solutions are arrived citing body functional examples.
2. Learn water as a resource, rain water harvesting as a method of conversation of water.
3. Explain solid waste and its management.
4. Understand environmental Protection Act laws, environmental Impact Analysis and air monitoring

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainmentof the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *typeof teaching methods* like power point presentations and group discussion may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating,and roleplaying.
3. Show ***Video/animation*** films to explain 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 students' understanding.

COURSE CONTENT:

UNIT 1: Environment and ecosystem	**3 Hrs**

Definition of environment; Scope and importance of environmental studies; Basic concepts Xenobiotic, natural & anthropogenic; why are we concerned? Eco-kinetic & Bio-kinetic Propertiesof a xenobiotic, Dose-Response Relationships;3 T's, Chronic and acute effects.

UNIT 2 : Pollution and management	**4 Hrs**

Air Pollution: Criteria pollutants – Ozone, Particulate Matter, Carbon Monoxide, Nitrogen, Oxides Sulphur Dioxide, Lead; Acid Rain Cycle. Water as a resource; Lentic and Lotic Water Systems; Rain Water Harvesting; Water Pollution; Noise pollution-sources and effects of noise; Municipal Solid Waste: Hazardous Waste: Electronic Waste: Biomedical Waste; Solid Waste Management: Landfills, composting Process.

UNIT 3: Energy	**2 Hrs**
Energy Types of energy: Conventional sources of energy, fossil fuel, Coal, Solar, wind; Non-conventional Sources of Energy, Biofuels - biomass, biogas.	
UNIT 4: Disaster	**2 Hrs**
Disasters & Management; Definition, Natural (Earthquakes, landslides, floods), Man-made disasters (biological, chemical, nuclear, radiological explosions) – definition, causes and management and/or mitigation strategies; Bhopal & Chernobyl Disasters.	
UNIT 5: Environmental acts	**2 Hrs**
Environmental Impact Assessment (EIA); Air pollution monitoring and Ambient Air Quality Standards (AAQS); Environment Protection Act, 1986.	

Course Outcome	**Description**	**Bloom's Taxonomy Level**
At the end of the course the student will be able to:		
1	**Critically elucidate** the basic concepts that govern environmental quality, ambient air quality standards.	L3
2.	**Distinguish** different Energy resources and their environmental implications	
3.	**Distinguish** natural and manmade disasters and prevention	L3
4.	**Demonstrate** different types of pollution and waste streams	L3
5.	**Apply** the process of environmental impact assessment and implications of Indian Environment Laws	

Activity Based Learning (Suggested Activities in Class)

1. Real world problem solving and puzzles using group discussion.
2. Demonstration of solution to a problem through experiential learning.
3. Demonstrations using real objects, taking students on an educational tour.

TEXT BOOKS:

1. Benny Joseph (2005). "Environmental Studies", Tata McGraw – Hill Publishing Company Limited, New Delhi.
2. R. J. Ranjit Daniels and Jagadish Krishnaswamy (2014). "Environmental Studies" (2014), Wiley India Pvt Limited, New Delhi.

REFERENCE BOOKS:

1. P. Aarne Vesilind, Susan M.Morgan, Thomson (2008) "Introduction to Environmental Engineering" (2008), Thomson learning, Second Edition, Boston.
2. R. Rajagopalan (2005). "Environmental Studies – From Crisis to Cure" Oxford University Press, New Delhi.

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KANNADA KALI

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

SEMESTER – I/II

Course Code	:	23EN1109	**Credits**	:	01
Hours /Week	:	01 Hours	**Total Hours**	:	13 Hours
L–T–P-J	:	1–0–0-0			

Course Learning Objectives:

This course enables students:

- To introduce Kannada language & culture to Non – Kannada speakers.
- To train them to communicate in colloquial Kannada with connivance.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.

UNIT – I	**08 Hour**
Introduction to Karnataka & Kannada Culture, Evolution of Kannada. Introduction to Kannada Alphabets. Introduction to Kannada Numbers.	
UNIT – II	**08 Hour**
Kannada words, sentences & phrase making for colloquial communication.	

TEXT BOOKS:

1. Kannada Kali –Dr. Lingadevaru Halemane
2. Kannada Paatagalu– Editor: Dr. Chandrashekara Kambara.
3. SLN Sharma & K Shankaranarayana "Basic Grammar", Navakarnataka Publications.
4. Spoken Kannada. Publication: Kannada Sahitya Parishat Bengaluru.

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SCHOOL OF ENGINEERING

Devarakaggalahalli, Harohalli, Bengaluru – 562 112

SINGLE AND MULTI VARIABLE CALCULUS

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

SEMESTER – II

Course Code	:	23EN1201	**Credits**	:	03
Hours /Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–J	:	3–0–0-0			

Course Learning Objectives:

This Course will enable students to:

1. **Apply** sophisticated techniques of differential calculus to solve problems involving functions of multiple variables.
2. **Apply** double and triple integrals in various coordinate systems (Cartesian, polar, cylindrical, and spherical) and effectively employ them to calculate areas, volumes.
3. **Acquire** a comprehensive understanding of fundamental concepts related to functions of multiple variables, including limits, continuity, and partial derivatives.
4. **Analyze** critical points of functions of two or more variables using partial derivatives and Lagrange multipliers, evaluate extreme values.
5. **Apply** vector calculus principles, such as line integrals, surface integrals, and the divergence theorem effectively to vector field.
6. **Analyze** the convergence and divergence of sequences and infinite series of real numbers by employing various convergence criteria and tests.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain 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. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I	**09 Hours**

Differential Calculus

Functions of two or more variables: Definition, Region in a plane, Level curves, Level surfaces, Limits, Continuity, Partial derivatives, Differentiability, Extreme values and saddle points, Lagrange multipliers. (***Textbook 1: Chapter 14: 14.1 – 14.4, 14.7, 14.8***)

Self-Learning Component: Single variable calculus

UNIT – II	09 Hours

Integral calculus

Double integral and iterated integrals - Cartesian and polar coordinates, Triple integral, Change of variables, Multiple integrals in cylindrical and spherical coordinates. (***Textbook 1: Chapter 15: 15.1 – 15.5, 15.7***)

UNIT – III	09 Hours

Vector Calculus

Line Integrals, Vector Fields, Work, Circulation and flux, Path independence, Potential functions and Conservative fields, Green's theorem in the plane, Surface area and surface integrals, Surface area of solid of revolution, Parametrized surfaces, Stokes' theorem, The Divergence theorem. (***Textbook 1: Chapter 16: 16.1-16.8***), (***Textbook 2: Chapter 10: 10.1, 10.2, 10.4 – 10.7, 10.9***)

UNIT – IV	6 Hours

Sequence and Series I:

Sequences of real numbers and their convergence criteria, Infinite series, Sequence of partial sums, Tests for convergence/divergence - nth term test, Boundedness and monotonicity, Integral, Condensation, Comparison, Ratio and root tests (***Textbook 1: Chapter 10: 10.1-10.5***)

UNIT – V	06 Hours

Sequence And Series II:

Alternating series, Absolute and conditional convergence, Rearrangement theorem, Power series, Taylor and Maclaurin series (one and two variables). (***Textbook 1: Chapter 10: 10.6-10.8***)

Course Outcomes:

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

1. **Apply** the principles of differential calculus to solve problems involving functions of two or more variables.
2. **Utilize** double and triple integrals in Cartesian, polar, cylindrical, and spherical coordinates to compute areas, volumes, and evaluate mathematical expressions.
3. **Extend** a comprehensive understanding of the concepts related to functions of multiple variables, encompassing topics such as limits, continuity, and partial derivatives, and effectively apply them to practical situations and problem-solving scenarios.
4. **Analyze** and evaluate critical points, including extreme values and saddle points, in functions of two or more variables using partial derivatives and Lagrange multipliers.
5. **Analyze** vector calculus concepts, such as line integrals, surface integrals, and the divergence theorem, in the context of vector fields and their applications.
6. **Apply** convergence criteria and various tests, such as the nth term test, boundedness and monotonicity, integral, condensation, comparison, ratio, and root tests, to analyze and determine the convergence or divergence of sequences and infinite series of real numbers

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**
CO1	3	2	1						1					
CO2	3	2	1						1					
CO3	3	2	1						1					
CO4	3	2	1						1					
CO5	3	2	1						1					
CO6	3	2	1						1					

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

TEXT BOOKS:

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, PalgraveMacmillan.
5. Basic Multi Variable Calculus, Marsden, Tromba and Weinstein, W.H. Freeman, ThirdEdition

E-Resources:

1. https://www.youtube.com/playlist?list=PLtKWB-wrvn4nA2h8TFxzWL2zy8O9th_fy
2. https://www.youtube.com/playlist?list=PLU6SqdYcYsfJqbZvQECrwnlQrp4fg 6isX

Activity Based Learning (Suggested Activities in Class)

1. Real world problem solving and puzzles using group discussion.
2. Demonstration of solution to a problem through programming.

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SCHOOL OF ENGINEERING

Devarakaggalahalli, Harohalli, Bengaluru – 562 112

ENGINEERING PHYSICS

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

SEMESTER – I /II

CourseCode	:23EN1110		**Credits**	: 04
Hours / Week	:	03 Hours	**Total Hours**	: 39 + 26 Hours
L–T–P-J	:	3–0–2-0		

Course Learning Objectives:

This Course will enable students to:

1. To introduce the fundamental ideas of quantum mechanics that are necessary fo understanding and addressing engineering challenges.
2. To comprehend solids' band structure, semiconductors' electrical conductivity, and semiconductor devices such as LEDs, photodiodes, and solar cells, as well as thei applications.
3. To examine many types of engineering materials, including electronic, electrica mechanical, and magnetic materials, as well as dielectric material properties and applications in science and engineering.
4. To comprehend various crystal systems and determine structure using miller-indices.
5. Describe thin-film phenomena, thin-film production processes, and applications i science and engineering.
6. To understand how to create Nano materials utilizing a top-down and bottom-up method, as well as to explore Nano science and technology, as well as its practica applications in engineering, biology, and medicine.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainmentof the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *typ of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming discussing, group work, focused listening, formulating questions, notetaking, annotating and roleplaying.
3. Show ***Video/animation*** films to explain 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. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rathe than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible,

it helps improve the students' understanding.

SYLLABUS

MODULE – I	**08 Hours**

QUANTUM MECHANICS:

- Foundations of quantum theory, Wave function and its properties, de-Broglie hypothesis Heisenberg Uncertainty principle. One dimensional time independent Schrodinger wave equation, Eigen values and Eigen functions. Applications: one dimensional motion of an electron in a potential-well. Basics of Quantum computing - Concepts of Superposition entanglement, Interference and Qubit. [5 hours]
  (Text book 1: Chapter 1.5 and Chapter 2 all units)

- **LASER PHYSICS:** Introduction to lasers. Conditions for laser action. Requisites of a Lase system Principle, Construction and working of Nd-YAG and Semiconductor Laser Application of Lasers in Defense (Laser range finder), Engineering (Data storage) and Applications of Lasers in medicine [3 hours]
  (Text book 1: Chapter 5.1, 5.2, 5.3, 5.4, 5.5)

MODULE – II	**08 Hours**

- **Semiconductor Physics**: Band structure, Fermi level in intrinsic and extrinsi semiconductors, Density of energy states in conduction and valence bands of 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, Hall effect Numericals. (5 hours)
  (Text Book-2: Chapter 24.1 to 24.9, Chapter 25.9 to 25.11)

- **Semiconducting devices for optoelectronics applications**: - Principle and working o LED, photodiode, Solar cell, BJT [3 hours]
  (Text Book-2: Chapter 25.1 to 25.8)

MODULE – III	**08 Hours**

- **Dielectrics:** Introduction – Dielectric polarization **–** Dielectric Polarizability Susceptibility and Dielectric constant - Types of polarizations: Electronic, Ionic and Orientation polarizations (qualitative) – Lorentz Internal field (Expression only) - Claussius - Mossoti equation (derivation) – Applications of Dielectrics – Numericals. (4 hours)
  (Text book 1: Chapter 4.1, 4.2, 4.3, 4.4, 4.5)

- **Magnetic Materials:** Introduction - Magnetic dipole moment - Magnetization-Magnet susceptibility and permeability - Classification of magnetic materials: Dia, para, Ferro antiferro & Ferri magnetic materials - Domain concept for Ferromagnetism & Domain walls (Qualitative) - Hysteresis - soft and hard magnetic materials - Engineering applications. Numiricals (4 hours)
  (Text book 1: Chapter 4.9, 4.10, 4.11)

MODULE – IV	08 Hours
• **Crystallography:** Lattice, unit cell, lattice parameters, crystal systems, Bravais lattices Packing fraction for SCC, BCC and FCC crystal systems. Introduction to Miller Indices Determination of Crystal structure by Miller Indices. Expression for Inter-planar distance X-ray diffraction, Bragg's law and Determination of Crystal structure by Powdermethod Numericals [4 hours] (Text book 1: Chapter 7 all units) • **Mechanical Engineering Materials** – mechanical properties: stress- strain curve for different materials. Introduction to Tensile strength, Compressive strength, Ductility, Toughness, Brittleness, Impact strength, Fatigue, Creep. Testing of engineering materials: Hardness Tests: Brinell and Vickers hardness test& Numiricals- (4 hours)Text Book-2: Chapter 2.1 to 2.7)	
MODULE – V	**07 Hours**
• **Thin films technology:** Introduction to thin-films-Advantages of thin-films over bull materials. Thin film deposition processes- Physical vapour deposition (Therma evaporation technique, and sputtering technique) process, Applications of Thin films. [3 hours] (Ref. Text Book-2: Chapter 2. All units) • **Nano Science &technology**: Introduction to Nano materials, Classification of nano materials, Size dependent properties of materials, Top-down and Bottom-up approach Ball-milling and Photolithography, Process. Fundamental Principles of Biophysics & Applications of Nano technology in Biology and Engineering. [4 hours] (Text Book-1: Chapter 8.1 to 8.7)	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Describe the concepts of Quantum mechanics and applications of Schrodinger time independent wave equation in one dimension.	L1 & L3
2	Illustrate Semiconductors, Semiconductor devices like Photodiode LED, Solar cell and its applications.	L2 & L3
3	Distinguish the different engineering materials such as Electronic, electrical and mechanical materials properties and their applications in engineering.Apply the concept of magnetism to magnetic data storage devices.	L2 & L3
4	Classify Lattice parameters of different crystalline solids by using X-ray diffraction methods and its applications in science and engineering	L1 & L3

5	Interpret Basic concepts of thin films and thin film deposition processes and their applications leads to Sensors and engineering devices.	L2
6	Categorize Nano materials, Properties, and fabrication of Nano materials by using Top-down and Bottom –up approach's - Applications for Science and technology.	L2 & L3

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
CO1	2													1
CO2	2													1
CO3	2													1
CO4	1													1
CO5	1											1		2
CO6	3											2		3

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

TEXT BOOKS:

1. P. S. Aithal, H. J. Ravindra, Textbook of Engineering Physics (2011), Acme learning Private Limited, New Delhi, India.
2. Shatendra Sharma, Jyotsna Sharma, Engineering Physics (2019), Pearson, Noida, Uttar Pradesh, India.

REFERENCE BOOKS:

1. M. Young (1977), Optics & Lasers An Engineering Physics approach, Springer
2 K.L. Chopra, Thin film Phenomena, McGraw Hill, New York.
3 S. O. Pillai (2018), Solid State Physics, revised edition, New Age International Publishers, New Delhi
4 M N Avadhanulu, P G Kshirsagar, TVS Arun Murthy (2018), A textbook of Engineering Physics, S Chand, New Delhi.

E-Resources:

1. https://nptel.ac.in/courses/106/101/106101060/
2. http://openclassroom.stanford.edu/MainFolder/CoursePage.php?course=IntroToAlgorithms

Activity Based Learning (Suggested Activities in Class)

1. Demonstration of solution to a problem through Project demo model.

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ENGINEERING PHYSICS LAB

Total Contact Hours: 26

Following are experiments to be carried out in Engineering Physics Lab

LABORATORY EXPERIMENTS:

List of Experiments:

1. I-V characteristics of a Zener Diode

I–V Characteristics of a Zener diode in forward and reverse bias condition (Module 2)

2. Planck's constant

Measurement of Planck's constant using LED (Module 2) 3.**Transistor characteristics**

Input and output characteristics of a NPN transistor in C-E configuration (Module2)

4. Dielectric constant

Determination of dielectric constant of a dielectric material (Module 2)

5. Torsional Pendulum

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

6. Diffraction grating

Determination of wavelength of a laser light using diffraction grating (Module 4)

7. LCR series and parallel resonance

Study the frequency response of a series and parallel LCR circuit (Module 3)

8. Band gap energy

Determination of energy gap of an intrinsic semiconductor (Module 2)

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INTRODUCTION TO ELECTRONICS ENGINEERING

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

SEMESTER – I/II

Course Code	:	23EN1111	**Credits**	:	03
Hours /Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P-J	:	3–0–0			

Course Learning Objectives:

This course enables students to

1. **Understand** the fundamental principles of diodes and their applications, including theband diagram of insulators, conductors, and semiconductors, diode construction, and V- characteristics.
2. **Analyze** diode circuits under different biasing conditions and comprehend the behavior o diodes in applications such as AND gates, OR gates, rectifiers, and voltage regulators and simulate the same circuits using LTspice software.
3. **Comprehend** the construction, operation, and characteristics of bipolar junction transistor (BJTs), including input and output characteristics, different biasing techniques, and transisto amplification.
4. **Simulate** common emitter amplifier circuits with voltage divider bias using LTspice software.
5. **Demonstrate** an understanding of operational amplifiers (Op-amps), including their symbol operation modes, properties, and applications such as amplifiers, comparators, and oscillators
6. **Demonstrate** an understanding of digital electronics, including binary number systems Boolean algebra, logic gates, sequential logic circuits, and the application of Flip-Flops.
7. **Simulate** digital circuits and components using LTspice software.
8. **Familiarize** themselves with microprocessors and microcontrollers, specifically Arduinc boards, and understand their architecture and components.
9. Set up the Arduino development environment, write and upload code to the Arduino board and **execute** simple Arduino programs.
10. Interface various sensors and engage in hands-on activities to reinforce understanding including LED blinking and **designing** and **implementing** a complete Arduino-based system as a student project.

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Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain 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. **Adopt Problem Based Learning, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.**
7. **Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.**
8. **Discuss how every concept can be applied to the real world - and when that's possible it helps improve the students' understanding.**

UNIT – I	**09 Hours**

Diodes and its application: Band diagram of insulators, conductors and semiconductors semiconductor types: intrinsic and extrinsic (n-type and p-type); overview of diode construction diode under no-bias, forward bias and reverse bias; V-I characteristics of diode;simplified equivalent circuit of practical diode and ideal diode; overview of diode specifications: peak inverse voltage reverse leakage current and maximum forward current; numerical on series diode configuration with DC input.

Applications: AND gate and OR gate using diodes, half wave rectifier and full-bridge full waverectifier with smoothing capacitor; simulation of rectifier circuits with smoothing circuit using LTspice software; zener diode: zener region and voltage regulator; numerical on rectifier and voltage regulator.

(Textbook 1: Chapter 1: 1.1 to 1.7, 1.9, 1.12, 1.15, Chapter 2: 2.3, 2.5, 2.6, 2.7, 2.11)

UNIT – II	**08 Hours**

Transistors: Construction of npn and pnp BJT transistors; transistor operation; input and output characteristics of CB and CE configurations; significance of different regions of operation: active, cut off and saturation (transistor as a switch); alpha, beta and current relations; transistor amplifying action; numerical on current relations and amplification; Needfor biasing: Q-point; types of biasing fixed, emitter stabilized and voltage divider; simulation of common emitter amplifier with voltage divider bias using LTspice software; numerical on biasing circuits; construction and characteristic of n-channel depletion type MOSFET;

(Textbook 1: Chapter 3: 3.1 to 3.5, Chapter 4: 4.1 to 4.5, Chapter 6.1 and 6.7)

UNIT – III	**08 Hours**

Operational amplifiers: Op-amp symbols, terminals and operation: single mode, differentialmode and common mode; basic properties of ideal and practical Op-amp: input offset voltage, inpu resistance, output resistance, gain, bandwidth, CMRR, slew rate; basic Op-map applications: invertin amplifier, non-inverting amplifier, summing amplifier, differential amplifier, differentiator and integrator; Op-amp comparator; feedback: positive and negativefeedback; criteria for stability and oscillations (Barkhausen criterion); RC phase shift and Weinbridge oscillators; simulation of summin amplifier and oscillators in LTspice software;

(Textbook 1: Chapter 10: 10.1, 10.4 to 10.7, Chapter 14: 14.5 to 14.7)

UNIT – IV	**08 Hours**

Digital Electronics: Binary number system: conversion and representation; logic levels: highand low; Boolean algebra: operators and DeMorgan's law; logic gates with truth-table and

representation: AND, OR, NOT, XOR, NAND, NOR; combination of gates and associated numerical; sequential logic circuits: SR latch using NAND/NOR gate, SR FLIP-FLOP, J-K Flip-Flop, D Flip-Flop; application of Flip-Flops: 4 bit binary counter and 4 stage shift register; simulation of counter using LTspice;

(Textbook 2: Chapter 1: 1.1 to 1.3, Chapter 2: 2.1 to 2.5, Chapter 4: 4.1 to 4.3, Chapter 5.1 to 5.5, Chapter 6.1 to 6.4)

UNIT – V	**06 Hours**

Electronic Prototyping with Arduino: Introduction to microprocessor and microcontroller (Architecture) , introduction to the Arduino board (UNO, R3) and components; setting up theArduin development environment; writing and running a simple Arduino program in *wokwi*environmen introduction to various sensors and actuators compatible with Arduino in *wokwi* environmen student project: Designing and implementing a complete Arduino-basedsystem.

E-Resources: 1 and 2

Course Outcome	**Description**	**Bloom's Taxonomy Level**
At the end of the course the student will be able to:		
1	**Demonstrate** a solid understanding of the fundamental principles underlying electronic components, such as diodes, transistors, operational amplifiers, logic gates, and microcontrollers.	L2
2	Apply knowledge of electronic components to **analyze** circuits for various applications, such as rectification, amplification, filtering, and digital logic operations.	L4
3	**Analyze** the performance of operational amplifiers (Op-amps) i various circuit configurations, including amplifiers, comparator and oscillators, to optimize their functionality and address desig requirements.	L4

4	Demonstrate proficiency in using simulation software (e.g., LTspice) to simulate and **analyze** electronic circuits, validate designs, and troubleshoot circuit performance**.**	L4
5	**Design** and implement electronic systems using Arduino microcontrollers, integrating sensors, actuators, and programming concepts to achieve specific functionalities and solve practical problems.	L6

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
CO1	3	2	1		3							2	3		
CO2	3	3	2	1	3							2	3		
CO3	3	3	2	2	3							2	3	2	
CO4	3	3	2	2	3							2	3	2	
CO5	3	3	3	1	3							3	3	3	

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

TEXT BOOKS:

1. R. L. Boylestad and L. Nashelsky, "Electronic Devices and Circuit Theory", 11th Ed,Pearson Education, 2013.
2. M. Moris. Mano and Michael D. Ciletti, "Digital Electronics", 4th Ed, Pearson Education, 2006.

REFERENCE BOOKS:

1. David A Bell, "Electronic Devices and Circuits", 5th Ed, Oxford university press,2008.
2. Millman & Halkias, "Electronics Devices and Circuits", 2nd Ed, McGraw Hill, 2010.

E-Resources:

1. Arduino- https://docs.arduino.cc/learn/
2. Wokwi- https://wokwi.com/arduino/
3. NPTEL- https://nptel.ac.in/courses/122/106/122106025
4. Virtual Labs- http://vlabs.iitkgp.ac.in/be/

Activity Based Learning (Suggested Activities in Class):

1. Real world problem solving using group discussion and hands-on activities. E.g.,Interfacing different types of sensors using Arduino.
2. Simulation of different electronic circuits. E.g., Rectifiers and Amplifiers.

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OBJECT ORIENTED PROGRAMMING

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

SEMESTER – II

Course Code Code	: 23EN1202	**Credits**	: 04
Hours / Week	: 05 Hours	**Total Hours**	: 26(L) + 13(T) + 26(P) Hours
L–T–P–J	: 2–1–2–0		

Course Learning Objectives:

This Course will enable students to:

1. **Understand** different programming paradigms, significance of object-oriented programming approach and their applications.
2. **Make use of** Python programming environment to develop programs using conditionals, iterations, functions, strings and files to store and retrieve data in system.
3. **Gain** skills to develop python programs using core data structures like Lists, Tuples, Setsand Dictionaries.
4. **Describe** the concepts of object-oriented concept using class, objects, methods.Polymorphism and different levels of inheritance.
5. **Explain** operator overloading, overriding, single and multiple exception handlingcapabilities in python.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain 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. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information ratherthan simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible,ithelps improve the students' understanding.

UNIT – I	**05 Hours**

INTRODUCTION TO OBJECT ORIENTED PROGRAMMING AND PYTHON

Programming paradigms, Object oriented programming features, applications, merits & demerits, Features of Python, variables, Data types, input operation, Reserved words, Indentation, Expressions, String operations, Type conversions.

(Text Book-1: Chapter 2: 2.3,2.4,2.5,2.6 Chapter 3: 3.1,3.6,3.7,3.8,3.10,3.11,3.13,3.14,3.16)

DECISION AND LOOP CONTROL STATEMENTS:
Conditional branch statements, Iterative statements, Nested loops, break, continue, pass, The elsestatement used with loops.
(Text Book-1: Chapter 4: 4.1-4.8)

UNIT – II	5 Hours

FUNCTIONS AND MODULES:
Need for functions, Function definition, Function call, Scope, Return statement, Lambdafunctions,Recursive functions, Modules.
(Chapter 5: 5.1 to 5.11)

PYTHON STRINGS:
String operations, Immutable, string formatting operator, built-in string methods, string slices,membership operator, comparing strings, Iterating strings.
(Chapter 6: 6.1 to 6.9)

UNIT – III	6 Hours

DATA STRUCTURES IN PYTHON:
Sequence, List, Tuple, sets, dictionaries
(Chapter 8: 8.1, 8.2, 8.4 to 8.6)

FILE HANDLING METHODS:
File path, File types, File operations, File positions, Rename and delete files.
(Chapter 7: 7.1 to 7.7)

UNIT – IV	5 Hours

USER DEFINED CLASSES & OBJECTS:
Classes, Objects, class method and self Argument, constructor, destructor, class variables, publicand private data members, private methods, Calling methods, static methods.
(Chapter 9: 9.1 to 9.10, 9.15)

INHERITANCE:
Introduction, Polymorphism, overriding, types of inheritance
(Text Book: Chapter 10: 10.1 to 10.6)

UNIT – V	5 Hours

OPERATOR OVERLOADING:
Introduction, Implementation of operator overloading, Reverse addition, overriding methods andfunctions.
(Text Book: Chapter 11: 11.1 to 11 .7)

ERROR AND EXCEPTION HANDLING:
Errors, Handling exceptions, Multiple except blocks, Multiple exceptions, Except block without exception, The else clause, Raising exceptions, Built-in and user defined exceptions, Finally block, clean-up action
(Text Book: Chapter 12: 12.1 to 12.7, 12.10 to 12.12)

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Course Outcomes:

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

1. **Write** a python program using 4 conditionals, definite loop, indefinite loop withjump statements.
2. **Write** an application using lambda, recursive functions, strings and files tostore andretrieve the data from the system.
3. **Write python** programs using Core data structures like Lists, Tuples, Sets and Dictionaries.
4. **Implement** the concepts of object-oriented concept using class, objects, methods. Polymorphism and different levels of inheritance.
5. **Implement** operator overloading, overriding, single and multiple exception handlingprogram capability in python

Table: Mapping Levels of COs to POs /PSOs

COs	Program Outcomes(POs)												PSOs	
				4	5	6	7	8	9	10	11	12	1	2
CO1					2					1				
CO2					2					1		2	1	
CO3					2					1		2	1	
CO4					2					1		2	1	
CO5	3				2					1		2	1	

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

TEXT BOOKS:

1. Reema Thareja, "Python programming: Using problem solving approach", 2ndEdition,Oxford university press, 2019.

REFERENCE BOOKS:

1. John V Guttag, "Introduction to Computation and Programming Using Python",The MITpress, 3rd edition, 2021.
2. Tony Gaddis, "Starting out with python", 4th edition, Pearson, 2019.
3. Allen Downey, Jeffrey Elkner and Chris Meyers, "How to think like a ComputerScientist, Learning with Python", Green Tea Press, 2014.
4. Richard L. Halterman, "Learning to Program with Python", 2011.
5. Charles Dierbach, "Computer Science Using Python: A Computational Problem-Solving Focus", John Wiley, 2012.

Activity Based Learning (Suggested Activities in Class)

1. Real world problem solving and puzzles using group discussion.
2. Demonstration of solution to a problem through programming.

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OBJECT ORIENTED PROGRAMMINGLABORATORY

Total 26Hours

List of Programming Experiments:

1. Python Program for Data Handling and Expression Evaluation.
2. Python Program for Quadratic Equation Roots and Number Analysis.
3. Python Program for Function Illustration and Module Creation.
4. Python Program for String Operations and Data Validation.
5. Python Program for File Handling and Script Copying.
6. Python Program for Data Structures and Built-in Methods.
7. Python Program for Object-Oriented Concepts and Inheritance.
8. Python Program for Operator Overloading and Special Methods.

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ENGINEERING GRAPHICS & DESIGN THINKING

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

SEMESTER – I/II

Course Code	:	23EN1113	**Credits**	:	03
Hours / Week	:	04 Hours	**Total Hours**	:	26+26 Hours
L–T–P–J	:	2–0–2–0			

Course Learning Objectives:

This Course will enable students to:

1. **Create** awareness and emphasize the need for Engineering Graphics & design thinking through Manual Sketching & Autocad Software
2. **Learn** using professional CAD software for construction of geometry
3. **Understand** the concepts of orthographic and isometric projections
4. **Draw** orthographic projection of points, lines, planes and solids by Manual Sketching & AutoCad Software
5. **Draw** development of surfaces of solids
6. **Draw** isometric projections of planes and solids
7. **Create** simple engineering 3D components
8. **Work** in a team for creating conceptual design of products
9. **Learn** application of design methods and tools on real world problem through Autocad Software & Physical Models

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainmentof the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *typeof teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating,and roleplaying.
3. Show ***Video/animation*** films to explain 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. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information ratherthan simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to comeup with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible,it helps improve the students' understanding.

MANUAL & COMPUTER SKETCHING

UNIT – I Introduction	**06 Hours**

Introduction to Engineering Graphics: Fundamentals, Drawing standard - BIS,

dimensioning, Lines, lettering, scaling, symbols, dimensioning & tolerances, conventions, Introduction to orthographic projection. Types of projections & their principles - (For CIA only) (For CIA only)
(Text Book-1: Chapter 3 & 8)

Introduction to Computer Aided Drafting software- Co-ordinate system and reference planes HP, VP, RPP & LPP of 2D/3D. Selection of drawing sheet size and scale. Commands and creation of Lines, coordinate points, axes, polylines, square, rectangle, polygons, splines, circles, ellipse, text, move, copy, off-set, coloring, mirror, rotate, trim, extend, break, chamfer, fillet and curves - (For CIA only)
(Text Book-2: Chapter 23 &24; Text Book-1: Chapter 26)

UNIT – II Projections of Points, Lines and Planes	**12 Hours**

Projection of Points - Orthographic projections of points in all the quadrants,
Orthographic projections of lines- inclined to both the principal planes - Determination oftrue lengths and true inclinations by rotating line method.
Orthographic projections of planes -triangle, square, rectangle, pentagon, hexagon andcircular laminae.
(First Angle Projection only) (Text Book-1: Chapter 9,10,12)

UNIT – III Projection of Solids & Development of Surfaces	**14 Hours**

Projection of regular solids like prisms, pyramids, cylinder & cone inclined to both the planes (change of position method)
(First Angle Projection only)(Text Book-1: Chapter 13)

Development of lateral surfaces of regular solids – Prisms, pyramids cylinders and cones***.(Text Book-2: Chapter 16)***

UNIT – IV Isometric Projections	**14 Hours**

Isometric projection - Principles of Isometric Projection, Isometric Scale, Isometric View, Isometric projection of combination of two solids
(Text Book-1: Chapter 17)

Transformation of Projections- Conversion of Isometric Views to Orthographic Views & Conversion of orthographic views to isometric projections.
(Text Book-1: Chapter 20; Text book- 2: Chapter 21)

UNIT – V Introduction to Design Thinking for Innovations	**10 Hours**

A brief history of Design, Engineering Design process, Product development cycle, creation of models and their presentation in standard 3D view. Theory, Practice & Examples in Design thinking, Storytelling, Creativity and Idea Generation, Concept Development, Testing and Prototyping.
(For CIA only)
(Text Book-3: Part 1- Chapter 1&2, Part3-Chapter 10)

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Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Make use of** instruments, dimensioning & tolerance principles, conventions and standards related engineering drawing	L1
2	**Construct** orthographic projections of points, lines, planes and solids	L3
3	**Develop** lateral surfaces of solids and **construct** isometric projections of solids	L3
4	**Apply** the design thinking principles for innovative product development	L3
5	**Make use of** AutoCad for modelling engineering components	L3

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
CO1	2	1	0	0	0	0	0	0	0	0	0	0	3	0	2
CO2	2	1	0	0	0	0	0	0	0	0	0	0	3	0	2
CO3	2	1	0	0	0	0	0	0	0	0	0	0	3	0	2
CO4	2	1	0	0	0	0	0	0	0	0	0	0	3	0	2
CO5	3	1	0	0	0	0	0	0	0	0	0	0	3	0	2

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

TEXT BOOKS:

1. Engineering Drawing, Bhatt N.D., 54th Edition, Charotar Publishing House, Gujarat,India, 2023
2. Engineering Drawing & Graphics+Autocad, K Venugopal, Fifth Edition, New Age International Publishers, 2011.
3. Engineering Design- A Project Based Introduction, C. L. Dym and Patrick Little, JohnWiley & Sons, 2022

REFERENCE BOOKS:

1. A Textbook of Computer Aided Engineering Drawing, Gopalakrishna, K. R. and Sudheer Gopala Krishna, Subash Publishers, Bangalore, India, 2017
2. Engineering Drawing with Introduction to AutoCAD, Dhananjay .A .J, Tata McGraw-Hill Publishing Company Ltd, 2018
3. Product Design and Development, Karl T Ulrich, Steven D Eppinger, Seventh Edition,McGraw-Hill Education, 2020

E-Resources:

1. https://archive.nptel.ac.in/courses/112/102/112102304/
2. https://nptel.ac.in/courses/112103019

https://nptel.ac.in/courses/112/105/112105294/

4. https://fractory.com/engineering-drawing-basics/

Activity Based Learning (Suggested Activities in Class)

1. Activity which makes students to apply the concepts learned in the course to thepractical engineering graphics will be discussed in class.
2. Activity provides space to students giving responsibility for their own design &engineering drawing methods for the products
3. Activity that makes the students for the development of skill set in computer drafting
4. Activity that makes the students to have critical thinking, developing a mind set,problem-solving and teamwork in design thinking process.
5. Real world problem solving and puzzles using group discussion.
6. Demonstration of solution to a problem through experiential learning.

ENGINEERING GRAPHICS & DESIGN THINKINGLABORATORY

Total Contact Hours: 26

Following are practical/laboratory experiments to be carried out:

1. Problems to be solved in first quadrant system.
2. Manual & Computer Sketching problems for all the modules in sketch book and alsotake print out of the problems.
3. Usage of various commands in AutoCad software and few simple exercises on theabove commands
4. Practice Problems on Projections of Points, Lines and Planes using Manual Sketching& AutoCad Software
5. Solve Problems on Projection of Solids & Development of Surfaces
6. Practice problems on Isometric Projections
7. Individual/Group work on Introduction to Design Thinking for Innovations (Examples on Solid Modeling - Using 3D Modelling Software & PhysicalModel Prototype).

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BIOLOGY FOR ENGINEERS

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

SEMESTER – I/II

Course Code	:	23EN1114	**Credits**	:	02
Hours / Week	:	02 Hours	**Total Hours**	:	26 Hours
L–T–P–J	:	2–0–0–0			

Course Learning Objectives:

This Course will enable students to:

1. Acquire an understanding on basic modern biological concepts with an emphasis on how bio-processes are analogous to engineering field, as a multidisciplinary field.
2. Understand basic engineering principles imminently run physiological processe particularly about engineering designs and solutions are arrived citing body functiona examples.
3. Explain aspects that many bio-solutions could be foundational to design, develop better processes, products and useful to achieve quality of life.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainmento the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *typec teaching methods* like power point presentations and group discussion may be adoptedtc develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain 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 students' understanding.

COURSE CONTENT:

UNIT 1 : Biomimetics	**5 Hrs**
Biology for Engineers, Body Fluid: Blood- Mechanics of heart, Blood pressure, Life molecules: Water, Carbohydrates, Proteins, Lipids and Nucleic acids, Biomimetics: Bio-processes - engineering analogies	
UNIT 2 : Bioenergy	**5 Hrs**
Unit of life: Human and Plant cell, Metabolism: Enzymes as Bio-catalysts and physiological entities, Anabolism- Bioenergy from Sun-Photosynthesis, catabolism	

UNIT 3 : Biomechanics (Human Body Movement Mechanics)	5 Hrs
Normal Human Movement: Force-Vector of Body; Movement Angles; Muscle contraction - Relaxation; Posture – Static & Dynamic; Ideal and abnormal posture, Practical: Stepping-Lifting-Sit-Stand.	
UNIT 4 : Bioelectronics	**6 Hrs**
Brain & Computer: Senso-neural networks, Biosensors and IoT as applied to biology, Bionic Eye: Mechanism of Vision, Electronic Nose: Bio-olfactory mechanisms (Science of smell), Impulses: Cardiac and Nerve, Biological Clock and Circadian rhythm	
UNIT 5 : Biopharma	**5 Hrs**
Metabolic syndromes, Cancer and its diagnostics, Lab on a chip, Drug Discovery	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Apply and Utilize** essential knowledge of the biological mechanisms of living organisms from the perspective of engineers and find solutions to solve bio-engineering problems with appropriate tools.	L3
2	**Distinguish and make use of** optimal designs in engineering that are bio-mechanical in nature and build and use by observing and understanding bio-physiological processes involved in sensing, locomotion, and knowledge application of range of bio-chemicals.	L3
3	**Demonstrate** that bio-chemical, bio-sensory, bio-processes could be path-finders to optimise similarities for functional aspects of electronic, computer, mechanical, electrical machines.	L3

Activity Based Learning (Suggested Activities in Class)

1. Real world problem solving and puzzles using group discussion.
2. Demonstration of solution to a problem through experiential learning.
3. Demonstrations using real objects, taking students on an educational tour.

REFERENCES:

- Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M,L.; Wasserman, S. A.; Minorsky, P. V.;Jackson, R. B. Pearson. "Biology: A global approach", , Global Edition, 10/E, 2014
- David Nelson, Michael Cox. "Lehninger Principles of Biochemistry". W H Freeman &Company, Seventh Edition, 2017.
- Janine M Benvus. "Biomimicry: Innovation inspired by Nature". William MorrowPaperbacks, 2002.
- Lecture Notes, PPT slides by course instructor.

DAYANANDA SAGAR UNIVERSITY

SCHOOL OF ENGINEERING

Devarakaggalahalli, Harohalli, Bengaluru – 562 112

CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS

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

SEMESTER – I/II

Course Code	: 23EN1115	**Credits**	: 01
Hours / Week	: 01 Hours	**Total Hours**	: 13 Hours
L–T–P–J	: 1–0–0–0		

Course Learning Objectives:

This Course will enable students to:

1. Acquaint the students with legacies of constitutional development in India and help thoseto understand the most diversified legal document of India and philosophy behind it.
2. Make students aware of the theoretical and functional aspects of the Indian Parliamentary System.
3. Channelize students' thinking towards basic understanding of the legal concepts and its implications for engineers.
4. Acquaint students with latest legislation and Laws with related regulatory framework.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainmento the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *typec teaching methods* like power point presentations and group discussion may be adoptedtc develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing group work, focused listening, formulating questions, notetaking, annotating, anc roleplaying.
3. Show ***Video/animation*** films to explain 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 students' understanding.

COURSE CONTENT

UNIT 1 : Introduction and Basic Information about Indian Constitution	**6 Hrs**

Meaning of the constitution law and constitutionalism, Historical Background of the Constituen Assembly, Government of India Act of 1935 and Indian Independence Act of 1947, Enforcement o the Constitution, Indian Constitution and its Salient Features, The Sources of Indian Constitution The Preamble of the Constitution, Fundamental Rights, Fundamental Duties, Directive Principles o State Policy, Parliamentary System, Federal System, Centre-State Relations, Amendment of th Constitutional Powers and Procedure, The historical perspectives of the constitutional amendments in India, Emergency Provisions: National Emergency, President Rule, Financial Emergency, and Local Self Government – Constitutional Scheme in India

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UNIT 2 : Union Executive and State Executive	7 Hrs
Powers of Indian Parliament Functions of Rajya Sabha, Functions of Lok Sabha, Powers andFunctions of the President, Powers and Functions of the Prime Minister, Judiciary – The Independence of the Supreme Court, Appointment of Judges, Judicial Review, Public Interest Litigation, Judicial Activism, LokPal, Lok Ayukta, The Lokpal and Lok ayuktas Act 2013, State Executives – Powers and Functions of the Governor, Powers and Functions of the Chief Minister, Functions of State Cabinet, Functions of State Legislature, Functions of High Court and Subordinate Court	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Identify and explore the basic features and modalities about Indian constitution.	L1
2	Differentiate and relate the functioning of Indian parliamentary system at the Centre and State level.	L2
3	Differentiate different aspects of Indian Legal System and its related bodies.	L2
4	Discover and apply different laws and regulations related to engineering practices.	L1
5	Correlate role of engineers with different organizations and governance models	L1

TEXT BOOKS:

1. The Indian Constitution, Madhav Khosla, Oxford University Press.
2. The Constitution of India, PM Bakshi. Latest Edition, Universal Law Publishing.

REFERENCE BOOKS:

1. The Indian Constitution: Cornerstone of a Nation (Classic Reissue), Granville Austin:,Oxford University Press.
2. Our Constitution: An Introduction to India's Constitution and Constitutional Law,
   Subhash C. Kashyap, NBT, 2018.
3. Introduction to the Indian Constitution, Brij Kishore Sharma, 8th Edition, PHI Learning Pvt. Ltd.

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SCHOOL OF ENGINEERING

Devarakaggalahalli, Harohalli, Bengaluru – 562 112

TRANSFORMS AND NUMERIAL TECHNIQUES

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

SEMESTER – III

Course Code	:	23CY2301	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–J	:	3–0–0–0			

Course Learning Objectives:

This Course will enable students to:

1. Apply their knowledge of Laplace transforms and inverse Laplace transforms to proficiently solve linear ordinary differential equations with constant coefficients, facilitating the analysis and modelling of complex systems.
2. Analyze periodic functions using Fourier series, assessing the convergence properties and precision of the series expansion, thereby enhancing their ability to understand and manipulate periodic phenomena.
3. Utilize complex exponential form, Fourier transforms of basic functions, and Fourier sine and cosine transforms to solve problems involving Fourier integrals, developing proficiency in applying these techniques to various mathematical scenarios.
4. Employ numerical methods, including Euler's Method, Runge-Kutta 4th order, Adams-Bashforth, and Adams-Moulton Methods, to solve differential equations and effectively analyze dynamic systems, enabling them to model real-world phenomena and make accurate predictions.
5. Apply finite difference methods, including the Crank-Nicolson method and appropriate techniques for hyperbolic PDEs, to effectively solve different types of partial differential equations (PDEs) such as elliptic, parabolic, and hyperbolic equations, enhancing their problem-solving skills in the context of differential equations and their applications.

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Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different
2. *type of teaching methods* may be adopted to develop the course outcomes.
3. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
4. Show ***Video/animation*** films to explain functioning of various concepts.
5. Encourage ***Collaborative*** (Group Learning) Learning in the class.
6. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
7. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
8. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I: Laplace Transform and Inverse Laplace Transform	**09 Hours**
Laplace Transforms of Elementary functions (without proof), ***(Text Book-1: Chapter 6: 203 to 207).*** Laplace Transforms of $e^{at}f(t)$, $t^n f(t)$ and $\frac{f(t)}{t}$, Periodic functions, Unit step function and impulse functions ***(Text Book-1: Chapter 6:208-230)***. Inverse Laplace Transforms- By the method of Partial Fractions, Logarithmic and Trigonometric functions, Convolution Theorem, Inverse Laplace transform using Convolution Theorem ***(Text Book-1: Chapter 6: 238)***. Solution to Differential Equations by Laplace Transform. ***(Text Book-1: Chapter 238-242)***.	
UNIT – II: Fourier Series	**09 Hours**
Periodic Functions, Trigonometric Series ***(Text Book-1: Chapter 11: 495).*** Fourier series Standard function, Functions of any Period 2L, Even and Odd functions, Half- range Expansions. ***(Text Book-1: Chapter 11: 483-492)*** Practical Harmonic analysis (calculate average power and RMS values of periodic waveforms)	
UNIT – III: Fourier Transform	**06 Hours**
Calculation of Fourier integrals using complex exponential form ***(Text Book-1: Chapter 11: 510).*** Fourier transform of basic functions ***(Text Book-1: Chapter 11: 510-516).*** Fourier sine and cosine transforms. ***(Text Book-1: Chapter 11: 518-522).***	
UNIT – IV: Numerical Methods for Solving Ordinary Differential Equations	**07 Hours**

Euler's Method-Basic principles of Euler's method for solving first-order ODEs ***(Text Book-1: Chapter 1:10-12).*** Runge-Kutta 4th order ***(Text Book-1: Chapter 21:904).*** Multistep Methods-Explanation of multistep methods (Adams-Bashforth, Adams–Moulton Methods) ***(Text Book-1: Chapter 21:911-913).*** Second-Order ODE. Mass–Spring System (Euler Method, Runge–Kutta Methods) ***(Text Book-1: Chapter 21:916-918).***
UNIT – V: Numerical Methods for Partial Differential Equations **08 Hours**
Classification of PDEs (elliptic, parabolic, hyperbolic), ***(Text Book-1: Chapter 21:922-923).*** Finite Difference Methods (Laplace and Poisson Equations), Derivation of finite difference approximations ***(Text Book-1: Chapter 21:923-927).*** Crank–Nicolson Method ***(Text Book-1: Chapter 21:938-941).*** Method for Hyperbolic PDEs ***(Text Book-1: Chapter 21:943-945).***

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Apply** Laplace transforms and inverse Laplace transforms to solve linear ordinary differential equations with constant coefficients, demonstrating proficiency in system analysis and modelling.	L3
2	**Analyze** periodic functions using Fourier series and evaluate the convergence properties and precision of the series expansion.	L2 & L3
3	**Solve** problems involving Fourier integrals by applying complex exponential form, Fourier transforms of basic functions, and Fourier sine and cosine transforms.	L3
4	**Utilize** numerical methods such as Euler's Method, Runge- Kutta 4th order, Adams-Bashforth, and Adams-Moulton Methods to solve differential equations and analyze dynamic systems	L2 & L3
5	**Apply** finite difference methods, including the Crank-Nicolson method and appropriate techniques for hyperbolic PDEs, to solve various types of partial differential equations (PDEs) such as elliptic, parabolic, and hyperbolic equations.	L3

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**
CO1	3	2	2	1					1					
CO2	3	2	2						1					
CO3	3	2	2	1					1					
CO4	3	2	2	1					1					
CO5	3	2	2	1					1					

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

TEXT BOOKS:

1. 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.

E-Resources:

1. https://nptel.ac.in/courses/111106139
2. https://nptel.ac.in/courses/111101164
3. https://nptel.ac.in/courses/111105038

DAYANANDA SAGAR UNIVERSITY

SCHOOL OF ENGINEERING

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DATA STRUCTURES

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

SEMESTER – III

Course Code	:	23CY2302	**Credits**	:	04
Hours / Week	:	03 Hours	**Total Hours**	:	39(Th)+26(P) Hours
L–T–P-J	:	3–0–2-0			

Prerequisites:

Proficiency in a C programming language.

Course Objectives:

This Course will enable students to:

1. **Understand** the basic approaches for analyzing and designing data structures.
2. **Introduce** dynamic memory allocation and C language concepts required for building data structures.
3. **Develop** essential skills to construct data structures to store and retrieve data quickly and **efficiently**.
4. **Utilize** different data structures that support different sets of operations which are suitable for various applications.
5. **Explore & implement** how to insert, delete, search, and modify data in any data structure- Stack, Queues, Lists, Trees.
6. **Develop** applications using the available data structure as part of the course for mini project.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture methods, but different *types of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note taking, annotating, and roleplaying.
3. Show ***Video/Animation*** films to explain 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. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I	08 Hours
IINTRODUCTION: Introduction to Data Structure, Classification, C Structure and Union, C Pointers, Array Definition, Representation, Operations (Insertion, Deletion, Search and Traversal), Two/Multidimensional Arrays, Sparse matrix. TB1: 1.1, 2.2, 2.5 ; TB2: 1.1, 1.2,1.3.1-1.3.4; RB1: 5.1 – 5.12, 6.4	
UNIT – II	**08 Hours**
INTRODUCTION TO ADT: **Stack:** Definition, Array Representation of Stack, Operations on Stacks. **Applications of Stack:** Expression evaluation, Conversion of Infix to Postfix, Infix to Prefix Recursion, Tower of Hanoi **Queue:** Definition, Representation of Queues, Operations of Queues, Circular Queue. **Applications of Queue:** Job Scheduling, A Maze Problem TB1: 3.1,3.2, 3.3,3.4,3.5 ; TB2: 2.1, 2.2, 2.3, 3.2, 3.3	
UNIT – III	**08 Hours**
DYNAMIC DATA STRUCTURES: **Linked List:** Types, Representation of Linked Lists in Memory. Traversing, Searching, Insertion & Deletion from Linked List. Circular List, Doubly Linked List, Operations on Doubly Linked List (Insertion, Deletion, Traversal). **Applications:** Stack & Queue Implementation using Linked Lists. **Case Study**: Josephus problem. TB2: 4.2,4.3,4.5	
UNIT – IV	**08 Hours**
TREES: Basic Terminology, Binary Trees and their representation, Complete Binary Trees, Binary Search Trees, Threaded Binary Trees, Operations on Binary Trees (Insertion, Deletion, Search & Traversal). **Applications:** Expression Evaluation **Case Study:** Game Tree TB2: 5.5.3,5.5.4,5.6	
UNIT – V	**07 Hours**
Efficient Binary Search Trees: Optimal Binary Search Trees, AVL Trees, Red Black Trees, Splay Trees. **Case Study**: B Trees TB1: 10.1,10.2,10.3,10.4, 11.2	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Apply the concepts of pointers, arrays, structures, and unions to address real-world problems and implement the concept in C programming language.	L3
2	Utilize stacks and queue data structures to solve problems such as infix to postfix, infix to prefix conversions, the Towers of Hanoi puzzle, job scheduling	L3

	and maze navigation.	
3	Implement and manipulate singly linked lists, doubly linked lists, and circular linked lists, executing operations such as insertion, deletion, and traversal.	L3
4	Understand the concepts of binary trees, binary search trees, and threaded binary trees, and their associated operations.	L2
5	Understand advanced binary tree structures includes optimal binary search trees, AVL trees, Red-Black trees, and Splay trees.	L2

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
CO1	1	2	3	-	3	-	-	-	-	-	-	-	2	2
CO2	1	2	3	-	3	-	-	-	-	-	-	-	2	2
CO3	1	2	3	-	3	-	-	-	-	-	-	-	2	2
CO4	-	1	2	-	3	-	-	-	-	-	-	-	2	2
CO5	-	1	2	-	-	-	-	-	-	-	-	-	2	2

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

TEXT BOOKS (TB):

1. Ellis Horowitz, Susan Anderson-Freed, and Sartaj Sahni, "Fundamentals of Data structures in C", 2nd Edition, Orient Longman, 2008.
2. A.M. Tannenbaum, Y Langsam, M J Augentien "Data Structures using C", 1st Edition, Pearson, 2019.

REFERENCE BOOKS:

1. Brian. W. Kernighan, Dennis. M. Ritchie, "The C Programming Language", 2nd Edition, Prentice-Hall, 1988.
2. Gilbert & Forouzan, "Data Structures: A Pseudo-code approach with C", 2nd Edition, Cengage Learning,2014.
3. Jean-Paul Tremblay & Paul G. Sorenson, "An Introduction to Data Structures with Applications", 2nd Edition, McGraw Hill, 2013.
4. R.L. Kruse, B.P. Learly, C.L. Tondo, "Data Structure and Program design in C", 5th Edition, PHI ,2009.

E-Resources:

1. https://nptel.ac.in/courses/106102064
2. https://www.coursera.org/learn/data-structures?specialization=data-structures-algorithms
3. https://www.udemy.com/topic/data-structures/free/
4. https://www.mygreatlearning.com/academy/learn-for-free/courses/data-structures
5. https://cse01-iiith.vlabs.ac.in/

6. https://kremlin.cc/k&r.pdf

Activity Based Learning (Suggested Activities in Class)

1. Real world problem solving using group discussion.
2. Role play E.g., Stack, Queue, etc.,
3. Demonstration of solution to a problem through programming.
4. Flip class activity E.g., arrays, pointers, dynamic memory allocation, etc.,

DATA STRUCTURES LABORATORY

Total Contact Hours: 26

Following are experiments to be carried out using either C programming language.

1. To Implement C programs to perform array operations.
2. To determine the validity of a 9x9 Sudoku board (application of 2-dimensional array).
3. To store, retrieve and update the elements in structures (structures and pointers to structures).
4. To implement stack using linked list.
5. To implement a queue data structure using a singly linked list.
6. To implement a singly linked list and its operations.
7. To implement a doubly linked list and its operations.
8. To create a circular queue using a circular linked list data structure
9. To implement binary tree traversal techniques.

OPEN-ENDED EXPERIMENTS

1. Design a web browser history tracker in C. Implement a stack data structure to keep track of visited URLs. Create functions to push new URLs onto the stack as users visit websites and pop URLs when users navigate backward in their browsing history.
2. Imagine you are responsible for designing a queue-based system to manage the queue of regular customers waiting to purchase cinema tickets at a popular movie theatre. Your system should ensure fair and efficient ticket sales for all customers. When a customer's arrive at the cinema, they join the queue. Each customer is represented by his name, age (for record-keeping), and number of tickets needed. When a customer reaches the front of the queue, they are served by the ticketing agent. Implement a ticket sale process where the agent provides the customer with the requested ticket(s). Initialize the total number of tickets and if the tickets are sold, then the ticketing agent should display a houseful message.

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DIGITAL LOGIC DESIGN

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

SEMESTER – III

Subject Code	:	23CY2303	**Credits**	:	04
Hours / Week	:	03 Hours	**Total Hours**	:	39(T)+26(P) Hours
L–T–P–J	:	3–0–2–0			

Course Learning Objectives:

This Course will enable students to:

1. Translate the elements of digital logic functions to digital system abstractions using Verilog.
2. Illustrate simplification of Boolean expressions using Karnaugh
3. Model combinational logic circuits for arithmetic operations and logical operations
4. Analyze and model sequential elements flip-flops, counter, shift registers.
5. Outline the concept of Mealy Model, More Model and apply FSM to solve a given design problem

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain 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 students' understanding.

UNIT – I	**08 Hours**

INTRODUCTION:

Number System- Binary, Hexa, Decimal, Octal and its conversion. Canonical Notation - SOP & POS forms, Minimization of SOP and POS forms.

ARITHMETIC CIRCUITS AND VERILOG MODELLING

Adders: Half adder, full adder, Ripple carry adder, parallel adder /subtractor, fast adders-CLA, comparator- 2 bit. Simplification using K-Maps

Introduction to Verilog, Syntax of Verilog coding, Modelling styles in Verilog, Verilog Operators, Test bench for simulation

Text Book-1: Chapter 1: 1.2 to 1.4, Chapter 2: 2.6

Text Book-2: Chapter 5: 5.2, 5.3.3, 5.4,5.5.2, 5.5.3

Text Book-3: Chapter 1: 1.1, 1.2.2, 1.3.1, 1.3.2, 1.3.3, 1.4.2, 1.5.1.2, 1.5.2.2, 1.5.3.2, 1.5.4.2, 1.6.2

UNIT – II	**07 Hours**

Combinational Circuit Building Multiplexers 4:1, 8:1, decoders 3:8, 2:4, demultiplexers 1:4, encoders 8:3, 4:2, code converters- B to G and G to B- Simplification using K-Maps

Verilog for combinational circuits, if else, case-casex, casez, for loop, generate.

Text Book-2: Chapter 6: 6.1, 6.2, 6.3, 6.4, 6.6

UNIT – III	08 Hours
Sequential Circuits-1 Basic Latch, Gated latches, Flip Flops SR, D, JK, T, master-slave flip-flops JK, Characteristic equations, 0's and 1's Catching Problem, Race round condition, Switch debounce, shift registers- SISO, SIPO, PISO, PIPO, Setup time, Hold time, Propagation Delay **Text Book-2: Chapter 7: 7.1, 7.2,7.3, 7.4,7.5,7.6, 7.8**	
UNIT – IV	**8 Hours**
Sequential Circuits-2 Binary counters – asynchronous and synchronous, mod-n counter, ripple counter- 4 bit. Verilog blocking and non-blocking, Mealy Model, Moore Model, State machine notation, Construction of Finite State Machine. **Text Book-2: Chapter 7: 7.9, 7.11, 7.12.3, 7.12.4, 8.1, 8.2, 8.3, 8.4**	
UNIT – V	**8 Hours**
Introduction to Electronic Design Automation: FPGA Design Flow, ASIC Design flow, architectural design, logic design, simulation, verification and testing, 3000 Series FPGA architecture. **Applications:** Design 4 Bit ALU, 7 Segment display, Vending Machine, 3 Pipeline. **Text Book-4: Chapter 1**	

Laboratory Experiments
Experiments are conducted using Verilog tool /Kits
1. Introduction to Xilinx tool, FPGA flow
2. Adder – HA, FA using data flow and behavior modelling styles
3. Adder – HA, FA using structural modelling style
4. Combinational designs – I (blocking and non-blocking/looping examples) a. Multiplexer: 4:1, 8:1 MUX. b. De Multiplexer: 1:4, 1:8 DEMUX.
5. Combinational designs – II (different types of case statements) c. Encoder with and without Priority: 8:3 and 4:2. c. Decoder: 3:8 and 2:4.
6. Design of 4-bit ALU
7. Flip Flop: D FF, T FF, JK FF
8. Design of Mod – n Up/Down Counter with Synchronous reset
9. Design of Mod – n Up/Down Counter with Asynchronous reset.
10. Design of Universal shift Register using FSM

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Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Interpret Boolean Expressions of digital design in simplified form	L2
2	Build the various elements of digital logic system with Verilog	L3
3	Construct Combinational and Sequential logic circuits	L3
4	Apply the hardware model of a digital system at different levels of abstraction in Verilog	L3
5	Apply the functionality of digital design by implementing on FPGA kits	L4
6	Build digital systems using FSM	L3

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
CO1	3		1										2	
CO2	3	1	1		1								2	
CO3	3	1	3										2	
CO4	3	1	2		1							1	2	
CO5	3	2	2		1								2	
CO6	3	2	2										2	

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

TEXT BOOKS:

1. M. Morris Mano Michael D. Ciletti , "Digital Design with an Introduction to the Verilog HDL", 6th Edition, Pearson Education, 2014.
2. Stephen Brown, Zvonko Vranesic, "Fundamentals of Digital Logic with Verilog design", McGraw Hill, 2014.
3. Nazein M. Botros, "HDL programming (VHDL and Verilog)", Dreamtech Press, 2006.
4. Douglas J Smith, "HDL Chip Design", Doone publications 1996.

REFERENCE BOOKS:

1. John M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2014.
2. Donald D. Givone, "Digital Principles and Design", McGraw Hill, 2015.
3. Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", Pearson Education, 2016.

E-Resources:

1. https://archive.nptel.ac.in/courses/106/105/106105165/
2. https://nptel.ac.in/courses/117105080

Activity Based Learning (Suggested Activities in Class)

1. Design problem solving and Programming using group discussion. E.g., Traffic light controller, Digital Clock, Elevator.
2. Demonstration of solution to a problem through simulation.

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DISCRETE MATHEMATICS AND GRAPH THEORY

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

SEMESTER – III

Subject Code	: 23CY2304	**Credits**	:	03
Hours / Week	: 03 Hours	**Total Hours**	:	39 Hours
L–T–P–J	: 3–0–0–0			

Course Learning Objectives:

This Course will enable students to:

1. **Learn** the set theoretic concept and its application in theory of computation.
2. **Determine** the concepts of mathematical induction, recursive relations and their application.
3. **Illustrate** the association of functions, relations, partial ordered set and lattices with problems related to theoretical computer science and network models.
4. **Discuss** the basics of graph theory and its application in computer networks. Learn the concepts of counting techniques and its application.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. **Lecture method** means it includes not only traditional lecture method, but different type of teaching methods may be adopted to develop the course outcomes.
2. **Interactive Teaching:** Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show **Video/animation** films to explain 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. Adopt **Problem Based Learning**, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the **different ways to solve** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every **concept can be applied to the real world** - and when that possible, it helps improve the students' understanding.

UNIT – I	**08 Hours**

SET THEORY: Sets and subsets, Operations on Sets: Basic set operations, algebraic properties of sets, The Addition Principle

RELATIONS AND ITS PROPERTIES: Relations and their properties, N-Ary Relations and their applications, Representing relations.

Textbook – 2: 1.1, 1.2 ; Textbook – 1: 7.1., 7.2, 7.3

UNIT – II	**06 Hours**

RELATIONS AND ORDER RELATIONS: Closure of relations, Equivalence Relations, Partial Orderings, Functions, The Growth of Functions.

Self-Study: Transitive Closure and Warshall's Algorithm.

Textbook – 1: 7.4., 7.5, 7.6, 3.2

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UNIT – III	08 Hours
MATHEMATICAL INDUCTION AND RECURSION: Mathematical Induction, Recurrence Relations: Rabbits and the Fibonacci Numbers, The Tower of Hanoi, Code word Enumeration, Solving Linear Recurrence Relations **Self-Study:** Basic Connectives and Truth Tables ***Textbook-1: 4.1;6.1, 6.2;1.1***	
UNIT – IV	**09 Hours**
GRAPH THEORY: Graphs and Graph Models. Graph Terminology and Special Types of Graphs: Basic Terminology, Some Special Simple Graphs, Bipartite Graphs, Complete Bipartite Graphs. Representing Graphs and graph isomorphism: Adjacency lists, Adjacency Matrices, Incidence Matrices, Connectivity: Paths, Connectedness in Undirected and Directed Graphs, Vertex and Edge connectivity and their applications. ***Textbook-1: 8.1, 8.2, 8.3, 8.4***	
UNIT – V	**08 Hours**
GRAPHS AND ITS APPLICATIONS: Euler and Hamilton Paths and their applications, Planar Graphs and their Applications, Graph Coloring and its applications. ***Textbook-1: 8.5, 8.7, 8.8***	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Identify** the membership of the Set, Relations and make use of basic Algebraic properties.	L3
2	**Examine** the steps involved in Mathematical Induction and Linear recurrence-related problems.	L4
3	**Construct** different types of graphs based on the properties and the real-time applications of graph theoretical concepts.	L3
4	**Analyze** the methods for optimizing the solution for graph coloring problem, Eulerian and Hamilton circuits/planes.	L4

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
CO1	3	1	2					1	1	1		2	1	0
CO2	3	3	2					1	1	1		2	1	0
CO3	3	3	3					1	1	1		1	1	0
CO4	3	3	3					1	1	1		1	1	0

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

TEXT BOOKS:

1. Kenneth H. Rosen, "Discrete Mathematics and its applications", Tata McGraw Hill, 2003.
2. Bernard Kolman, Robert C. Busby, Sharon Ross, "Discrete Mathematical Structures", 3rdEdition, PHI 2001.

REFERENCE BOOKS:

1. Ralph P. Grimaldi, "Discrete and Combinatorial Mathematics", IV Edition, Pearson Education, Asia, 2002.
2. J. P. Tremblay, R. Manohar, "Discrete Mathematical Structures with applications to computer Science", Tata McGraw Hill, 1987.
3. J K Sharma, "Discrete Mathematics", 3rd edition, 2013, Macmillan India Ltd.

E-Resources:

1. Discrete Mathematics with Algorithms by M. O. Albertson, J. P. Hutchinson – J 1988, Wiley.
2. Discrete Mathematics for Computer Science, Gary Haggard, John Schlipf, Sue Whitesides,Thomson Brooks/Cole, 2006.
3. http://ocw.mit.edu/courses/mathematics/
4. http://www.nptelvideos.in/2012/11/discrete-mathematical-structures.html
5. http://cglab.ca/~discmath/notes.html
6. https://www.cs.odu.edu/~toida/nerzic/content/web_course.html

Activity Based Learning (Suggested Activities in Class)

1. Real world problem solving and puzzles using group discussion.
2. Demonstration of solution to a problem using graph theory.

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INTRODUCTION TO COMPUTER NETWORKS

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

SEMESTER – III

Course Code	:	23CY2305	**Credits**	:	04
Hours / Week	:	03 Hours	**Total Hours**	:	39(Th) + 26(P) Hours
L–T–P-J	:	3–0–2-0			

Course Learning Objectives:

This Course will enable students to:

1. **Outline** the basic principles of computer networking and how computer network hardware and software operate.
2. **Evaluate** the operation and performance of practical data link protocols using the principles of framing, error detection and correction.
3. **Apply** the principles of network layer design to the analysis and evaluation of routing algorithms, congestion control techniques, internetworking and addressing.
4. **Investigate** the basic transport layer facilities and essentials of transport. protocol
5. **Illustrate** the working of various application layer protocols.

Teaching-Learning Process (General Instructions)

1. These are sample new pedagogical methods, where teachers can use to accelerate the attainment of the various course outcomes.
2. ***Lecture method*** means it includes not only traditional lecture methods, but different *typesof teaching methods* may be adopted to develop the course outcomes.
3. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note taking, annotating, and roleplaying.
4. Show ***Video/Animation*** films to explain functioning of various concepts.
5. Encourage ***Collaborative*** (Group Learning) Learning in the class.
6. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
7. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
8. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

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UNIT – I	**08 Hours**
INTRODUCTION: Networks, network types, internet history, standards and administration (TB1-Ch1); Network models: Protocol layering, TCP/IP protocol suite, the OSI model (TB1-Ch2); Transmission media: Introduction, guided media, unguided media (TB1-Ch7); Switching: Introduction, circuit-switched networks, packet switching (TB1-Ch8).	
UNIT – II	**08 Hours**
Link layer addressing; (TB1-Ch10) Error detection and correction: Cyclic codes, checksum, forward error correction; (TB1-Ch10) Data link control: DLC services, data link layer protocols; (TB1-Ch11 & TB2-Ch3) Media access control: Random access, virtual LAN. (TB1-Ch12, Ch15)	
UNIT – III	**08 Hours**
Network layer design issues; (TB2-Ch5) Routing algorithms; (TB2-Ch5) Congestion control algorithms; (TB2-Ch5) Quality of service, and internetworking; (TB2-Ch5) The network layer in the internet: IPv4 addresses, IPv6; (TB2-Ch5, TB1-Ch19) Internet control protocols, OSPF (Open Shortest Path First), IP (Internet Protocol); (TB2-Ch5)	
UNIT – IV	**08 Hours**
The transport service, elements of transport protocols; (TB2-Ch6) Congestion control; (TB2-Ch6) The internet transport protocols: UDP (User Datagram Protocol), TCP (Transport Control Protocol); (TB2-Ch6) Performance problems in computer networks, and network performance measurement. (TB2-Ch6)	
UNIT – V	**07 Hours**
Introduction, client server programming, WWW (World Wide Web) and HTTP (Hyper Text Transfer Protocol); (TB1-Ch27) FTP (File Transfer Protocol); (TB1-Ch26) E-mail, telnet, (TB1-Ch26 & TB2-Ch7) DNS (Domain Naming System); (TB2-Ch7) SNMP (Simple Network Management Protocol) (TB1-Ch28)	

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Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course, the student will be able to:		
1	**Elaborate** the basic concepts of data communications including the key aspects of networking and their interrelationship, packet switching, circuit switching and cell switching as internal and external operations, physical structures, types, models, and internetworking.	L6
2	**Apply** the concept of Hamming distance, the significance of the minimum Hamming distance and its relationship to errors as well as the detection and correction of errors in block codes.	L3
3	**Estimate** the mechanics associated with IP addressing, device interface, the association between physical and logical addressing, and how the Internet protocols IPv4, and IPv6 operate.	L6
4	**Evaluate** the concept of reliable and unreliable transfer protocol of data and how TCP and UDP implement these concepts.	L5
5	**Infer** the significance, and purpose of protocols (FTP, SMTP), standards, and use in data communications and networking and **analyze** the most common DNS resource records that occur in a zone file.	L4

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
CO1	3	-	-	-	-	-	-	-	-	-	-	-	1	-
CO2	3	3	3		-	-	-	-	-	-	-	-	2	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	2	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	1	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	1	-

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

TEXT BOOKS:

1. Behrouz A. Forouzan,—Data Communications and Networking||, TataMcGraw-Hill,5thEdition, 2012.
2. Andrew S. Tanenbaum, David.J.Wetherall, —Computer Networks||, Prentice-Hall, 5th Edition, 2010.

REFERENCE BOOKS:

1. Chwan-Hwa Wu, Irwin, —Introduction to Computer Networks and Cyber Security||, CRCpublications, 2014.
2. Douglas E. Comer, —Internetworking with TCP/IP —, Prentice-Hall, 5thEdition,2011.
3. Peterson, Davie, Elsevier, —ComputerNetworks,5thEdition,2011
4. Comer, —Computer Networks and Internets with Internet Applications,4thEdition,2004.

E-Resources:

1. http://computer.howstuffworks.com/computer-networking-channel.htm
2. https://www.geeksforgeeks.org/layers-osi-model/
3. https://www.wikilectures.eu/w/Computer_Network
4. https://technet.microsoft.com/en-us/network/default.aspx

Activity Based Learning (Suggested Activities in Class)

1. Real world problem solving using group discussion.
2. Flip class activity

LABORATORY EXPERIMENTS

1. Analyse the various line coding techniques used for data transmission of a digital signalover a transmission line
2. Design a program for error-detecting code using CRC-CCITT (16- bits).
3. Design a program to find the shortest path between vertices using Belman- ford algorithm
4. Given a graph derive the routing table using distance vector routing and link state routing algorithm
5. Try out some simple subnetting problems.
6. Using TCP/IP sockets, write a client–server program to make the client send the filename and to make the server send back the contents of the requested file if present.Implement the above program using message queues or FIFOs as IPC channels
7. Implement a webserver program to fetch a URL request and display the home page of thesame in the browser
8. Implement a simple DNS server to resolve the IP address for the given domain name

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PROBABILITY AND STATISTICS

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

SEMESTER – IV

Course Code: 23CY2401	**Credits** : 03
Hours / Week: 03 Hours	**Total Hours**: 39 Hours

L–T–P : 3–0–0–0

Course Learning Objectives:

This Course will enable students to:

1. **Apply** statistical principles and probability concepts to solve complex problems in real- world scenarios involving uncertainty and randomness.
2. **Evaluate** and select appropriate probability distributions and statistical techniques to analyze and interpret data accurately in various applications.
3. **Justify** the use of estimation methods and hypothesis testing techniques for drawing meaningful inferences about population parameters.
4. **Analyze** and interpret sample test results for different statistical relationships, such as means variances, correlation coefficients, regression coefficients, goodness of fit, and independence, to make informed decisions.
5. **Identify** sample tests using appropriate statistical procedures to investigate the significance of observed data and communicate findings effectively.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different
2. *type of teaching methods* may be adopted to develop the course outcomes.
3. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
4. Show ***Video/animation*** films to explain functioning of various concepts.
5. Encourage ***Collaborative*** (Group Learning) Learning in the class.
6. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
7. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
8. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I : Probability	**09 Hours**
Definitions of Probability, Addition Theorem, Conditional Probability, Multiplication Theorem, Bayes' Theorem of Probability	
UNIT – II: Random Variables and their Properties and Probability Distributions	**09 Hours**

Discrete Random Variable, Continuous Random Variable, Joint Probability Distributions Their Properties, Probability Distributions: Discrete Distributions: Binomial, Poisson Distributions and their Properties; Continuous Distributions: Exponential ,Normal, Distributions and their Properties.	
UNIT – III: Estimation and testing of hypothesis	**06 Hours**
Sample, Populations, Statistic, Parameter, Sampling Distribution, Standard Error, Un- Biasedness, Efficiency, Maximum Likelihood Estimator, Notion & Interval Estimation.	
UNIT – IV: Sample Tests-1	**07 Hours**
Large Sample Tests Based on Normal Distribution , Small Sample Tests : Testing Equality of Means, Testing Equality of Variances, Test of Correlation Coefficient	
UNIT – V: Sample Tests-2	**08 Hours**
Test for Regression Coefficient; Coefficient of Association, 2 – Test for Goodness of Fit, Test for Independence.	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Apply** the principles of probability to solve complex problems in various real-world scenarios.	L2 & L3
2	**Solve** and **compare** different probability distributions, including discrete and continuous random variables, in order to make informed decisions and predictions.	L2 & L3
3	**Apply** statistical estimation techniques, such as maximum likelihood estimation and interval estimation, to draw meaningful inferences about population parameters from sample data.	L3
4	**Examine** hypothesis testing methods, including large and small sample tests, to assess the significance of observed data and draw valid conclusions.	L4
5	**Analyze** statistical relationships and perform sample tests to assess the Equality of means in different populations, Correlation coefficients between variables to determine the strength and direction of the relationship. Independence of variables using appropriate statistical tests to assess the absence of any relationship.	L4

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**
CO1	3	2	2		2				1					
CO2	3	2	2		2				1					
CO3	3	2	2						1					
CO4	3	2	2		2				1					
CO5	3	2	2		2				1					

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

TEXT BOOKS:

1. Probability & Statistics for Engineers and Scientists, Walpole, Myers, Myers, Ye. Pearson Education.

REFERENCE BOOKS:

1. Probability, Statistics and Random Processes T. Veerarajan Tata McGraw – Hill
2. Probability & Statistics with Reliability, Queuing and Computer Applications, Kishor S. Trivedi, Prentice Hall of India ,1999

E-Resources:

1. https://nptel.ac.in/courses/106104233
2. https://nptel.ac.in/courses/117103067
3. https://nptel.ac.in/courses/103106120
4. https://www.coursera.org/learn/probability-intro#syllabus
5. https://nptel.ac.in/courses/111104073

Activity Based Learning (Suggested Activities in Class)

1. Tools like Python programming, R programming can be used which helps student to develop a skill to analyze the problem and providing solution.
2. Regular Chapter wise assignments/ Activity/Case studies can help students to have critical thinking, developing an expert mind set, problem-solving and teamwork.

Following are Assignments/ Activities Can be carried out using either R programming language or Python Programming or excel solver.

1. There are n people gathered in a room. What is the probability that at least 2 of them will have the same birthday? (Use excel solver, R Programming, Python Programming)
   a. Use simulation to estimate this for various n., and Produce Simulation Graph.
   b. Find the smallest value of n for which the probability of a match is greater than 0.5.
   c. Explore how the number of trials in the simulation affects the variability of our estimates.
2. **Case Study 1: Customer Arrivals at a Coffee Shop**
   a. A coffee shop wants to analyze the number of customer arrivals during its morning rush hour (7:00 AM to 9:00 AM). The shop has been recording the number of customer arrivals every 15 minutes for the past month.
   b. Data: The data consists of the number of customer arrivals recorded at the coffee shop during each 15-minute interval for the past month.
   c. Here is a sample of the data:

Time Interval	stomer Arrivals
00 AM - 7:15 AM	**6**
15 AM - 7:30 AM	**4**
30 AM - 7:45 AM	**9**
45 AM - 8:00 AM	**7**
00 AM - 8:15 AM	**5**
15 AM - 8:30 AM	**8**
30 AM - 8:45 AM	**10**
45 AM - 9:00 AM	**6**

analyze the customer arrivals and determine the probability distribution that best fits the data. Specifically, explore both discrete and continuous probability distributions, including the binomial, Poisson, exponential, and normal distributions.

3. **Case Study 2: Comparing the Performance of Two Groups**
   a. Suppose you are a data analyst working for a company that manufactures a new energy drink. The marketing team conducted a promotional campaign in two different cities (City A and City B) to determine the effectiveness of the campaign in increasing sales. The sales data for a random sample of customers in each city was collected over a week. Your task is to compare the average sales between the two cities and test whether there is a significant difference in the variance of sales.
   b. **Data**: Let's assume the following sample data for the number of energy drinks sold in each city:

City A: [30, 28, 32, 29, 31, 33, 34, 28, 30, 32]
City B: [25, 24, 26, 23, 22, 27, 29, 30, 26, 24]

perform a two-sample t-test to test the equality of means and a test for equality of variances using Python's SciPy library.

4. **Case study 3:** testing independence between two categorical variables.
   1. Data: Sample of 100 employees, and each employee is classified as either Male or Female. They were asked to rate their job satisfaction on a scale of 1 to 5, where 1 represents low satisfaction and 5 represents high satisfaction. The data is as follows:

Employee	Gender	Job Satisfaction
1	Male	4
2	Female	3
3	Male	2
4	Female	5
...	...	...
100	Female	4

   b. Test for independence between gender and job satisfaction, use the chi-squared test in R.

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DESIGN AND ANALYSIS OF ALGORITHMS

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

SEMESTER – IV

Subject Code	: 23CY2402	**Credits**	: 04
Hours / Week	: 03 Hours	**Total Hours**	: 39(L) + 26(P) Hours
L–T–P-J	: 3–0–2-0		

Course Learning Objectives:

This Course will enable students to:

1. **Analyze** the non-recursive and recursive algorithms and to represent efficiency of these algorithms in terms of the standard Asymptotic notations.
2. **Devise** the Brute Force and Divide and Conquer techniques to design the algorithms and apply these methods in designing algorithms to solve a given problem.
3. **Explain** the Decrease and Conquer, Transform and Conquer algorithm design techniques, and Time versus Space Trade-offs.
4. **Get the idea** of Greedy method and dynamic programming methods and apply these methods in designing algorithms to solve a given problem.
5. **Describe** and illustrate the idea of Backtracking and Branch and Bound algorithm design techniques to solve a given problem.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture methods, but different *types of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain 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. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I	**08 Hours**

INTRODUCTION:

What is an Algorithm? Fundamentals of Algorithmic Problem Solving. ***(Text Book-1: Chapter 1: 1.1 to 1.2)***

FUNDAMENTALS OF THE ALGORITHMS EFFICIENCY:

Analysis Framework, Asymptotic Notations and Standard notations and common functions ***(Text Book-2: Chapter 3: 3.1, 3.2)***,

Mathematical Analysis of Non-recursive and Recursive Algorithms,

(Text Book-1: Chapter 2: 2.1, 2.3, 2.4,)	
UNIT – II	**08 Hours**
BRUTE FORCE: Background, Selection Sort, Brute-Force String Matching. ***(Text Book-1: Chapter 3: 3.1, 3.2)*** **DIVIDE AND CONQUER:** General method, Recurrences: The recursion-tree method, The master method. ***(Text Book-2: Chapter 4: 4.4, 4.5***), Merge sort, Quick sort, Binary Search, Multiplication of large integers, **Case study:** Strassen's Matrix Multiplication. ***(Text Book-1: Chapter 4: 4.1 to 4.3, 4.5)***	
UNIT – III	**06 Hours**
DECREASE & CONQUER: General method, Insertion Sort, Graph algorithms: Depth First Search, Breadth First Search, Topological Sorting **TRANSFORM AND CONQUER:** **Case study:** Heaps and Heap sort. **TIME AND SPACE TRADEOFFS:** Input Enhancement in String Matching: Horspool's algorithm, Hashing: Open and Closed hashing. ***(Text Book-1: Chapter 5: 5.1 to 5.3, Chapter 6: 6.3 to 6.4, Chapter 7: 7.2 to 7.3)***	
UNIT – IV	**09 Hours**
GREEDY TECHNIQUE: General method of Greedy technique, Single-Source Shortest Paths: General method, The Bellman-Ford algorithm, Single-Source Shortest Paths in DAGs, Dijkstra's Algorithm ***(Text Book-2: Chapter 24: 24.1 to 24.3).*** Minimum Spanning Trees: Prim's Algorithm, Optimal Tree problem: Huffman Trees; **Case study:** Kruskal's Algorithm. ***(Text Book-1: Chapter 9: 9.1, 9.2, 9.4).*** **DYNAMIC PROGRAMMING:** General method, The Floyd-Warshall Algorithm, Johnson's algorithm for sparse graphs ***(Text Book-2: Chapter 25: 25.1 to 25.3)***, The Knapsack problem ***(Text Book-1: Chapter 8: 8.4).***	
UNIT – V	**08 Hours**
LIMITATIONS OF ALGORITHMIC POWER P, NP and NP-complete problems ***(Text Book-1: Chapter 11: 11.3***) **BACKTRACKING:** General method, N-Queens problem, Subset-sum problem. ***(Text Book-1: Chapter 12: 12.1***) **BRANCH AND BOUND:** General method, Travelling Salesman problem, Approximation algorithms for TSP. **Case study:** Knapsack Problem. ***(Text Book-1: Chapter 12: 12.2, 12.3***)	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Analyze the given recursive and non-recursive algorithms for time using step count, substitution method, recurrence tree method and mathematical analysis method. Represent the complexity of the algorithm using asymptotic notation.	L3
2	Solve sorting, searching, matrix multiplication problems based on divide and conquer design technique and implement in C programming language.	L3
3	Apply algorithms for graph-based problems (DFS, BFS and Topological sorting) using decrease and conquer design techniques. Distinguish the trade-offs between space and time complexity.	L3
4	Apply algorithms for finding the shortest path and minimum spanning tree for a given graph using greedy and dynamic programming techniques and implement the 0/1 knapsack problem in C programming language.	L3
5	Apply an efficient algorithm to solve N-Queens problem, Subset-sum problem, Knapsack and Traveling salesman problem using branch and bound and backtracking design technique. Describe the limitation of algorithmic power in terms of P, NP, NP hard and NP complete categorizations.	L3
6	Implement the graph-based algorithms including DFS, BFS, Warshall's Algorithm, Floyd's Algorithm, Kruskal's Algorithm, and Dijkstra's Algorithm in C programming language. (**Lab Experiments**)	L3

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
CO1	2	3	-	-	-	-	-	-	-	1	-	1	-	1
CO2	2	3	-	-	3	-	-	-	-	1	-	1	-	1
CO3	1	2	3	-	-	-	-	-	-	1	-	1	-	2
CO4	1	2	3	-	3	-	-	-	-	1	-	1	-	2
CO5	1	2	3	-	-	-	-	-	-	1	-	1	-	2
CO6	1	2	3	-	3	-	-	-	-	1	-	1	-	3

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

TEXT BOOKS:

1. Anany Levitin, "Introduction to the Design & Analysis of Algorithms", 2nd Edition, Pearson Education, 2011.
2. Thomas H. Cormen, Charles E.Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", 3rd Edition, PHI, 2014.

REFERENCE BOOKS:

1. Horowitz E., Sahni S., Rajasekaran S, "Computer Algorithms", Galgotia Publications, 2001.
2. R.C.T. Lee, S.S. Tseng, R.C. Chang & Y.T.Tsai, "Introduction to the Design and Analysis of Algorithms: A Strategic Approach", Tata McGraw Hill, 2005.

E-Resources:

1. https://nptel.ac.in/courses/106/101/106101060/
2. http://cse01-iiith.vlabs.ac.in/
3. http://openclassroom.stanford.edu/MainFolder/CoursePage.php?course=IntroToAlgorithms
4. https://www.coursera.org/specializations/algorithms

Activity Based Learning (Suggested Activities in Class)

1. Real world problem solving and puzzles using group discussion. E.g., Fake coin identification, Cabbage puzzle, Konigsberg bridge puzzle etc.,
2. Demonstration of solutions to a problem through programming.

DESIGN AND ANALYSIS OF ALGORITHMS LABORATORY

Total Contact Hours: 26

Following are experiments to be carried out using either C programming language or Object-oriented programming language:

1. Implementation of Binary Search algorithm.
2. Sort a given set of n integer elements using the Merge Sort method and compute its time complexity. Demonstrate this algorithm using the Divide-and-Conquer method.
3. Sort a given set of n integer elements using Quick Sort method and compute its time complexity. Demonstrate this algorithm using the Divide-and-Conquer method.
4. Incorporate the array data structure and demonstrate whether a given unweighted graph is connected or not using the DFS method.
5. Implement the graph traversal technique using the BFS method to print all the nodes reachable from a given starting node in an unweighted graph.
6. Compute the Transitive Closure for a given directed graph using Warshall's algorithm.
7. For a given weighted graph, construct an All-Pairs Shortest Paths problem using Floyd's algorithm and implement this algorithm to find the shortest distance and their shortest paths for every pair of vertices.
8. Implement 0/1 Knapsack problem using Dynamic Programming Memory Functions technique
9. Find Minimum Cost Spanning Tree for a given weighted graph using Prim's and Kruskal's algorithm.

10. From a given vertex in a weighted connected graph, determine the Single Source Shortest Paths using Dijkstra's algorithm.
11. Implement N-Queens problem using Backtracking technique.
12. Case Study

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SCHOOL OF ENGINEERING

Devarakaggalahalli, Harohalli, Bengaluru – 562 112

DATABASE MANAGEMENT SYSTEMS

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

SEMESTER – IV

Subject Code	:	23CY2403	**Credits**	:	04
Hours / Week	:	03 Hours	**Total Hours**	:	39 (L)+ 26(P) Hours
L–T–P-J	:	3–0–2-0			

Course Learning Objectives:

This Course will enable students to:

1. Acquire the concept of databases and Relational Model., Entity-Relationship Model and relational model for creating and designing databases for the real-world scenario.
2. Develop queries to extract data from the databases using a structured query language.
3. Draw ER Diagrams and Optimize the Database design using Normalization Concepts.
4. Understand the importance of Transaction Management, Concurrency control mechanism and recovery techniques.
5. Understand NoSQL Database concepts and Demonstrate CRUD operations on MongoDB.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain 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. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I	**08 Hours**

RELATIONAL DATABASES

Purpose of Database System – Views of data – Data Models – Database System Architecture- Database System Applications - Introduction to relational databases – Structure of Relational Databases – Database Schema – Keys – Schema Diagrams.

(Text Book 1: Chapter 1, 2)

UNIT – II	**08 Hours**

RELATIONAL QUERY LANGUAGE

Overview of the SQL Query Language - SQL Data Definition - Basic Structure of SQL Queries - Additional Basic Operations - Aggregate Functions - Nested Subqueries - Join Expressions – Views – Transactions - SQL Data Types and Schemas – Authorization - Accessing SQL from a Programming Language - Functions and

Procedures – Triggers.
(Text Book 1: Chapter 3, 4, 5)

UNIT – III	**06 Hours**

DATABASE DESIGN

Entity-Relationship model – E-R Diagrams – Complex Attribute – Mapping Cardinalities – ER-to-Relational Mapping – Features of Good Relational Designs - Decomposition Using Functional Dependencies – Non- loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form
(Text Book 1: Chapter 6, 7)

UNIT – IV	**09 Hours**

TRANSACTION MANAGEMENT

Transaction Concepts – ACID Properties – A simple Transaction Model - Transaction Atomicity and Durability - Transaction Isolation - Schedules – Serializability – Transactions as SQL Statements - Concurrency control –Lock Based Protocols - Deadlock Handling – Recovery System - Failure Classification - Recovery Algorithm - Buffer Management - ARIES
(Text Book 1: Chapter 17, 18, 19)

UNIT – V	**08 Hours**

NOSQL DATABASES

NOSQL Databases: Introduction – CAP Theorem – Document-Based NOSQL Systems and MongoDB – CRUD Operations - NOSQL Key-Value Stores - Column-Based or Wide Column NOSQL Systems - NOSQL Graph Databases and Neo4j
(Text Book 2 : Chapter 24)

Course Outcome	**Description**	**Bloom's Taxonomy Level**
At the end of the course the student will be able to:		
1	Understand the basic concepts of database management system and Relational Model	L2
2	Utilize SQL concepts to build and manipulate relational databases for a given schema.	L3
3	Create E-R diagrams and design relational schema, Apply normalization techniques in designing the relational database	L3
4	Understand the Transaction Management, concurrency control and recovery management techniques.	L2
5	Use NoSQL queries and build databases in MongoDB for the given collection.	L3

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**
CO1	**1**	-	-	-	-	-	-	-	-	-	-	-	-	**2**
CO2	**1**	**2**	**3**	**-**	**3**	**-**	**-**	**-**	**2**	**1**	**-**	**1**	**-**	**3**
CO3	**1**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**-**	**1**	**-**	**3**
CO4	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**1**
CO5	**1**	**2**	**3**	**-**	**3**	**-**	**-**	**-**	**2**	**1**	**-**	**1**	**-**	**3**

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

TEXT BOOKS:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Seven th Edition, McGraw Hill, 2020.
2. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Seventh Edi tion, Pearson Education, 2017

REFERENCE BOOKS:

1. Raghu Ramakrishnan and Johannes Gehrke, "Database Management Systems", Third Edition, McGraw-Hill, 2003.
2. C.J. Date, A. Kannan, S. Swamynatham: "An Introduction to Database Systems", Eight Edition, Pearson Education, 2012.

E-Resources:

1. https://www.ibm.com/docs/en/zos-basic-skills?topic=zos-what-is-database-management-system
2. **https://www.mongodb.com/resources/basics/database-management-system**
3. **https://www.oracle.com/in/database/what-is-database/**
4. **https://onlinecourses.swayam2.ac.in/cec19_cs05/preview**
5. **https://onlinecourses.nptel.ac.in/noc19_cs46/preview**

Activity Based Learning (Suggested Activities in Class)

1. Real world problem solving and puzzles using group discussion.
2. Demonstration of solution to a problem through programming.

DESIGN AND ANALYSIS OF ALGORITHMS LABORATORY

Total Contact Hours: 26

1. Database Table Creation and Manipulation - Create a database table and add constraints such as primary key, unique, check, and not null. Insert, update, and delete rows using SQL DDL and DML commands.
2. Foreign Keys and Referential Integrity - Create a set of tables with foreign key constraints to ensure referential integrity between them.
3. Querying with Conditions and Aggregates - Query the database tables using various WHERE clause conditions and implement aggregate functions like SUM, AVG, COUNT, etc.
4. Subqueries and Basic Joins - Perform queries involving subqueries and simple join operations to retrieve data from multiple tables.
5. Advanced Join Operations - Explore and implement natural joins, equijoins, and outer joins in your queries.

6. UserDefined Functions and Stored Procedures - Write and execute userdefined functions and stored procedures in SQL for various operations.
7. Transactions and Control Commands - Execute complex transactions and understand the use of Data Control Language (DCL) and Transaction Control Language (TCL) commands.
8. SQL Triggers - Write SQL triggers for handling insert, delete, and update operations on a database table.
9. Views - Create views to enhance manageability.
10. NoSQL Database Operations - Create and manage document based data using MongoDB database tools.

Open ended Questions

1. GUIBased Database Application - Develop a simple GUIbased database application incorporating features such as table creation, constraints, queries, joins, functions, procedures, transactions, and triggers.
2. Case Study: RealLife Database Application

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INTRODUCTION TO CYBER SECURITY

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

SEMESTER – IV

Course Code	: 23CY2404	**Credits**	: 03
Hours / Week	: 03 Hours	**Total Hours**	: 39 Hours
L–T–P-J	: 3–0–0-0		

Course Learning Objectives:

This Course will enable students to:

1. **Give** insights into the Cyber-incident, Cyber-crime, Cyber-Physical systems and Cybersecurity.
2. **Recognize** the basic programming to detect and protect the systems from cyberthreats.
3. **Understand** the design and development framework for IDS and IPS.
4. **Deploy** the Cloud infrastructure using different methods from the scratch.
5. **Apply** and map theoretical knowledge of Cybersecurity to assess risk and vulnerabilityof a given system.

Teaching-Learning Process

1. ***Lecture method*** along with traditional lecture method, different *type of teachingmethods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *incorporating* brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Showing ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, asking Higher order Thinking questions in the class in the form of Quiz and writing programs with complex solutions.
6. Showing the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.

MODULE 1: Cybersecurity Foundation	**10Hrs**

Modern Computing Trends, Application Threat Vectors, Cyber space, Cyber-attacks on business: Attacker profiles, Cyber-attack Life-cycle (CAL), High-profile Cybersecurity attacks, Advanced Persistent Threats (APTs), Types of malwares, vulnerabilities, and exploits: Spamming and Phishing attacks, Bot and Botnets, Zero Trust Design principles and Architecture: Perimeter- based network security strategies: Demilitarized security zone, Next Generation Firewall (NGFW) and Traps.

MODULE 2: Network Security Fundamentals	**7Hrs**

Identification of common enterprise network devices: Topologies: Protocols in OSI and TCP model layers: Ports and packet filtering procedures: Routed versus Routing protocols: DNS, FQDN, and IoT: Structure and fields of an IP header, IPV4 and IPV6 addressing, Subnet mask, DHCP and Network Address Translation (NAT), Endpoint and network security technologies like SSH, SSL, and TLS.
MODULE 3: Cloud Security Fundamentals **8Hrs**
Cloud computing service, deployment, and shared responsibility models: cloud native technologies- virtual machines, containers and orchestration, and serverless computing: Cloud native security- Kubernetes security, DevOps, and DevSecOps- Security challenges like visibility, governance, and compliance: East-West and North-South traffic protection methods: Layers and capabilities in a Secure Access Service Edge (SASE).
MODULE 4: Security Operations Fundamentals **7Hrs**
Key elements of Security Operations (SecOps), SecOps processes: Log forwarding: Security Information and Event Management (SIEM), Security Analysis tools: Security Operations Center (SOC) Engineering: Security Orchestration, Automation, and Response (SOAR) for SecOps: Threat Intelligence: Vulnerability Profiles to secure Endpoints.
MODULE 5: Modern Tools and Use Cases in Cyber Security **7Hrs**
AutoFocus: Mindmeld: Cortex XDR: Cortex XSOAR: Cortex Data Lake: Normalization of Enterprise Security data with advanced Artificial Intelligence (AI) and Machine Learning (ML): Reconnaissance Attacks: Mindmeld for threat intelligence gathering and response: Prisma Access architecture: Four pillars of Prisma Cloud: Next Generation Firewall to use Dynamic Block Lists

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Summarize the fundamental concept of cybersecurity to design zero-trust and perimeter-centric robust security system.	L2
2	Apply the basic concept of network security and packet filtering techniques to protect end nodes in a public network.	L3
3	Summarize the fundamental concept of cloud security to develop a robust and secure cloud-centric application.	L3
4	Apply the knowledge of Security Operations (SecOps) utilizing Log forwarding, SIEM, SOAR to assess end-point vulnerabilities.	L3
5	Make use of different cyber security tools and techniques like AutoFocus, Mindmeld, Cortex XDR, Cortex XSOAR, Cortex Data Lake to detect and prevent cyber security threats.	L3

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**
CO1	2	2			1				1			1	2	1
CO2	2	1			2				1			2	2	2
CO3	2	1			1							1	2	1
CO4	2	2			2				1			2	2	2
CO5	2	1			3							1	2	1

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

TEXT BOOKS:

1. Palo Alto Networks Cybersecurity Survival Guide Fundamental Principles & Best Practices, Fifth Edition, 2020.
2. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectivesby Nina Godbole and Sumit Belapure, Wiley, First Edition, 2011.

E-Resources:

1. https://onlinecourses.swayam2.ac.in/cec23_cs16/preview
2. https://onlinecourses.swayam2.ac.in/nou23_ge65/preview
3. Introduction to Cyber Security - Course (swayam2.ac.in)
4. https://www.coursera.org/learn/introduction-to-cybersecurity-foundations/

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CYBER FORENSICS AND CYBER LAW

SEMESTER – IV

Subject Code	:	23CY2405	**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 introduce the Fundamentals of cyber forensics.
2. To Learn forensic tools and techniques used for Forensic Investigations.
3. To Provide an overview of the legal issues arising from the use of information technology and the internet.

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.

UNIT – I	**08 Hours**

INTRODUCTION TO CYBER FORENSICS:

Introduction, Defining Cyber Forensics, Cyber Forensic Investigation Process, Forensic Protocol for Evidence Acquisition, Digital Forensics Standards and Guidelines, Digital Evidence, What Is a Cybercrime? Types of Cyber Crime, Challenges in Cyber Forensics, Skills Required to Become a Cyber Forensic Expert, Cyber Forensic Tools. **(Text Book-3: Chapter 1)**

UNIT – II	**08 Hours**

CYBER FORENSICS: INVESTIGATIVE SMART PRACTICES:

The Forensic Process, Forensic Investigative Smart Practices, The Initial Contact, the Request, Evidence Handling, Acquisition of Evidence, Data Preparation.

INVESTIGATION: INCIDENT CLOSURE -

Forensic Investigative Smart Practices, Investigation (Continued), Communicate Findings, Characteristics of a Good Cyber Forensic Report, Report Contents, Retention and Curation of Evidence. **(Text Book-1: Chapter 10 and Chapter 12).**

UNIT – III	08 Hours
NETWORK FORENSICS: The OSI Model, Forensic Footprints, Seizure of Networking Devices, Network Forensic Artifacts, ICMP Attacks-Traceroute Attack, Inverse Mapping Attack, ICMP Smurf Attack, DriveBy Downloads, Network Forensic Analysis Tools-Wireshark, Case Study: Wireshark, Network Miner, Case Study: Network Miner, Xplico, Case Study: Xplico. **(Text Book:2: Chapter 6)**	
UNIT – IV	**08 Hours**
CLOUD FORENSICS: Cloud Computing Models Defining Cloud Forensics, Server-Side Forensics, ClientSide Forensics, Challenges in Cloud Forensics, Artifacts in Cloud Forensics, Use of Cloud Forensics, Forensics as a Service (FaaS) Case Study: Google Drive Investigation, Case Study: Dropbox Investigation, WhatsApp Forensics, Case Study: WhatsApp Database Extraction. **(Text Book:2: Chapter 8)**	
UNIT – V	**07 Hours**
CYBER FORENSICS AND THE LAW: LEGAL CONSIDERATIONS – Introduction, Objectives, Cyber Forensics, Digital Information, Identification and Analysis, Digital Forensics Complexity Problem, Proliferation of Digital Evidence- Slack Space, RAM Slack, Drive Slack, Swap File. Chain of Custody, Discredit the Witness (aka Refute the Cyber Forensic Expert), Outline of an Investigation, Obtaining Proper Authorization, Who Are You Going to Call? Secure the Scene of the Alleged E-Crime, Seizing Evidence, Chain of Evidence, Chain-of-Evidence Model, seizing a Computer, Pros and Cons of Pulling the Plug. **(Text Book-3: Chapter 11)**	

Course Outcomes:

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

1. Summarize the cyber forensics tools and techniques to interpret cybercrimes.
2. Build a good cyber forensic report by utilizing evidence acquisition and data preparation methodologies.
3. Inspect the network forensic tools and techniques like Wireshark, Network Miner, Xplico to detect and prevent intrusions.
4. Survey the cloud forensic techniques associated with Google Drive, Dropbox and WhatsApp.
5. Summarize different hardware specific tools and techniques like Slack Space, RAM Slack, Drive Slack, Swap File to investigate cybercrime.

TEXT BOOKS:

1. Albert J. Marcella Jr., Frederic Guillossou, "Cyber Forensics from Data to Digital Evidence" 2012 by John Wiley & Sons.
2. Niranjan Reddy, "Practical Cyber Forensics. An Incident-based Approach to Forensic Investigations", A press publication.
3. Albert J. Marcella, Jr., Doug Menendez, "Cyber Forensics: A Field Manual for Collecting, Examining, andPreserving Evidence of Computer Crimes", Second Edition, Auerbach Publications.

REFERENCE BOOKS:

1. R.K. Jain "Zero To Mastery In Information Security And Cyber Laws", Vayu Education of India, First Edition: 2022.
2. Gerard Johansen "Digital Forensics and Incident Response-An intelligent way to respond to attacks" 7,
   Packt Publishing, 2017, ISBN 978-1-78728-868-3

3. Albert J. Marcella "Cyber Forensics Examining Emerging and Hybrid Technologies", CRC Press ,2022.
4. Cybersecurity: Managing Systems, Conducting Testing, and Investigating Intrusions, Thomas J. Mowbray, John Wiley & Sons, 2013.
5. Cyber Security Essentials James Graham, Ryan Olson, Rick Howard, CRC Press

E-Resources:

1. https://onlinecourses.swayam2.ac.in/cec21_ge10/preview
2. Cyber Forensics case study from India
3. https://www.eccouncil.org/academia/digital-forensics-essentials-dfe
4. https://www.ifsedu.in/cyber-forensics

Activity Based Learning (Suggested Activities in Class)

1. Use of Network forensics tools like Wireshark, Network Miner, Xplico to detect and prevent intrusions.
2. Collaborative Activity is case study with a team of 4 students.

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COMPUTER ORGANIZATION AND ARCHITECTURE

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

SEMESTER – IV

Subject Code	:	23CY2406	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–J	:	3–0–0–0			

Course Learning Objectives:

This Course will enable students to:

1. Understand the Architecture and programming of ARM microprocessor.
2. Develop program using Arm instruction set and appreciate the advanced features provided in the ARM
3. Understand the exception handling techniques.
4. Study in detail the concept of instruction level parallelism and concepts of pipelining.
5. Understand various cache memory mapping techniques and memory Organization.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain 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 students' understanding.

UNIT – I	**05 Hours**

An Overview of Computing Systems:
History of Computers, The Computing Device.
The ARM7TDMI Programmers' Model:
Introduction, Data types, Processor Modes, Registers, Program Status Registers, The vector Table.
Assembler Rules and Directives: Structure of Assembly Language Modules, Registers, Directives and Macros.
Loads, Stores and Addressing: LODS and STORES instructions, Operand Addressing, ENDIANNES

Text Book-1: 1.1 to 1.3; 2.1 to 2.3; 4; 5.3, 5.4, 5.5

UNIT – II	**05 Hours**

Constants and Literal Pools:

The ARM Rotation Scheme, Loading Constants and address into Registers **Logic and Arithmetic:** Flags and their Use, Compare instructions, Data Processing Instructions **Loops and Branches:** Branching, Looping, Conditional Execution, Straight-Line Coding **Subroutines and Stacks:** Stack, Subroutines, Passing parameters to subroutines. **Text Book-1: 6.1 to 6.4; 7.1 to 7.4; 8.2 to 8.5; 13.1 to 13.4**	
UNIT – III	**05 Hours**
Mixing C and Assembly Language: Inline Assembler Embedded Assembler, Calling Between C and Assembly. **Exception Handling:** Interrupts, Error Conditions, Processor Exception Sequence, The Vector Table, Exception Handlers, Exception Priorities, Procedures for Handling Exceptions. **Text Book-1: 18.1 to 18.4; 14.1 to 14.8**	
UNIT – IV	**12 Hours**
Pipelining: Basic and Intermediate Concepts: Introduction, The Major Hurdle of Pipelining, How Pipelining Implemented, what makes Pipelining hard to Implement, Extending the MIPS Pipeline to Handle Multicycle Operations, The MIPS R4000 Pipeline, Crosscutting Issues, score boarding Technique. **Text Book-2: C.1 to C.7**	
UNIT – V	**12 Hours**
Memory Hierarchy: Introduction, Cache Performance, Six basic cache Optimizations, Virtual Memory, Protection and examples of Virtual Memory, Fallacies and Pitfalls. **Text Book-2: B.1 to B.6**	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Interpret** the knowledge of the internal architecture and organization of ARM microprocessors to understand their components and functionalities.	L2
2	**Apply** the instruction set of ARM Microprocessor by writing Assembly language programs.	L3
3	**Understand** the various exception handling techniques.	L2
4	**Demonstrate** the integration of C and Assembly language to manage function calls between C and Assembly language.	L2
5	**Apply** the concept of instruction-level parallelism and understand the principles of Pipelining techniques.	L3
6	**Understand** memory hierarchy and its impact on computer cost/performance.	L2

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**
CO1	3		2										2	
CO2	3		3		1								2	
CO3	3	1	1										2	
CO4	3	1	1										2	
CO5	3	2	1										2	

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

TEXT BOOKS:

1. William Hohl, "ARM Assembly Language", 2nd Edition, CRC Press, 2009.
2. John L Hennessy, David A Patterson, "Computer Architecture, A Quantitative Approach", 6th Edition, Morgan Kaufmann publishers, 2019.

REFERENCE BOOKS:

1. David A Patterson, John L Hennessy, "Computer Organization and Design", 4th Edition, Morgan Kaufmann publishers, 2010.
2. Steve Furber, "ARM System-on-chip Architecture", 2nd Edition, Pearson Publications, 2000.
3. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, "Computer Organization", 5th Edition, Tata McGraw Hill, 2002.

E-Resources:

1. https://www.udemy.com/topic/arm-cortex-m/
2. https://www.edx.org/school/armeducation
3. https://onlinecourses.nptel.ac.in/noc22_cs93/preview

Activity Based Learning (Suggested Activities in Class)

1. Mini project implementation using Assembly Language Programming.
2. Demonstration of solution to a problem through programming.

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