SANTHIRAM ENGINEERING COLLEGE :: NANDYAL

(AUTONOMOUS)

Approved by A.I.C.T.E., New Delhi, Permanently Affiliated to JNT University, Ananthapuramu
Accredited by NAAC with Grade-A, Accredited by NBA (ECE & CSE)
An ISO 9001:2015 Certified Institution, 2(f) &12(B) recognition by UGC Act, 1956
NH-40, NANDYAL - 518501 (Dist). A.P.

Learn - Grow - Empower

R-26

ACADEMIC REGULATIONS
COURSE STRUCTURE
AND
DETAILED SYLLABI

B.TECH-CSE(05)

Regular Four Year UG Degree Course
(Applicable for the batches admitted from 2026-27)
&
Lateral Entry Three Year UG Degree Course
(Applicable for the batches admitted from 2027-28)

website: www.srecnandyal.edu.in

SANTHIRAM ENGINEERING COLLGE

(**AUTONOMOUS**)

NANDYAL – 518501 (A.P) INDIA

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Academic Regulations (R26) for B. Tech (Regular-Full time)

(Effective for the students admitted into I year from the Academic Year **2026-27** onwards)

&

Academic Regulations (R26) for

B.Tech.(Lateral Entry Scheme)

(Effective for the students admitted into II year through Lateral Entry Scheme from the Academic Year 2027 - 28 onwards)

Academic Regulations (R26) for B. Tech (Regular-Full time)

(Effective for the students admitted into I year from the Academic Year **2026-27** onwards)

1. Award of the Degree

a) Award of the B.Tech. Degree / B.Tech. Degree with a Minor if he/she fulfils the following:

(i) Pursues a course of study for not less than four academic years and not more than eight academic years. However, for the students availing Gap year facility this period shall be extended by two years at the most and these two years would in addition to the maximum period permitted for graduation (Eight years).

(ii) Registers for 171 credits and secures all 171 credits.

b) **Award of B.Tech. degree with Honors** if he/she fulfils the following:

(i) Student secures additional 18 credits fulfilling all the requisites of a B.Tech. program i.e., 171 credits.

(ii) Registering for Honors is optional.

(iii) Honors is to be completed simultaneously with B.Tech. programme.

c) Award of B.Tech. degree with Minors

(i) Student secures additional 18 credits fulfilling all the requisites of a B.Tech. program i.e., 171 credits.

(ii) Registering for Minors is optional.

(iii) Minors is to be completed simultaneously with B.Tech. programme.

2. Students, who fail to fulfil all the academic requirements for the award of the degree within eight academic years from the year of their admission, shall forfeit their seat in B.Tech. course and their admission stands cancelled. This clause shall be read along with clause 1 a) i).

3. Admissions

Admission to the B. Tech Program shall be made subject to the eligibility, qualifications and specialization prescribed by the A.P. State Government/University from time to time. Admissions shall be made either based on the merit rank obtained by the student in the common entrance examination conducted by the A.P. Government/University or any other order of merit approved by the A.P. Government/University, subject to reservations as prescribed by the Government/University from time to time.

4. Program related terms

Credit: A unit by which the course work is measured. It determines the number of hours of instruction required per week. One credit is equivalent to one hour of teaching (Lecture/Tutorial) or two hours of practical work/field work per week.

Credit Definition:

1 Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week	0.5 credit
Hrs. Practical (Lab) per week	1 credit

a) ***Academic Year:*** Two consecutive (one odd + one even) semesters constitute one academic year.

b) ***Choice Based Credit System (CBCS):*** The CBCS provides a choice for students to select from the prescribed courses.

5. Semester/Credits:

i) A semester comprises 90 working days and an academic year is divided into two semesters.

ii) The summer term is for eight weeks during summer vacation. Internship/ apprenticeship / work-based vocational education and training can be carried out during the summer term, especially by students who wish to exit after two semesters or four semesters of study.

iii) Regular courses may also be completed well in advance through MOOCs satisfying prerequisites.

6. Structure of the Undergraduate Programme

All courses offered for the undergraduate program (B. Tech.) are broadly classified as follows:

S.No.	Category	Breakup of Credits (Total 171)	Percentage of total credits	AICTE Recommendation (%)
1.	Humanities and Social Science including Management (HM)	15	9%	8 – 9%
2.	Basic Sciences (BS)	22	13 %	12 - 16%
3.	Engineering Sciences (ES)	26	15%	10 – 18%
4.	Professional Core (PC)	57	33 %	30 – 36%
5.	Electives – Professional (PE) & Open (OE); Domain Specific Skill Enhancement Courses (SEC)	35	20 %	19 - 23%
6.	Internships & Project work (PR)	16	10 %	8 – 11%
7.	Mandatory Courses (MC)	Non-credit	Non-credit	-

The total degree credits become 171, including 2 credits for. The syllabus for this online examination shall comprise core courses studied by the student up to IV Year – I Semester and this examination will be conducted by the university for both affiliated and autonomous colleges.

7. Course Classification:

All subjects/ courses offered for the undergraduate programme in Engineering & Technology (B.Tech. degree programmes) are broadly classified as follows:

S.No.	Broad Course Classification	Course Category	Description
1.	Foundation Courses	Foundation courses	Includes Mathematics, Physics and Chemistry; fundamental engineering courses; humanities, social sciences and management courses
2.	Core Courses	Professional Core Courses (PC)	Includes subjects related to the parent discipline/department/branch of Engineering
3.	Elective Courses	Professional Elective Courses (PE)	Includes elective subjects related to the parent discipline/department/ branch of Engineering
		Open Elective Courses (OE)	Elective subjects which include interdisciplinary subjects or subjects in an area outside the parent discipline/ department/ branch of Engineering
		Domain specific skill enhancement courses (SEC)	interdisciplinary/job-oriented/domain courses which are relevant to the industry
4.	Project & Internships	Project	B.Tech. Project or Major Project
		Internships	Summer Internships – Community based and Industry Internships; Industry oriented Full Semester Internship
5.	Audit Courses	Mandatory non-credit courses	Covering subjects of developing desired attitude among the learners

8. Programme Pattern

i. Total duration of the of B. Tech (Regular) Programme is four academic years.
ii. Each academic year of study is divided into two semesters.
iii. Minimum number of instruction days in each semester is 90 days.
iv. There shall be mandatory student induction program for fresher's, with a three-week duration before the commencement of first semester. Physical activity, Creative Arts, Universal Human Values, Literary, Proficiency Modules, Lectures by Eminent People, Visits to local Areas, Familiarization to Dept./Branch & Innovations etc., are included as per the guidelines issued by AICTE.
v. Health/wellness/yoga/sports and NSS /NSS /Scouts & Guides / Community service activities are made mandatory as credit courses for all the under graduate students.
vi. Courses like Environmental Sciences, Indian Knowledge System, Cybersecurity Awareness for Engineers, Gender Sensitization, Technical Paper Writing & IPR are offered as non-credit mandatory courses for all the undergraduate students.

vii. Design Thinking & Tinkering Labs are made mandatory as credit courses for all the undergraduate students. All lateral entry students shall mandatorily complete the Design Thinking course as a Zero-Credit MOOC. The course shall be successfully completed before the award of the degree, preferably by the commencement of the III Year I Semester. The successful completion of the course shall be recorded and reflected in the IV Year II Semester marks memorandum.

viii. A comprehensive online examination will be conducted in IV Year – I Semester for 2 credits

ix. Increased flexibility for students through an increase in the elective component of the curriculum, with 05 Professional Elective courses and 04 Open Elective courses.

x. Professional Elective Courses, include the elective courses relevant to the chosen specialization/branch. Proper choice of professional elective courses can lead to students specializing in emerging areas within the chosen field of study.

xi. A total of 04 Open Electives is offered in the curriculum.

xii. While choosing the electives, students shall ensure that they do not opt for the courses with syllabus contents similar to courses already pursued.

xiii. A pool of interdisciplinary/job-oriented/domain skill courses which are relevant to the industry are integrated into the curriculum of all disciplines. There shall be 05 skill-oriented courses offered during III to VII semesters. Among the five skill courses, four courses shall focus on the basic and advanced skills related to the domain/interdisciplinary courses and the other shall be a soft skills course.

xiv. Students shall undergo mandatory summer internships, for a minimum of six-eight weeks duration at the end of second and third year of the programme. The internship at the end of second year shall be community oriented and industry internship at the end of third year.

xv. There shall also be mandatory full internship in the final semester of the programme along with the project work.

xvi. Undergraduate degree with Honors and Minors is introduced by the Institution for the students having good academic record.

xvii. Each college shall take measures to implement Virtual Labs (https://www.vlab.co.in) which provide remote access to labs in various disciplines of Engineering and will help student in learning basic and advanced concept through remote experimentation. Student shall be made to work on virtual lab experiments during the regular labs.

xviii. The college shall assign a faculty advisor/mentor after admission to a group of students from same department to provide guidance in courses registration/career growth/placements/opportunities for higher studies/GATE/other competitive exams etc.

xix. Preferably 25% of course work for the theory courses in every semester shall be conducted in the blended mode of learning.

9. Evaluation Process

The performance of a student in each semester shall be evaluated subject wise with a maximum of 100 marks for theory and 100 marks for practical subject. Summer Internships shall be evaluated for 50 marks, Full Internship & Project work in final semester shall be evaluated for 200 marks, mandatory courses with no credits shall be evaluated for 30 mid semester marks.

A student has to secure not less than 35% of marks in the end examination and a minimum of 40% of marks in the sum total of the mid semester and end examination marks taken together for the theory, practical, design, drawing subject or project etc. In case of a mandatory course, he/she should secure 40% of the total marks.

Theory Courses

Assessment Method	Marks
Continuous Internal Assessment	30
Semester End Examination	70
Total	**100**

i) For theory subject, the distribution shall be 30 marks for Internal Evaluation and 70 marks for the End-Examination.
ii) For practical subject, the distribution shall be 30 marks for Internal Evaluation and 70 marks for the End- Examination.
iii) If any course contains two different branch subjects, the syllabus shall be written in two parts with 3 units each (Part-A and Part-B) and external examination question paper shall be set with two parts each for 35 marks.
iv) If any subject is having both theory and practical components, they will be evaluated separately as theory subject and practical subject. However, they will be given same subject code with an extension of 'T' for theory subject and 'P' for practical subject.

a) Continuous Internal Evaluation

i) For theory subjects, during the semester, there shall be two midterm examinations. Apart from two, one of the midterm examinations will be conduct in online mode for 25 marks and 5 marks for assignment or Each midterm examination shall be evaluated for 30 marks of which 10 marks for objective paper (20 minutes duration), 15 marks for subjective paper (90 minutes duration) and 5 marks for assignment.
ii) Objective paper shall contain for 05 short answer questions with 2 marks each or maximum of 20 bits for 10 marks. Subjective paper shall contain 3 either or type questions (totally six questions from 1 to 6) of which student has to answer one from each either-or type of questions. Each question carries 10 marks. The marks obtained in the subjective paper are condensed to 15 marks.

Note:

- The objective paper shall be prepared in line with the quality of competitive examinations questions.
- The subjective paper shall contain 3 either or type questions of equal weight age of 10 marks. Any fraction shall be rounded off to the next higher mark.
- The objective paper shall be conducted by the respective institution on the day of subjective paper test.
- Assignments shall be in the form of problems, mini projects, design problems, slip tests, quizzes etc., depending on the course content. It should be continuous assessment throughout the semester and the average marks shall be considered.

iii) If the student is absent for the mid semester examination, no re-exam shall be conducted and mid semester marks for that examination shall be considered as zero.

iv) First midterm examination shall be conducted for I, II units of syllabus with one either or type question from each unit and third either or type question from both the units. The second midterm examination shall be conducted for III, IV and V units with one either or type question from each unit.

v) Final mid semester marks shall be arrived at by considering the marks secured by the student in both the mid examinations with 80% weight age given to the better mid exam and 20% to the other.

For Example:

Marks obtained in first mid: 25
Marks obtained in second mid: 20
Final mid semester Marks: (25x0.8) + (20x0.2) = 24

If the student is absent for any one midterm examination, the final mid semester marks shall be arrived at by considering 80% weight age to the marks secured by the student in the appeared examination and zero to the other. For Example:

Marks obtained in first mid: Absent
Marks obtained in second mid: 25
Final mid semester Marks: (25x0.8) + (0x0.2) =20

b) End Examination Evaluation:

End examination theory subjects are evaluated via online mode shall have the following pattern:

i) There shall be 6 questions and all questions are compulsory.
ii) Question I shall contain 10 compulsory short answer questions for a total of 20marks such that each question carries 2 marks. There shall be 2 short answer questions from each unit.
iii) The questions from 2 to 6 shall be set by covering one unit of the syllabus for each question. In each of the questions from 2 to 6, there shall be either/or type questions of 10 marks each. Student shall answer any one of them

End examination of theory subjects consisting of two parts of different subjects, for Example: Basic Electrical &Electronics Engineering shall have the following pattern:

i) Question paper shall be in two parts viz., Part A and Part B with equal weight age of 35 marks each.
ii) In each part, question 1 shall contain 5 compulsory short answer questions for a total of 5 marks such that each question carries 1mark.
iii) In each part, questions from 2 to 4, there shall be either/or type questions of 10 marks each. Student shall answer any one of them.
iv) The questions from 2 to 4 shall be set by covering one unit of the syllabus for each question.

b) For practical courses, there shall be a continuous evaluation during the semester for 30 sessional marks and end examination shall be for 70 marks.
   i) Day-to-day work in the laboratory shall be evaluated for 15 marks by the concerned laboratory teacher based on the record/viva and 15 marks for the internal test.
   ii) The end examination shall be evaluated for 70 marks, conducted by the concerned laboratory teacher and a senior expert in the subject (from the same department) and from the other college nominated by the principal from the panel of Three members submitted by the Head of the Department.

a. Procedure: 20 marks
b. Experimental work & Results: 30 marks
c. Viva voce: 20 marks.

In a practical subject consisting of two parts (Eg: Basic Electrical & Electronics Engineering Lab), the end examination shall be conducted for 70 marks as a single laboratory in 3 hours. Mid semester examination shall be evaluated as above for 30 marks in each part and final mid semester marks shall be arrived by considering the average of marks obtained in two parts.

iii) For the subject having design and/or drawing, such as Engineering Drawing, the distribution of marks shall be 30 for mid semester evaluation and 70 for end examination.

Assessment Method	Marks
Continuous Internal Assessment	30
Semester End Examination	70
Total	**100**

Day-to-day work shall be evaluated for 15 marks by the concerned subject teacher based on the reports/submissions prepared in the class. And there shall be two midterm examinations in a semester for duration of 2 hours each for 15 marks with weight age of 80% to better mid marks and 20% for the other. The subjective paper shall contain 3 either or type questions of equal weight age of 5 marks. There shall be no objective paper in mid semester examination. The sum of day- to-day evaluation and the mid semester marks will be the final sessional marks for the subject.

The end examination pattern for Engineering Graphics, shall consists of 5 questions, either/or type, of 14 marks each. There shall be no objective type questions in the end examination. However, the end examination pattern for other subjects related to design/drawing, multiple branches, etc is mentioned along with the syllabus.

iv) There shall be no external examination for mandatory courses including competitive enhancement courses and foreign language courses with zero credits. However, attendance shall be considered while calculating aggregate attendance and student shall be declared to have passed the mandatory course only when he/she secures 40% or more in the internal examinations. In case, the student fails, a re-examination shall be conducted for failed candidates for 30 marks satisfying the conditions mentioned in item 1 & 2 of the regulations.

v) The laboratory records and Answer booklets including external & mid semester test papers shall be preserved for a minimum of 2 years in hard form in the respective institutions, and thereafter maintain soft copies of the same for the remaining period as per the University/Institution norms and shall be produced to the Committees of the University as and when the same are asked for.

NOTE

- **The end-semester examinations shall be conducted based on the theoretical components of the prescribed syllabus.**
- **Assignments shall be designed to incorporate AI-integrated elements of the syllabus to promote applied and experiential learning.**
- **The mid-semester examinations may include a combination of both theoretical content and AI-integrated components**

10. Skill oriented Courses

i) There shall be five skill-oriented courses offered during III to VII semesters.

ii) Out of the five skill courses two shall be skill-oriented courses from the same domain. Of the remaining three skill courses, one shall be a soft skill course and the remaining two shall be skill-advanced courses from the same domain/Interdisciplinary/Job oriented.

iii) The course shall carry 100 marks and shall be evaluated through continuous assessments during the semester for 30 sessional marks and end examination shall be for 70 marks. Day-to-day work in the class / laboratory shall be evaluated for 30 marks by the concerned teacher based on the regularity/assignments/viva/mid semester test. The end examination similar to practical examination pattern shall be conducted by the concerned teacher and an expert in the subject nominated by the principal.

iv) The Head of the Department shall identify a faculty member as coordinator for the course. A committee consisting of the Head of the Department, coordinator and a senior Faculty member nominated by the Head of the Department shall monitor the evaluation process. The marks/grades shall be assigned to the students by the above committee based on their performance.

v) The student shall be given an option to choose either the skill courses being offered by the college or to choose a certificate course being offered by industries/Professional bodies or any other accredited bodies. If a student chooses to take a Certificate Course offered by external agencies, the credits shall be awarded to the student upon producing the Course Completion Certificate from the agency. A committee shall be formed at the level of the college to evaluate the grades/marks given for a course by external agencies and convert to the equivalent marks/grades.

vi) The recommended courses offered by external agencies, conversions and appropriate grades/marks are to be approved by the Institution. The Head of the Department shall forward such proposals to the University for approval.

vii) If a student prefers to take a certificate course offered by external agency, the department shall mark attendance of the student for the remaining courses in that semester excluding the skill course in all the calculations of mandatory attendance requirements upon producing a valid certificate as approved by the Principal.

11. Massive Open Online Courses (MOOCs):

To promote self-learning and lifelong learning, students are encouraged to enroll in Massive Open Online Courses (MOOCs) offered through **SWAYAM, SWAYAM Plus, and NPTEL** or other University/Institution-approved platforms.

A student may earn up to 40% of the total credits prescribed in a semester through MOOCs, subject to the University's/Institution guidelines and equivalence requirements.

Further, every student shall mandatorily complete at least one MOOC course before the commencement of the IV Year II Semester. In addition, the Fifth Professional Elective (PE-V) and the Fourth Open Elective (OE-IV) shall be mandatorily completed through the SWAYAM/SWAYAM Plus platforms. This provision is intended to facilitate students in undertaking the Long-Term Internship during the final semester. Accordingly, every student shall mandatorily complete a total of three MOOC courses for the award of the B.Tech. degree. The following are guidelines for MOOC courses.

i. Students may earn a maximum of 40% of the credits in a semester through MOOCs for PE, OE, and SEC. Further, students of III and IV year are also permitted to pursue Core Courses (CC) through MOOCs.

ii. The all the courses for Honors and Minors may studied through MOOCs platform

iii. Students shall register for MOOCs courses of a minimum duration of either 8 weeks or 12 weeks with the prior approval of the Head of the Department. Credits shall be awarded as follows:

   a) 2 credits for an 8-week course
   b) 3 credits for a 12-week course

iv. The NCrF rating for the Course is 4.5 for UG program

v. The Head of the Department shall nominate a faculty mentor to monitor the academic progress of students enrolled in MOOCs. It is also responsibility of the mentor to see that the registered subjects is in the approved list provided by the Institution.

vi. Students shall have the option to choose either the regular offline (classroom) mode or the SWAYAM mode for a particular subject. However, a student shall not be permitted to opt for both modes simultaneously for the same subject. Students opting for SWAYAM shall be exempted from attending regular classroom sessions for that subject, and attendance shall not be counted. Further, Institution should not insist the student to opt SWAYAM course compulsorily.

vii. All students in a class are not required to opt for the same SWAYAM course. Institutions shall arrange regular classes for students opting for offline mode, while the same faculty member may act as a mentor for students enrolled in the SWAYAM course. If all students opt for a SWAYAM course, the subject need not be included in the timetable; however, a mentor shall be assigned to address student queries as per mutual convenience.

viii. Students who completed the prescribed assignments successfully and secured at least 40% of the internal marks shall be permitted to appear for the end-semester examination conducted either by the National Testing Agency (NTA)/NPTEL or by the University/institution. University/Institute-conducted examinations shall be held along with regular end-semester examinations, with a weightage of 70% for the end-term examination and 30% for assignments and quizzes evaluated by the SWAYAM Course Coordinator.

ix. Credits shall be awarded only upon submission of a successful course completion certificate. Internal marks obtained through SWAYAM shall be extrapolated to 30 and external marks interpolated to 70, and shall exactly correspond to the marks secured by the student in the SWAYAM course.

x. In case where University/Institution-prescribed passing marks are higher than SWAYAM's minimum requirements, the University/Institution norms shall prevail. In such cases, even if a student submits a SWAYAM certificate but fails to secure the University's/Institution minimum passing marks, the student shall be declared unsuccessful and must appear for the supplementary examination.

xi. In cases where a student obtains less than the prescribed minimum internal marks (12 out of 30) in a SWAYAM course, and the said course is not offered again in the subsequent semester, the University/Institution may, through a special notification, conduct a full-course supplementary examination for 100 marks during the final semester of the programme. The examination shall be conducted in accordance with the University/Institution question paper pattern for **70 marks**, strictly following the University/Institution -prescribed syllabus and it will be extrapolated to 100.

xii. For SWAYAM courses where end-term examinations are conducted by the University/Institution, students shall not be issued a SWAYAM certificate.

xiii. If a SWAYAM course carries more credits than the corresponding JNTUA/Institution course, credit transfer shall be restricted to the number of credits prescribed by JNTUA/Institution to maintain uniformity in total credit requirements. Credit transfer shall not be permitted if the SWAYAM course carries fewer credits than the JNTUA/Institution course.

Students who have qualified in the proctored examinations conducted through MOOCs platform can apply for credit transfer as specified and are exempted from appearing internal as well as external examination (for the specified equivalent credit course only) conducted by the university/Institution.

Necessary amendments in rules and regulations regarding adoption of MOOC courses would be proposed from time to time.

12. Credit Transfer Policy

Adoption of MOOCs is mandatory, to enable Blended model of teaching-learning as also envisaged in the NEP 2020. As per University Grants Commission (Credit Framework for Online Learning Courses through SWAYAM) Regulation, 2016, the University/Institution shall allow up to a maximum of 40% of the credits in a semester being offered in a particular programme i.e., via Swayam/Swayam Plus courses through MOOCs platform.

i) The University/Institution shall offer credit mobility for MOOCs and give the equivalent credit weight age to the students for the credits earned through online learning courses.
ii) Student registration for the MOOCs shall be only through the respective department of the institution, it is mandatory for the student to share necessary information with the department.
iii) Credit transfer policy will be applicable to the Professional & Open Elective courses only.

iv) The concerned department shall identify the courses permitted for credit transfer.
v) The University/institution shall notify at the beginning of semester the list of the online learning courses eligible for credit transfer.
vi) The institution shall designate a faculty member as a Mentor for each course to guide the students from registration till completion of the credit course.
vii) The university/Institution shall ensure no overlap of MOOC exams with that of the university/Institution examination schedule. In case of delay in results, the university/Institution will re-issue the marks sheet for such students.
viii) Student pursuing courses under MOOCs shall acquire the required credits only after successful completion of the course and submitting a certificate issued by the competent authority along with the percentage of marks and grades.
ix) The Head of the department shall submit the following to the examination section of the Institution:
    a) List of students who have passed MOOC courses in the current semester along with the certificate of completion.
    b) Undertaking form filled by the students for credit transfer.
x) The universities shall resolve any issues that may arise in the implementation of this policy from time to time and shall review its credit transfer policy in the light of periodic changes brought by UGC, SWAYAM, NPTEL and state government.

13. Academic Bank of Credits (ABC)

The Institution has implemented Academic Bank of Credits (ABC) to promote flexibility in curriculum as per NEP 2020 to

i. provide option of mobility for learners across the universities/institutions of their choice
ii. provide option to gain the credits through MOOCs from approved digital platforms.
iii. facilitate award of certificate/diploma/degree in line with the accumulated credits in ABC
iv. execute Multiple Entry and Exit system with credit count, credit transfer and credit acceptance from students' account.

14. Mandatory Internships

Summer Internships & Projects: Two summer internships with a minimum of 06-08 weeks duration (2 credits each), done at the end of second and third years, respectively are mandatory. It shall be completed in collaboration with local industries, Govt. Organizations, construction agencies, Power projects, software MNCs or any industries in the areas of concerned specialization of the Undergraduate program. One of the two summer internships at the end of second year (Community Service Project) shall be society oriented and shall be completed in collaboration with government organizations/NGOs & others. The other internship at the end of third year is Industry Internship and shall be completed in collaboration with Industries. The student shall register for the internship as per course structure after commencement of academic year. The guidelines issued by the APSCHE / University/Institution shall be followed for carrying out and evaluation of Community Service Project and Industry Internship.

Evaluation of the summer internships shall be through the departmental committee. A student will be required to submit a summer internship report to the concerned department and appear for an oral presentation before the departmental committee comprising of Head of the Department, Mentor of the internship and a senior faculty member of the department. A certificate of successful completion from industry shall be included in the report. The report and the oral presentation shall carry 50% weight age each. It shall be evaluated for 50 external marks. There shall be no internal marks for Summer Internship. The institution shall also introduce Micro Projects in the II Semester, Minor Projects in the IV Semester, and Mini Projects in the VI Semester, each carrying 50 marks for internal evaluation and zero credits. A student shall secure minimum 40% of marks for successful completion. In case, if a student fails, he/she shall reappear as and when semester supplementary examinations are conducted by the University/Institution.

Full Semester Internship and Project work: In the final semester, the student should mandatorily register and undergo internship and in parallel he/she should work on a project with well-defined objectives. At the end of the semester the candidate shall submit an internship completion certificate and a project report. A student shall also be permitted to submit project report on the work carried out during the internship.
The Long-Term Industry Internship undertaken in the final semester (IV Year – II Semester) shall be evaluated for 50 marks by a committee consisting of the Head of the Department along with two senior faculty members of the department. Further, every student shall undertake at least one Industry Visit between the V and VII Semesters, as part of the mandatory internships and practical training requirements.

The project report shall be evaluated with an external examiner. The total marks for project work 200 marks (8 credits) and distribution shall be 60 marks for internal and 140 marks for external evaluation. The supervisor assesses the student for 30 marks (Report: 15 marks, Seminar: 15 marks). At the end of the semester, all projects shall be show cased at the department for the benefit of all students and staff and the same is to be evaluated by the departmental Project Review Committee consisting of supervisor, a senior faculty and HOD for 30 marks. The external evaluation of Project Work is a Viva-Voce Examination conducted in the presence of internal examiner (Supervisor), Head of the department and external examiner appointed by the principal from the panel of Three members submitted by the Head of the Departments and is evaluated for 140 marks.

The respective departments shall facilitate and monitor the student internship programs. Completion of internships is mandatory, if any student fails to complete internship, he/she will not be eligible for the award of degree. In such cases, the student shall repeat and complete the internship.

15. Student Development Program (SDP) – Department-Wise Workshop (Mandatory Non-Credit Course)

Each Department shall design and conduct a **Student Development Programme (SDP)/Department-Wise Workshop** relevant to its discipline for all B.Tech. students. The programme shall carry **Zero Credits** and shall be conducted **at the end of the III B.Tech. I Semester**.

The following guidelines shall govern the conduct and evaluation of the programme:

1. **Programme Planning:** The Head of the Department (HoD) shall prepare and notify the workshop schedule, syllabus/content, learning outcomes, and assessment plan at least **two weeks prior to the commencement** of the programme.
2. **Attendance:** Attendance in all workshop sessions shall be **mandatory**. Students shall attend the programme as per the notified schedule.
3. **Evaluation:** The programme shall be evaluated for a total of **50 marks**, comprising:
   - **25 marks** for continuous assessment based on participation, assignments, practical activities, presentations, or other evaluation components prescribed by the Department; and
   - **25 marks** for a final examination to be conducted on the **last day of the workshop**.
4. **Pass Requirements:** A student shall be declared to have **successfully completed** the programme only if he/she secures 40% marks in both:
5. **Submission of Marks:** The HoD shall submit the finalized marks list to the **Controller of Examinations of the institution,** in the prescribed format within the timeline notified by the Principal of the Institution.
6. **Certification:** A **Workshop Completion Certificate** shall be issued only to those students who have successfully fulfilled the prescribed attendance and pass requirements.
7. **Supplementary Examination:** A student who fails to secure the minimum prescribed marks in either the continuous assessment or the final examination shall be required to appear for the **supplementary examination** conducted by the University/Institute in the subsequent semester, as per the University/Institute rules and schedule.

Successful completion of the **Student Development Programme (SDP)/Department-Wise Workshop** is **mandatory for the award of the B.Tech. degree**, and its completion status shall be reflected in the student's academic records.

16. Guidelines for offering a Minor

To promote interdisciplinary knowledge among the students, the students admitted into B.Tech. in a major stream/branch are eligible to obtain degree in Minor in another stream.

i) Minors is introduced in the curriculum of all B. Tech. programs offering a major degree and is applicable to all B. Tech (Regular and Lateral Entry) students admitted in Engineering & Technology.

ii) A student shall earn additional 18 credits (comprising 5 theory courses and 2 laboratory/project courses, offered in tracks) for award of B.Tech.(Minors) degree. This is in addition to the credits essential for obtaining the Undergraduate degree in Major Discipline (i.e., 171 credits).

iii) A student is permitted to register for Minors in IV semester after the results of III Semester are declared and students may be allowed to take maximum two subjects per semester pertaining to the Minors from V Semester onwards.

iv) The concerned Principal of the college shall arrange separate class work and timetable of the courses offered under Minors program.

v) Courses that are used to fulfil the student's primary major (Open Elective) may not be double counted towards the Minors. Courses with content substantially

equivalent to courses in the student's primary Major may not be counted towards the Minors.

vi) Students can complete the courses offered under Minors either in the college or in online platforms like SWAYAM with a minimum duration of 12 weeks for a 3-credit course and 8 weeks duration for a 2-credit course satisfying the criteria for credit mobility. If the courses under Minors are offered in conventional mode, then the teaching and evaluation procedure shall be similar to regular B. Tech courses.

vii) The attendance for the registered courses under Minors and regular courses offered for Major degree in a semester are to be considered separately.

viii) A student shall maintain an attendance of 75% in all registered courses under Minors to be eligible for attending semester end examinations.

ix) A student registered for Minors shall pass in all subjects that constitute the requirement for the Minors degree program. No class/division (i.e., second class, first class and distinction, etc.) shall be awarded for Minors degree programme.

x) If a student drops or is terminated from the Minors program, the additional credits so far earned cannot be converted into open or core electives; they will remain extra. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.

xi) The Minors will be mentioned in the degree certificate. Every engineering department in the institution shall offer minor program and A Minor course on Quantum Computing shall be offered for all branches, with the curriculum framed by the CSE Department.

xii) A student who fails in any course of the Minor Programme shall be permitted to appear for the corresponding supplementary examination(s) as per the University/Institute rules. However, the student shall successfully complete all the prescribed courses of Minor program before Completion of Major Degree Programme. Failure to do so shall result in the cancellation of admission to the Minor Programme, and no Minor credential shall be awarded.

xiii) All the courses offered under Minor may also be pursued through MOOCs. The Bloom's Taxonomy level for Minor courses shall be 3 and below

17. Guidelines for offering Honors

The objective of introducing B.Tech. (Hons.) is to facilitate the students to choose additionally the specialized courses of their choice and build their competence in a specialized area in the UG level. The programme is a best choice for academically excellent students having good academic record and interest towards higher studies and research.

i. Honors is introduced in the curriculum of all B. Tech. programs offering a major degree and is applicable to all B. Tech (Regular and Lateral Entry) students admitted in Engineering & Technology.

ii. Students with CGPA of 7 and no back logs upto 2nd year I semester are eligible to register for honors programs.

iii. A student shall earn additional 18 credits (comprising 5 theory courses and 2 laboratory/project courses, offered in tracks) for award of B.Tech.(Honors) degree from same branch/department/discipline registered for major degree. This is in addition to the credits essential for obtaining the Undergraduate degree in Major Discipline (i.e., 171 credits).

iv. A student is permitted to register for Honors in IV semester after the results of

III Semester are declared and students may be allowed to take maximum two subjects per semester pertaining to the Honors from V Semester onwards.

v. The concerned HODs of the college shall arrange separate class work and timetable of the courses offered under Honors program.

vi. Courses that are used to fulfil the student's primary major may not be double counted towards the Honors. Courses with content substantially equivalent to courses in the student's primary Major may not be counted towards the Honors.

vii. Students can complete the courses offered under Honors either in the college or in online platforms like SWAYAM with a minimum duration of 12 weeks for a 3-credit course and 8 weeks duration for a 2-credit course satisfying the criteria for credit mobility. If the courses under Honors are offered in conventional mode, then the teaching and evaluation procedure shall be similar to regular B. Tech courses.

viii. The attendance for the registered courses under Honors and regular courses offered for Major degree in a semester are to be considered separately.

ix. A student shall maintain an attendance of 75% in all registered courses under Honors to be eligible for attending semester end examinations.

x. A student registered for Honors shall pass in all subjects that constitute the requirement for the Honors degree program. No class/division (i.e., second class, first class and distinction, etc.) shall be awarded for Honors degree programme.

xi. Registration for honors program continue even if the student fails in any of the regular course after his registration to honors course.

xii. A student who fails in any course of the Honor Programme shall not be permitted write the supplementary examination and the registration for the Honor Programme will be cancelled.

xiii. If a student drops or is terminated from the Honors program, the additional credits so far earned cannot be converted into open or core electives; they will remain extra. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.

xiv. The Honors will be mentioned in the degree certificate as Bachelor of Technology (Honors) in XYZ. For example, B.Tech. (Honors) in Mechanical Engineering

xi) All the courses offered under Honors may also be pursued through MOOCs. The Bloom's Taxonomy level for Honors courses shall be 3 and above,

Enrolment into Honors:

i) Students of a Department/Discipline are eligible to opt for Honors program offered by the same Department/Discipline

ii) The enrolment of student into Honors is based on the CGPA obtained in the major degree program. CGPA shall be taken up to III semester in case of regular entry students and only III semester in case of lateral entry students. Students having 7 CGPA without any backlog subjects will be permitted to register for Honors.

iii) If a student is detained due to lack of attendance either in Major or in Honors, registration for Honors shall be cancelled.

iv) Transfer of credits from Honors to regular B. Tech degree and vice-versa shall not be permitted.

v) Honors is to be completed simultaneously with a Major degree program.

Registration for Honors/Minors:

i) The eligible and interested students shall apply through the HOD of his/her parent department. The whole process should be completed within one week before the start of every semester. Selected students shall be permitted to register the courses under Honors/ Minors.
ii) The students enrolled in the Honors/ Minors courses will be monitored continuously. An advisor/mentor from parent department shall be assigned to a group of students to monitor the progress.
iii) There is no fee for registration of subjects for Honors/ Minors program offered in offline at the respective institutions.

Failure & Supplementary Examination Procedure for Honors/Minors Courses:

i) Time Limit for Completion:
The student must successfully complete all Honours/ Minors courses within the regular period of study applicable to the B.Tech. programme.
ii) Cancellation of Honours/ Minors Registration:
If the student fails to complete all Honours requirements within the stipulated regular period of study, the Honours/ Minors registration shall stand cancelled, and the additional credits earned shall remain extra. These credits should not be counted for the award of the major Degree.

18. Attendance Requirements:

i) A student shall be eligible to appear for the Institution external examinations if he/she acquires a minimum of 40% attendance in each subject and 75% of attendance in aggregate of all the subjects. b) Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester may be granted by the College Academic Committee.
ii) Shortage of Attendance below 65% in aggregate shall in NO CASE be condoned.
iii) A stipulated fee shall be payable towards condonation of shortage of attendance to the University/Institution.
iv) Students whose shortage of attendance is not condoned in any semester are not eligible to take their end examination of that class and their registration shall stand cancelled.
v) A student will not be promoted to the next semester unless he satisfies the attendance requirements of the present semester. They may seek readmission for that semester from the date of commencement of class work.
vi) If any candidate fulfils the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.
vii) If the learning is carried out in blended mode (both offline & online), then the total attendance of the student shall be calculated considering the offline and online attendance of the student.
viii) For induction programme attendance shall be maintained as per AICTE norms.
ix) Attendance in SWAYAM courses shall be excluded from the calculation of the student's overall attendance requirement for the semester.

19. Promotion Rules:

The following academic requirements must be satisfied in addition to the attendance requirements mentioned in section 16.

i) A student shall be promoted from first year to second year if he/she fulfils the

minimum attendance requirement as per university/institution norms.

ii) A student will be promoted from II to III year if he/she fulfils the academic requirement of securing 40% of the credits (any ***decimal*** fraction should be ***rounded off*** to ***lower*** digit) up to in the subjects that have been studied up to III semester.

iii) A student shall be promoted from III year to IV year if he/she fulfils the academic requirements of securing 40% of the credits (any ***decimal*** fraction should be ***rounded off*** to ***lower*** digit) in the subjects that have been studied up to V semester. And in case a student is detained for want of credits for a particular academic year by ii) & iii) above, the student may make up the credits through supplementary examinations and only after securing the required credits he/she shall be permitted to join in the V semester or VII semester respectively as the case may be.

iv) When a student is detained due to lack of credits/shortage of attendance he/she may be re-admitted when the semester is offered after fulfilment of academic regulations. In such case, he/she shall be in the academic regulations into which he/she is readmitted.

20. Grading:

As a measure of the student's performance, a 10-point Absolute Grading System using the following Letter Grades and corresponding percentage of marks shall be followed:

After each course is evaluated for 100 marks, the marks obtained in each course will be converted to a corresponding letter grade as given below, depending on the range in which the marks obtained by the student fall.

Structure of Grading of Academic Performance

Range in which the marks in the subject fall	Grade	Grade points Assigned
90 & above	S (Superior)	10
80 - 89	A(Excellent)	9
70 - 79	B (Very Good)	8
60 - 69	C (Good)	7
50 - 59	D (Average)	6
40 - 49	E (Below Average)	5
< 40	F (Fail)	0
Absent	Ab (Absent)	0

i) A student obtaining Grade 'F' or Grade 'Ab' in a subject shall be considered failed and will be required to reappear for that subject when it is offered the next supplementary examination.

ii) For non-credit audit courses, "Satisfactory" or "Unsatisfactory" shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA/Percentage.

Computation of Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

The Semester Grade Point Average (SGPA) is the ratio of sum of the product of the number of credits with the grade point scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.,

$$SGPA = \Sigma(C_i \times G_i)/\Sigma C_i$$

Where, C_i is the number of credits of the ith subject and G_i is the grade point scored by the student in the ith course.

The Cumulative Grade Point Average (CGPA) will be computed in the same manner considering all the courses undergone by a student over all the semesters of a program, i.e.,

$$CGPA = \Sigma(C_i \times S_i)/\Sigma C_i$$

Where "S_i" is the SGPA of the ith semester and C_i is the total number of credits up to that semester.

Both SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

While computing the SGPA the subjects in which the student is awarded Zero grade points will also be included.

Grade Point: It is a numerical weight allotted to each letter grade on a 10-point scale.
Letter Grade: It is an index of the performance of students in a said course. Grades are denoted by the letters S, A, B, C, D and F.

Award of Class:

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of B. Tech. Degree, he/she shall be placed in one of the following four classes:

Class Awarded	CGPA Secured
First Class with Distinction	≥ 7.5
First Class	≥ 6.5 < 7.5
Second Class	≥ 5.5 < 6.5
Pass Class	≥ 4.5 < 5.5

Both CGPA and Marks shall be given in the marks memos.

21. With–holding of Results

If the candidate has any dues not paid to the Institution or if any case of indiscipline or malpractice is pending against him/her, the result of the candidate shall be withheld in such cases.

22. Multiple Entry / Exit Option

(a) Exit Policy:

The students can choose to exit the four-year programme at the end of first/second/third year.

i) **UG Certificate in (Field of study/discipline)** - Programme duration: First year (first two semesters) of the undergraduate programme, followed by an additional exit 10-credit bridge course(s) lasting two months, including at least 6- credit job-specific internship/ apprenticeship that would help the candidates acquire job-ready competencies required to enter the workforce.

ii) **UG Diploma (in Field of study/discipline)** - Programme duration: First two years (first four semesters) of the undergraduate programme, followed by an additional exit 10-credit bridge course(s) lasting two months, including at least 6- credit job-specific internship/ apprenticeship that would help the candidates acquire job-ready competencies required to enter the workforce.

iii) **Bachelor of Science (in Field of study/discipline)** i.e., **B.Sc. Engineering in (Field of study/discipline)**- Programme duration: First three years (first six semesters) of the undergraduate programme.

(b) Entry Policy:

Modalities on multiple entry by the student into the B.Tech. programme will be provided in due course of time.

Note: The Universities shall resolve any issues that may arise in the implementation of Multiple Entry and Exit policies from time to time and shall review the policies in the light of periodic changes brought by UGC, AICTE and State government.

23. Gap Year Concept:

Gap year concept for Student Entrepreneur in Residence is introduced and outstanding students who wish to pursue entrepreneurship / become entrepreneur are allowed to take a break of one year at any time after II year to pursue full-time entrepreneurship programme/to establish start-ups. This period may be extended to two years at the most and these two years would not be counted for the time for the maximum time for graduation. The Head of the department of the respective college shall forward such proposals submitted by the students to the Principal. An evaluation committee constituted by the University/Institution shall evaluate the proposal submitted by the student and the committee shall decide whether to permit the student(s) to avail the Gap Year or not

24. Transitory Regulations

Discontinued, detained, or failed candidates are eligible for readmission as and when the semester is offered after fulfilment of academic regulations. Candidates who have been detained for want of attendance or not fulfilled academic requirements or who have failed after having undergone the course in earlier regulations or have discontinued and wish to continue the course are eligible for admission into the unfinished semester from the date of commencement of class work with the same or equivalent subjects as and when subjects are offered, and they will follow the academic regulations into which they are readmitted.

Candidates who are permitted to avail Gap Year shall be eligible for re-joining into the succeeding year of their B. Tech from the date of commencement of class work, and they will follow the academic regulations into which they are readmitted

25. Minimum Instruction Days for a Semester:

The minimum instruction days including exams for each semester shall be 90 days.

26. Medium of Instruction

The medium of instruction of the entire B. Tech undergraduate programme in Engineering & Technology (including examinations and project reports) will be in English only

27. Student Transfers:

Student transfers shall be as per the guidelines issued by the Government of Andhra Pradesh and the Universities from time to time.

28. General Instructions:

i. The academic regulations should be read as a whole for purpose of any interpretation.
ii. Malpractices rules-nature and punishments are appended.
iii. Where the words "he", "him", "his", occur in the regulations, they also include "she", "her", "hers", respectively.
iv. In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.
v. The Universities may change or amend the academic regulations or syllabi at any time and the changes or amendments shall be made applicable to all the students on rolls with effect from the dates notified by the Universities.
vi. In the case of any doubt or ambiguity in the interpretation of the guidelines given, the decision of the Vice-Chancellor / Head of the institution is final.

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ACADEMIC REGULATIONS (R26)

FOR B.TECH. (LATERAL ENTRY SCHEME)

*(Effective for the students admitted into II year through Lateral Entry Scheme from the Academic Year **2027-28** onwards)*

1. **Award of the Degree**
   (a) Award of the B.Tech. Degree / B.Tech. Degree with a Minor if he/she fulfils the following:
      (i) Pursues a course of study for not less than three academic years and not more than six academic years. However, for the students availing Gap year facility this period shall be extended by two years at the most and these two years would in addition to the maximum period permitted for graduation (Six years).
      (ii) Registers for 131 credits and secures all 131 credits.

   (b) **Award of B.Tech. degree with Honors** if he/she fulfils the following:
      (i) Student secures additional 18 credits fulfilling all the requisites of a B.Tech. program i.e., 131 credits.
      (ii) Registering for Honors is optional.
      (iii) Honors is to be completed simultaneously with B.Tech. programme.

   (c) Award of B.Tech. degree with Minors
      (i) Student secures additional 18 credits fulfilling all the requisites of a B.Tech. program i.e., 131 credits.
      (ii) Registering for Minors is optional.
      (iii) Minors is to be completed simultaneously with B.Tech. programme.

2. Students, who fail to fulfil the requirement for the award of the degree within <u>six</u> consecutive academic years from the year of admission, shall forfeit their seat.

3. All lateral entry students shall mandatorily complete the Design Thinking course as a Zero- Credit MOOC. The course shall be successfully completed before the award of the degree, preferably by the commencement of the III Year I Semester. The successful completion of the course shall be recorded and reflected in the IV Year II Semester marks memorandum.

4. Course Pattern

i) The entire course of study is three academic years on semester pattern.

ii) A student eligible to appear for the end examination in a subject but absent at it or has failed in the end examination may appear for that subject at the next supplementary examination offered.

iii) When a student is detained due to lack of credits/shortage of attendance the student may be re-admitted when the semester is offered after fulfilment of academic regulations, the student shall be in the academic regulations into which he/she is readmitted.

5 All other academic regulations, including those relating to attendance, examinations, promotion, evaluation, and the award of the degree, shall be the same as those prescribed for regular B.Tech. students, unless otherwise specified

RULES FOR

DISCIPLINARY ACTION FOR MALPRACTICES / IMPROPER CONDUCT IN EXAMINATIONS

	Nature of Malpractices/Improper conduct	Punishment
	If the candidate:	
1.(a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The Hall Ticket of the candidate is to be cancelled and handed over to the examination of the autonomous college.
3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred for four consecutive semesters from class work and all examinations. The continuation of the course by the regulations in connection with forfeiture of seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for four consecutive semesters from class work and all examinations, if his involvement is established. Otherwise, the candidate is debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.

4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject only.
6.	Refuses to obey the orders of the Chief Superintendent /Assistant - Superintendent /any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. If the candidate physically assaults the invigilator/ officer-in-charge of the Examinations, then the candidate is also debarred and forfeits his/her seat. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9.	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the college expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also

		debarred and forfeits the seat. Person (s) who do not belong to the College will be handed over to police and, a police case will be registered against them.
10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject only or in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester / year examinations, depending on the recommendation of the committee.
12	Tampering of the NPTEL/SWAYAM/SWAYAM certificate	Cancellation of student performance in the entire semester
13.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the College for further action to award suitable punishment.	

Malpractices identified by squad or special invigilators

1. Punishments to the candidates as per the above guidelines.
2. Punishment for institutions: (if the squad reports that the college is also involved in encouraging malpractices)
3. A show cause notice shall be issued to the college.
4. Impose a suitable fine on the college.
5. Shifting the examination centre from the college to another college for a specific period of not less than one year.

Note:-

Whenever the performance of a student is cancelled in any subject/subjects due to Malpractice, he has to register for End Examinations in that subject/subjects consequently and has to fulfil all the norms required for the award of Degree.

R26 Regulations – Students Mandatory Academic Requirements:

1. A minimum of **171 credits for Regular** students and **131 credits for Lateral Entry students** must be secure for the award of the B.Tech. degree.
2. Students must maintain a minimum of **75% aggregate attendance** and at least **40% attendance in each subject**. Aggregate attendance **below 65% cannot** be condoned.
3. Students must secure a **minimum of 40% overall marks** and **at least 35% marks** in the End Examination for regular courses.
4. **Three MOOCs** are mandatory for the award of the B.Tech. degree, in which **PE-V and OE-IV** must be completed through SWAYAM/SWAYAM Plus.
5. A **Micro Project** in B.Tech. I Year – II Semester, a **Minor Project** in B.Tech. II Year – II Semester, and a **Mini Project** in B.Tech. III Year – II Semester are mandatory for the award of the B.Tech. degree.
6. **Two summer internships**, along with the f**inal-semester internship and project**, are mandatory for the award of the B.Tech. degree.
7. A **comprehensive online examination** carrying 2 credits will be conducted by the University in IV Year – I Semester. The examination will cover the complete core syllabus up to B.Tech. IV Year – I Semester.
8. **Promotion Rule:** Students must earn at least **40% of the prescribed credits** to be promoted from **II Year to III Year and from III Year to IV Year**, in addition to fulfilling the attendance requirements.
9. **Honors:** Students must have a minimum **CGPA of 7.0** and no backlogs up to the specified semesters to be eligible for Honors. **Minors** are open to all eligible students and require an additional **18 credits** from the **IV Semester onwards**.

SANTHIRAM ENGINEERING COLLEGE

(AUTONOMOUS)

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

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I B.TECH I & II SEMESTER COURSE STRUCTURE

R-26

SANTHIRAM ENGINEERING COLLEGE

(AUTONOMOUS)

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

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I B.TECH I SEMESTER (R26) - COMPUTER SCIENCE & ENGINEERING							
S.NO	Course code	Title	L/D	T	Pr	P	Credits
1	26A91101	LINEAR ALGEBRA & CALCULUS	3	0	2	0	4
2	26A05101T	COMPUTATIONAL THINKING & PROBLEM SOLVING WITH PYTHON	3	0	0	3	3
3	26A99101	DESIGN THINKING	1	0	4	0	3
4	26A03101	ENGINEERING GRAPHICS	1	0	4	0	3
5	26A93102T	APPLIED CHEMISTRY FOR COMPUTER SCIENCE	3	0	0	0	3
6	26A05101P	COMPUTATIONAL THINKING AND PROBLEM SOLVING WITH PYTHON LAB	0	0	0	3	1.5
7	26A93102P	APPLIED CHEMISTRY FOR COMPUTER SCIENCE LAB	0	0	0	3	1.5
8	26A03102	ENGINEERING WORKSHOP	0	0	0	3	1.5
9	26A99102	NSS/NCC/SCOUTS & GUIDES/COMMUNITY SERVICE	0	0	0	1	0.5
10	26A05102	CYBERSECURITY AWARENESS FOR ENGINEERS	2	0	0	0	0
11	26A91102	COMPETITIVE ENHANCEMENT COURSE - I	2	0	0	0	0
TOTAL			15	00	10	13	21

I B.TECH II SEMESTER (R26) - COMPUTER SCIENCE & ENGINEERING							
S.NO	Course code	Title	L/D	T	Pr	P	Credits
1	26A91202	DIFFERENTIAL EQUATIONS & VECTOR CALCULUS	3	0	2	0	4
2	26A05203T	PROFESSIONAL CORE 1 - DATA STRUCTURES & EFFICIENT PROBLEM SOLVING	3	0	0	0	3
3	26A33101P	AI TOOLS & APPLICATIONS	1	0	4	0	3
4	26A94101T	COMMUNICATIVE ENGLISH	2	0	0	0	2
5	26A92101T	PHYSICS FOR ADVANCED COMPUTING	3	0	0	0	3
6	26A94101P	COMMUNICATIVE ENGLISH LAB	0	0	0	2	1
7	26A92101P	PHYSICS FOR ADVANCED COMPUTING LAB	0	0	0	3	1.5
8	26A05203P	DATA STRUCTURES & EFFICIENT PROBLEM SOLVING LAB	0	0	0	2	1
9	26A99103	HEALTH AND WELLNESS, YOGA AND SPORTS	0	0	0	1	0.5
10	26A91203	COMPETITIVE ENHANCEMENT COURSE - II	2	0	0	0	0
TOTAL			14	00	06	08	19

SANTHIRAM ENGINEERING COLLEGE

(AUTONOMOUS)

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

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I B.TECH I SEMESTER COURSE STRUCTURE

SANTHIRAM ENGINEERING COLLEGE

(AUTONOMOUS)

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

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I B.TECH I SEMESTER (R26) - COMPUTER SCIENCE & ENGINEERING							
S.NO	Course code	Title	L/D	T	Pr	P	Credits
1	26A91101	LINEAR ALGEBRA & CALCULUS	3	0	2	0	4
2	26A05101T	COMPUTATIONAL THINKING & PROBLEM SOLVING WITH PYTHON	3	0	0	3	3
3	26A99101	DESIGN THINKING	1	0	4	0	3
4	26A03101	ENGINEERING GRAPHICS	1	0	4	0	3
5	26A93102T	APPLIED CHEMISTRY FOR COMPUTER SCIENCE	3	0	0	0	3
6	26A05101P	COMPUTATIONAL THINKING AND PROBLEM SOLVING WITH PYTHON LAB	0	0	0	3	1.5
7	26A93102P	APPLIED CHEMISTRY FOR COMPUTER SCIENCE LAB	0	0	0	3	1.5
8	26A03102	ENGINEERING WORKSHOP	0	0	0	3	1.5
9	26A99102	NSS/NCC/SCOUTS & GUIDES/COMMUNITY SERVICE	0	0	0	1	0.5
10	26A05102	CYBERSECURITY AWARENESS FOR ENGINEERS	2	0	0	0	0
11	26A91102	COMPETITIVE ENHANCEMENT COURSE - I	2	0	0	0	0
TOTAL			**15**	**00**	**10**	**13**	**21**

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I B.TECH I SEMESTER SYLLABUS

R-26

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Course Code	LINEAR ALGEBRA AND CALCULUS	L	T	Pr	P	Credits
26A91101	CSE | I Year I Sem	3	0	2	0	4
Prerequisite:	Higher Secondary Mathematics					

Course Objectives

- Build strong foundations in linear algebra and multivariable calculus with direct engineering relevance.
- Integrate analytical methods with AI-assisted computational tools for visualization, simulation, and verification.
- Develop outcome-oriented problem-solving skills aligned with NEP 2020 and modern engineering applications.
- Apply matrix methods, eigen analysis, and multivariable calculus to solve engineering problems.
- Use computational tools for approximation, optimization, differentiation, and integration.

Course Outcomes (COs)

After successful completion of the course, the student will be able to:

CO	Course Outcome Statement	Bloom's Level
CO1	Apply matrix algebra techniques to solve systems of linear equations and analyze matrix properties relevant to engineering models.	L3 (Apply)
CO2	Analyze eigenvalue problems, diagonalization, and quadratic forms to interpret linear transformations and engineering systems.	L4 (Analyze)
CO3	Apply mean value theorems, Taylor and Maclaurin series, and curvature concepts to approximate and interpret engineering functions.	L3 (Apply)
CO4	Analyze multivariable functions using partial derivatives, Jacobians, gradients, and optimization techniques.	L4 (Analyze)
CO5	Evaluate areas, volumes, and coordinate transformations using multiple integrals in engineering contexts.	L5 (Evaluate)

Course Content

UNIT – 1	Matrix Algebra and Linear Systems	9 Hrs
Content	• Matrices, types of matrices, operations, transpose, inverse, symmetric and skew-symmetric matrices; Hermitian, Skew-Hermitian and unitary matrices, determinant properties; rank of a matrix; echelon and normal forms. • System of linear equations; consistency conditions; Gauss elimination and Gauss-Jordan methods; iterative methods: Jacobi and Gauss-Seidel.	
AI Integration	Python-based solution of large linear systems using NumPy; visualization of convergence in iterative methods; AI-assisted debugging of matrix algorithms; using ChatGPT/Copilot to explain row operations and rank reduction. Free/Open-Source AI Tools: Python (NumPy, SciPy, Matplotlib) on Google Colab; SymPy; Jupyter Notebook; Scilab.	

UNIT – 2	Eigenvalues, Eigenvectors, Diagonalization and Quadratic Forms	9 Hrs

Content	• Eigenvalues and eigenvectors; characteristic equation; Cayley-Hamilton theorem; diagonalization; similarity transformation; powers and inverse of matrices using Cayley-Hamilton theorem. • Quadratic forms; canonical form; reduction by orthogonal transformation; rank, index, signature; positive definite forms.	
AI Integration	AI-assisted eigenvalue computation and verification; Python/SciPy visualization of eigenmodes and quadratic surfaces; use of AI tools to explain diagonalization and matrix classification; numerical checking of Cayley-Hamilton theorem. Free/Open-Source AI Tools: Python (NumPy, SciPy, Matplotlib); SymPy; GNU Octave; Google Colab.	
UNIT – 3	**Single Variable Calculus and Series Expansions**	**9 Hrs**
Content	• Rolle's theorem; Lagrange's mean value theorem; Cauchy's mean value theorem; Taylor's and Maclaurin's series with remainder; Applications: approximation of functions; Rate of Changes, error estimation. • Curvature of plane curves; radius and centre of curvature; circle of curvature	
AI Integration	SymPy-based Taylor and Maclaurin expansion generation; plotting truncation error and convergence; AI-supported derivation checking for mean value theorems; curvature plot visualization and interpretation. Free/Open-Source AI Tools: Python (SymPy, NumPy, Matplotlib); Google Colab; Jupyter Notebook; Wolfram Alpha free tier.	
UNIT – 4	**Multivariable Differentiation and Optimization**	**9 Hrs**
Content	• Functions of several variables; limits and continuity; partial derivatives; higher order partial derivatives; total derivative; chain rule. • Jacobians; functional dependence; Taylor expansion of two-variable functions; maxima and minima; second derivative test; Lagrange multipliers and constrained optimization.	
AI Integration	Gradient field visualization using Python; AI-assisted Jacobian computation and verification; constrained optimization using SciPy; use of AI tools to interpret saddle points, extrema, and optimization constraints. Free/Open-Source AI Tools: Python (NumPy, SciPy, SymPy, Matplotlib); Google Colab; Jupyter Notebook; SciPy optimize module.	

UNIT – 5	**Multiple Integrals and Coordinate Transformations**	**9 Hrs**
Content	• Double integrals; evaluation over type I and type II regions; change of order of integration; triple integrals; change of variables; polar, cylindrical and spherical coordinates. • Engineering applications of multiple integration: Area and volume computation; mass.	
AI Integration	Numerical evaluation of double and triple integrals using SciPy; 2D and 3D region visualization; AI-assisted generation of integration code; interpreting Jacobian as geometric scaling factor in transformed coordinates. Free/Open-Source AI Tools: Python (NumPy, SciPy, Matplotlib); Google Colab; SymPy; Jupyter Notebook; 3D plotting tools.	

Bloom's Taxonomy Coverage – Summary

Bloom's Level	Level Name	CO(s)	Sample Activities

L3	Apply	**CO1, CO3**	Gauss elimination and Gauss-Jordan problem-solving; Taylor series approximation exercises.
L4	Analyze	**CO2, CO4**	Eigenvalue and diagonalization analysis; Jacobian and constrained optimization problems.
L5	Evaluate	**CO5**	Multiple integral evaluation for area/volume/centroid computation; coordinate transformation assessment.

CO – PO Articulation Matrix (NBA)

Scale: 3 – Strong, 2 – Moderate, 1 – Slight, – No Correlation

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	1	-	-	-	1	2	-	-
CO2	3	3	3	2	1	-	-	-	1	2	-	-
CO3	3	2	2	2	1	-	-	-	-	2	-	-
CO4	3	3	3	3	2	-	-	-	1	2	-	-
CO5	3	3	2	3	3	-	1	1	2	2	1	-
CO-PO Correlation Highlights	CO1 and CO2 strongly align with PO1 (Engineering Knowledge) and PO2 (Problem Analysis) through matrix and eigenvalue problem-solving. CO4 and CO5 map to PO3 and PO4 through optimization and multiple integral applications. PO5 (Modern Tools) is addressed throughout via Python, SymPy, and Google Colab integration. CO5 additionally links to PO7 and PO8 through engineering field interpretation, and strongly to PO12 (Lifelong Learning) through continued computational skill development beyond the course.											

LEARNING RESOURCES

Textbooks

1. Grewal, B. S. (2017). Higher Engineering Mathematics (44th ed.). Khanna Publishers.
2. Kreyszig, E. (2018). Advanced Engineering Mathematics (10th ed.). Wiley.

Reference Books

1. Thomas, G. B., Weir, M. D., & Hass, J. (2018). Thomas' Calculus (14th ed.). Pearson.
2. Jain, R. K., & Iyengar, S. R. K. (2021). Advanced Engineering Mathematics (5th ed.). Alpha Science
3. International.
4. Strang, G. (2016). Introduction to Linear Algebra (5th ed.). Wellesley-Cambridge Press.
5. Lay, D. C., Lay, S. R., & McDonald, J. J. (2015). Linear Algebra and Its Applications (5th ed.). Pearson.
6. Arfken, G. B., Weber, H. J., & Harris, F. E. (2012). Mathematical Methods for Physicists (7th ed.).
7. Academic Press.
8. Zill, D. G., & Wright, W. S. (2018). Advanced Engineering Mathematics (6th ed.). Jones & Bartlett.

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Online Resources

- NPTEL: Linear Algebra – https://nptel.ac.in
- MIT Open CourseWare – Linear Algebra: https://ocw.mit.edu
- MIT Open Courseware – Multivariable Calculus: https://ocw.mit.edu
- Python SymPy Documentation: https://docs.sympy.org
- Google Colab for Python: https://colab.research.google.com

Recommended Free & Open-Source AI/Computational Tools

- Python (NumPy, SciPy, Matplotlib) – FREE on Google Colab for matrix computation, visualization, and numerical analysis.
- SymPy (free, open-source) – For symbolic algebra, calculus, matrix operations, and verification.
- scikit-learn (free, open-source) – For regression, classification, and exploratory predictive modeling.
- Jupyter Notebook (free, open-source) – For interactive computation and lab documentation.
- OpenCV (free, open-source) – For image-based experimentation and visualization support where needed.
- GNU Octave (free, open-source) – MATLAB-like numerical computing for matrix and calculus workflows.
- TensorFlow / Keras (free, open-source) – For optional AI demonstrations in regression and classification tasks.

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Course Code	COMPUTATIONAL THINKING AND PROBLEM SOLVING WITH PYTHON	L	T	Pr	P	Credits
26A05101T	CSE | I Year I Sem	3	0	0	0	3

Course Objectives

- Introduce students to computational thinking and problem-solving techniques.
- Develop the ability to design algorithms, flowcharts, and pseudocode.
- Provide foundational knowledge of Python programming — data types, operators, and I/O.
- Enable students to implement logic using control structures and data structures.
- Develop skills in modular programming, file handling, and basic OOP concepts.

Course Outcomes

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

CO	Course Outcome Statement
CO1	Apply computational thinking concepts to design algorithms, flowcharts, and basic Python programs. (L3)
CO2	Develop programs using decision-making and looping constructs to solve logical problems. (L3)
CO3	Analyse and manipulate data using strings, lists, tuples, and sets for problem solving. (L4)
CO4	Design modular programs using functions, recursion, and dictionaries to improve code reusability. (L4)
CO5	Implement file handling, exception handling, and basic object-oriented programming concepts in Python applications. (L3)

UNIT – I	COMPUTATIONAL THINKING AND PROGRAMMING BASICS
Content	• Computational thinking: characteristics, problem-solving strategies, steps in problem solving; algorithms — definition and properties; flowcharts — symbols and construction; pseudocode — writing and conversion; abstraction, decomposition, pattern recognition, algorithm efficiency basics. • Introduction to Python: installation and execution environment; variables, identifiers, keywords; data types, type conversion; input and output statements; expressions and operators — arithmetic, relational, logical, assignment; operator precedence. • **Source:** TB1: Chapters 1–3 (Sponeck — computational thinking, algorithms, flowcharts, Python basics); TB2: Chapters 1–2 (Thareja — introduction to programming, Python fundamentals).
AI Tools Integration	Use Flow growth to design and simulate algorithms (e.g., largest of 3 numbers); draw flowcharts using Lucid chart; use Algorithm Visualizer to trace algorithm execution; use ChatGPT to convert pseudocode to Python and verify output.
Unit Outcomes	• Apply computational thinking — abstraction, decomposition, pattern recognition — to a given problem. • Write algorithms and draw flowcharts for simple problems. • Write and execute Python programs using variables, data types, and operators.
UNIT – II	**DECISION MAKING AND LOOPING**
Content	• Decision control statements: Boolean expressions; if, if-else, if-elif-else, nested if; conditional expressions (ternary operator).

	• Looping statements: while loop, for loop, iteration techniques, nested loops, infinite loops; loop control — break, continue, pass; else with loops. • Practical problem solving: prime number check, pattern programs using nested loops, menu-driven programs using control statements. • **Source:** TB2: Chapters 4–5 (Thareja — decision making, loops, control statements); TB1: Chapters 4–5 (Spronck — conditions, loops, iteration)
AI Tools Integration	Use Python Tutor to visualize if-else and loop execution step by step; use Thonny to debug loop-based programs; use Replit for online coding practice; use ChatGPT to generate test cases for control flow programs.
Unit Outcomes	• Write Python programs using if, if-else, and if-elif-else for decision making. • Implement while and for loops with break, continue, and pass for iterative problems. • Develop menu-driven and pattern programs using control statements.
UNIT – III	**STRINGS AND DATA STRUCTURES**
Content	• Strings: representation, indexing, slicing, operations, built-in functions and methods. • Lists: creation, indexing and slicing, operations, functions, methods, nested lists. • Tuples: creation, operations, packing and unpacking. • Sets: creation, set operations — union, intersection, difference; frozen sets. • **Source:** TB2: Chapters 6–8 (Thareja — strings, lists, tuples, sets, dictionaries); TB1: Chapters 6–7 (Spronck — strings, lists, tuples)
AI Tools Integration	Use NLTK and Text Blob to perform text analysis (sentiment, word frequency) on strings; use Pandas and NumPy for list and array operations; use ChatGPT to explain string slicing and list comprehensions with concrete examples.
Unit Outcomes	• Apply string operations — reverse, palindrome check, frequency count. • Implement list operations — sorting, searching, merging, nested lists. • Apply set operations (union, intersection, difference) and tuple packing/unpacking.
UNIT – IV	**FUNCTIONS AND PROBLEM SOLVING**
Content	• Dictionaries: creation, operations, methods; dictionary-based applications. • Functions: built-in and user-defined functions; function definition and calling; arguments — positional, keyword, default, variable-length; scope of variables (local and global). • Recursion: recursive functions — factorial, Fibonacci; lambda functions (anonymous functions); applications of functions in problem solving. • **Source:** TB2: Chapters 9–10 (Thareja — functions, recursion, lambda, dictionaries); TB1: Chapters 8–9 (Spronck — functions, recursion, problem solving)
AI Tools Integration	Use Jupyter Notebook for interactive function experiments; use SymPy for symbolic mathematical expressions; use PyCharm for modular program development; use ChatGPT to trace recursive function calls step by step.
Unit Outcomes	• Write user-defined functions with all argument types and explain scope rules. • Implement recursive functions for factorial, Fibonacci, and similar problems. • Use lambda functions and dictionaries for compact, reusable Python programs.
UNIT – V	**FILE HANDLING, EXCEPTION HANDLING, AND OOP**

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Content	• Modules and packages: creating and importing modules; standard library modules. • File handling: opening, reading, writing, and closing files; file modes; working with text files; processing CSV and Excel files. • Exception handling: types of errors (syntax, runtime, logical); try, except, finally blocks; raising exceptions. • Introduction to OOP: classes, objects, attributes, methods, constructors, self-keyword; basic applications of OOP in Python. • **Source:** TB2: Chapters 11–13 (Thareja — modules, file handling, exception handling, OOP); TB1: Chapter 10 (Spronck — file handling, exceptions, object-oriented programming)
AI Tools Integration	Use Pandas and OpenPyXL to read and write CSV/Excel files; use Pytest for testing exception handling; use ChatGPT to explain OOP class design with real-world examples; use Django for a simple mini web application as a capstone project.
Unit Outcomes	• Read and write text files; process CSV/Excel files using Pandas and OpenPyXL. • Implement exception handling using try-except-finally for robust Python programs. • Design and implement classes with constructors and methods using OOP principles.

LEARNING RESOURCES

Textbooks

- TB1: Pieter Spronck, Computational Thinking with Python, (course textbook — covers computational thinking, algorithms, and Python programming).
- TB2: Reema Thareja, Programming in Python, Oxford University Press. (Primary implementation reference — all five units.)

Reference Books

- Allen B. Downey, Think Python: How to Think Like a Computer Scientist, 2nd Edition, O'Reilly Media. (Free at greenteapress.com)
- Eric Matthes, Python Crash Course, 2nd Edition, No Starch Press.

Online Tools Used in This Course

- Algorithm & Flowchart: Flow growth – flowgorithm.org |Lucid chart – lucidchart.com | Algorithm Visualizer – algorithm-visualizer.org
- Programming & Debugging: Python Tutor – pythontutor.com | Thonny – thonny.org |Replit – replit.com
- Data & Scientific: Pandas – pandas.pydata.org | NumPy – numpy.org |SymPy – sympy.org
- NLP & Text: NLTK – nltk.org |Text Blob – textblob.readthedocs.io
- Development: Jupyter Notebook – jupyter.org | PyCharm – jetbrains.com/PyCharm |OpenPyXL

– openpyxl.readthedocs.io

- NPTEL – Problem Solving through Programming in C / Python – nptel.ac.in

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Course Code	DESIGN THINKING	L	T	Pr	P	Credits
26A99101	CSE | I Year I Sem	1	0	4	0	3
Prerequisite:	None					

Course Objectives

- Introduce the philosophy, principles, and five-stage model of Design Thinking as a human-centred innovation methodology.
- Develop empathy-driven research skills including interviews, observation, and persona creation to understand user needs.
- Apply structured ideation techniques and AI-assisted tools to generate and prioritise creative solutions.
- Build low-fidelity and digital prototypes incorporating AI-assisted design tools.
- Conduct user testing, iterate based on feedback, and present design solutions effectively.

Course Outcomes (COs)

After successful completion of the course, the student will be able to:

CO	Course Outcome Statement	Bloom's Level
CO1	Recall and understand the philosophy, principles, and stages of the Design Thinking process and its relevance to human-centred problem solving.	L1–L2 (Remember/Understand)
CO2	Apply empathy tools (interviews, observation, personas) and problem-framing techniques to real-world engineering scenarios.	L3 (Apply)
CO3	Analyse user needs and problem statements using the 'How Might We' framework and AI-powered insight generation tools.	L4 (Analyse)
CO4	Evaluate and select the most viable prototype solution through structured testing, user feedback, and AI-assisted evaluation rubrics.	L5 (Evaluate)
CO5	Create innovative prototypes and pitch solutions to identified problems using AI ideation tools and digital prototyping platforms.	L6 (Create)

Course Content

UNIT – 1	Introduction to Design Thinking	9 Hrs
Content	• Design Thinking: Definition, origin (Stanford d.school, IDEO), and relevance to engineering. • The 5-Stage Model: Empathise – Define – Ideate – Prototype – Test. • Human-centred design principles: Desirability, Feasibility, Viability. • Systems Thinking vs. Linear Thinking: Understanding complexity. • Case Studies: Successful design thinking applications (IDEO shopping cart, Stanford Mobile Clinic).	
AI Integration	AI Tool: ChatGPT/Copilot – use AI to explain design thinking in different domains (healthcare, education, agriculture). Activity: Mind Meister (free, open-source alternative: Free Mind) to create a mindmap of the 5-stage process. AI Video Analysis: summarise key DT principles from documentary case studies.	
UNIT – 2	Empathise and Define Stages	9 Hrs

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Content	• Empathy Methods: Interviews, Observation, Immersion, Shadowing. • Creating User Personas: Demographic, psychographic, goals and pain points. • Empathy Mapping: Says, Thinks, Does, Feels. • Point of View (POV) Statement: User + Need + Insight formula. • How Might We (HMW) Questions: Reframing problems as opportunities.	
AI Integration	AI Tool: Miro (free plan) for digital empathy maps and POV statements. AI Tool: ChatGPT for generating diverse user persona profiles. Activity: interview peers about a campus problem and use AI to analyse transcripts and extract themes. AI Tool: Dovetail (free plan) for affinity mapping of qualitative research data.	
UNIT – 3	**Ideation Stage**	**9 Hrs**
Content	• Creative Thinking Techniques: Brainstorming, Brainwriting, SCAMPER, Random Word Association. • Lateral Thinking: Edward de Bono's Six Thinking Hats. • Affinity Diagramming: Grouping ideas by themes. • Prioritisation Matrix: Impact vs. Effort, Dot Voting. • Concept Selection: Morphological charts and Pugh Matrix.	
AI Integration	AI Tool: ChatGPT – use 'expand my idea' prompts to generate variations of a concept. AI Tool: IdeaFlip (free)/Miro for digital brainstorming and affinity diagramming. AI Tool: Midjourney (free trial)/DALL-E (free credits) for visual concept sketches. Activity: run an AI-augmented brainstorming session and compare idea quality with pure human brainstorming.	
UNIT – 4	**Prototyping**	**9 Hrs**
Content	• Principles of Prototyping: Low-fidelity vs. High-fidelity prototypes. • Paper Prototyping: Sketching UI and physical models. • Digital Wireframing: Introduction to wireframes and mockups. • 3D Prototyping Concepts: Introduction to 3D printing and rapid prototyping. • Role Plays and Experience Prototyping: Service design scenarios.	
AI Integration	AI Tool: Figma AI for converting sketches to digital wireframes. AI Tool: Tinkercad (free, web-based) for simple 3D models for physical prototyping. Activity: build a paper prototype for a chosen problem and photograph for digital documentation.	
UNIT – 5	**Testing, Iteration and AI in Design**	**9 Hrs**
Content	• User Testing Methods: Think-aloud protocol, A/B testing, Usability testing. • Feedback Analysis: Affinity mapping of test feedback. • Iteration Cycle: Incorporating feedback and pivoting. • Design Presentation: Pitching to stakeholders (elevator pitch, demo day format). • AI in Design: Overview of AI-assisted design (generative design, co-creation with AI).	
AI Integration	AI Tool: Maze (free plan) – conduct remote usability tests on Figma prototypes. AI Tool: ChatGPT – analyse collected user feedback and generate insights and improvement suggestions. Activity: present final prototype to a panel; use AI to prepare pitch slides in Canva. Reflection: Design Thinking journal documenting each stage with AI tool usage notes.	

Bloom's Taxonomy Coverage – Summary

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Bloom's Level	Level Name	CO(s)	Sample Activities
L1/L2	Remember/ Understand	CO1	Design Thinking principle identification; 5-stage model recall exercises.
L3	Apply	CO2	Empathy interview conduction; persona creation and POV statement formulation.
L4	Analyse	CO3	HMW framework problem reframing; AI-assisted insight generation analysis.
L5/L6	Evaluate/Create	CO4, CO5	Prototype evaluation using testing rubrics; final prototype creation and stakeholder pitch.

CO-PO Mapping Matrix

Scale: 3 = High, 2 = Medium, 1 = Low, '-' = No correlation

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	2	1	1	2	1	1	2	2	1	2	1	1
CO2	1	2	3	2	2	3	1	1	3	2	2	2	2	2
CO3	2	3	3	2	3	3	1	1	2	2	2	3	2	2
CO4	2	3	3	3	3	2	1	2	2	2	2	3	2	2
CO5	2	3	3	3	3	2	2	2	3	3	3	3	3	3
Average	1.6	2.6	2.8	2.2	2.4	2.4	1.2	1.4	2.4	2.2	2.0	2.6	2.0	2.0

Text Books

1. T1. Brown, Tim. (2019). Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation. Harper Business, New York.
2. T2. Lewrick, Michael, Link, Patrick & Leifer, Larry. (2018). The Design Thinking Playbook. Wiley, New Jersey.

Reference Books

1. R1. IDEO.org. (2015). The Field Guide to Human-Centered Design. IDEO.org, San Francisco.
2. R2. Kelley, Tom & Kelley, David. (2013). Creative Confidence: Unleashing the Creative Potential Within Us All. Crown Business.
3. R3. Liedtka, Jeanne & Ogilvie, Tim. (2011). Designing for Growth: A Design Thinking Tool Kit for Managers. Columbia Business School Press.
4. R4. Plattner, Hasso, Meinel, Christoph & Leifer, Larry (Eds.). (2018). Design Thinking Research. Springer.
5. R5. Kumar, Vijay. (2012). 101 Design Methods: A Structured Approach for Driving Innovation. Wiley.
6. R6. Stickdorn, Marc & Schneider, Jakob. (2021). This Is Service Design Thinking (Expanded ed.). BIS Publishers.

Web Resources

- Stanford d.school Resources: dschool.stanford.edu/resources

- IDEO Design Kit: www.designkit.org/methods
- MIT OpenCourseWare – Design Thinking: ocw.mit.edu
- Interaction Design Foundation: www.interaction-design.org
- NPTEL Design Thinking: swayam.gov.in

YouTube / Video Resources

- YouTube: Stanford d. school – Design Thinking Bootcamp – www.youtube.com/@stanforddschool
- YouTube: IDEO U – www.youtube.com/@ideou
- YouTube: Crash Course – Design Thinking Series – www.youtube.com/@crashcourse
- YouTube: AJ&Smart – Design Sprint tutorials – www.youtube.com/@AJSmart
- YouTube: NPTEL Design Thinking – www.youtube.com/c/nptel

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Course Code	ENGINEERING GRAPHICS	L	T	Pr	P	Credits
26A03101	CSE | I Year I Sem	1	0	4	0	3
Prerequisite:	Basic Geometry, Fundamental Python Programming					

Lab Course Outcomes

After successful completion of the lab, the student will be able to:

CO	Course Outcome Statement	Bloom's Level
CO1	Construct engineering curves and scales using traditional drafting geometry validated by automated algorithmic paths.	L3 (Apply)
CO2	Solve multi-planar projection instances of linear points, segments, and standard regular planar silhouettes.	L4 (Analyze)
CO3	Render projections of standard 3D solids and identify variations using structural boundary algorithms.	L4 (Analyze)
CO4	Draft complex cross-sectional geometries and mapped surface extensions of sliced geometric forms.	L4 (Analyze)
CO5	Produce composite isometric layouts alongside generative text-to-CAD system alternatives for dynamic prototyping.	L5 (Evaluate)

List of Experiments

Unit 1		Introduction to Engineering Graphics, Curves and Scales
1	Manual Construction of Engineering Curves	Construct an ellipse using the eccentricity method and general method given the major and minor axes; construct a parabola and a hyperbola using the rectangle/eccentricity method. Verify dimensional accuracy through measurement and document construction steps.
2	Cycloidal Curves and Involutes Construction	Draw a cycloid generated by a rolling circle and an involute of a given circle/polygon using standard geometric construction methods. Annotate the generating points and verify the curve trace against theoretical points.
3	Construction of Plain, Diagonal and Vernier Scales	Construct a plain scale, a diagonal scale, and a vernier scale for given representative fractions and measure specified distances using each. Cross-verify readings between manually constructed scales and a digital scale tool.
4	AI-Assisted Conic Curve Generation and CV Edge Detection	Use AI prompt engineering to generate code blocks that algorithmically plot conic curves (ellipse, parabola, hyperbola) and compare with the manually drafted curve. Capture a hand-drawn geometric sketch and apply Computer Vision edge detection (Canny Edge/Hough Transform) to extract a clean vector shape.

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Unit 2		Orthographic Projections of Points, Lines and Planes
1	Projection of Points in All Four Quadrants	Draw the orthographic projections (top view and front view) of points located in each of the four quadrants relative to the horizontal and vertical reference planes. Verify the position of each projection against the given point coordinates.
2	Projection of Lines Inclined to Reference Planes	Determine the projections of a straight line inclined to one or both reference planes; find the true length and true inclination of the line using the rotation or auxiliary plane method. Cross-check results using trigonometric calculation.
3	Projection of Planes in Various Orientations	Draw projections of regular planes (triangle, square, pentagon, hexagon) positioned perpendicular to both reference planes, parallel to one reference plane, and inclined to both reference planes. Verify true shape recovery using the auxiliary view method.
4	3D Coordinate Estimation Script from 2D Projections	Develop a transformation script where a user inputs 2D projection endpoints (top view and front view coordinates) and the script automatically computes the 3D line representation, true spatial length, and inclination angles. Validate the script output against a manually solved projection problem.
Unit 3		**Projection of Regular Solids**
1	Projection of Solids with Axis Perpendicular to a Reference Plane	Draw the projections of a hexagonal prism and a cone with the axis perpendicular to the horizontal plane, and repeat with the axis perpendicular to the vertical plane. Verify true shape and hidden line conventions in each case.
2	Projection of Solids with Axis Inclined to a Reference Plane	Draw the projections of a square pyramid with its axis inclined to one reference plane and parallel to the other, using the change-of-position or auxiliary plane method. Verify the apparent and true lengths of the solid's edges.
3	Solid Classification Using a Machine Learning Notebook	Set up a classification notebook using scikit-learn or a simple convolutional model to automatically identify the type of solid (e.g., hexagonal prism vs. cone) present within a given orthographic engineering layout image. Test the classifier against five different solid images and document accuracy.
Unit 4		**Sections of Solids and Development of Surfaces**
1	Sectional Views of Solids with Inclined Cutting Planes	Draw the sectional view and true shape of section for a pyramid and a cone cut by a section plane inclined to the base, for solids in simple position. Verify the true shape of the cut surface using the auxiliary projection method.
2	Development of Lateral Surfaces — Parallel Line Method	Develop the lateral surface of a cylinder and a prism using the parallel-line development method. Verify the unfolded pattern dimensions against the original solid's surface measurements.
3	Development of Lateral Surfaces — Radial Line Method	Develop the lateral surface of a cone and a pyramid using the radial-line development method. Verify the unfolded pattern by reconstructing a physical or digital model from the developed surface.

4	Sheet Nesting Optimization Using Heuristic Algorithms	Use a nesting optimization script (genetic algorithm or standard heuristic) to arrange multiple custom flat-surface solid developments onto a finite raw sheet grid, minimizing material margins and cut lines. Compare the optimized layout with a manually arranged layout in terms of material utilization.
Unit 5		**Isometric Projections and Computer Graphics**
1	Isometric Projection of Simple and Compound Solids	Construct the isometric view of a simple solid (cube, prism, pyramid) using the isometric scale, and extend to a compound solid formed by combining two basic solids. Verify isometric axis angles and dimensional accuracy.
2	Conversion Between Orthographic and Isometric Views	Given a set of orthographic views (front, top, side) of an object, construct the corresponding isometric view; conversely, given an isometric view, derive the orthographic views. Cross-verify both conversions for dimensional consistency.
3	Computer-Aided Drafting Using AutoCAD	Create 2D drawings of simple machine components and a basic PCB layout using AutoCAD; apply transformation commands (move, rotate, scale, mirror) to manipulate the drawn entities. Export and document the final drawings (not for end examination).
4	2D-to-3D Depth Reconstruction Using a Pretrained Model	Use a pretrained depth-estimation or pixel-to-voxel neural model to parse a set of front, top, and side drawings, compiling them into an interactive 3D point cloud or boundary surface rendering. Compare the AI-reconstructed 3D model with the manually constructed isometric drawing.

AI Tools Integration (Lab)

AI Tools Integration (Lab)	AI prompt engineering for generating geometric profiles and algorithmic conic curve code; Computer Vision (OpenCV — Canny Edge/Hough Transform) for parsing hand-drawn sketches into vector shapes. Machine learning pipelines (scikit-learn, simple CNNs) for 3D coordinate estimation and solid-type classification from orthographic images. Generative Adversarial Networks (GANs) and heuristic/genetic algorithms for flat-pattern nesting optimization. Neural Radiance Fields (NeRF) and pixel-to-voxel models for 2D-to-3D depth reconstruction from multi-view engineering sketches. AutoCAD for computer-aided 2D/3D drafting and transformations.

CO – PO Articulation Matrix (NBA)

Scale: 3 – Strong, 2 – Moderate, 1 – Slight, – No Correlation

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	–	–	–	–	–	–	2	–	1
CO2	3	3	2	–	–	–	–	–	–	2	–	1
CO3	3	3	2	1	–	–	–	–	–	2	–	1
CO4	3	3	3	1	2	–	–	–	–	2	–	2

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CO5	3	2	2	–	3	–	–	–	1	3	–	2
CO-PO Correlation Highlights	CO1 and CO2 strongly align with PO1 (Engineering Knowledge) and PO2 (Problem Analysis) through traditional drafting validated with algorithmic verification. CO3 and CO4 connect to PO3 (Design) and PO5 (Modern Tools) through ML-based solid classification and nesting optimization. CO5 demonstrates the strongest PO5 alignment, integrating generative AI text-to-CAD concepts with traditional isometric drafting skills.											

LEARNING RESOURCES

Textbooks

1. Bhatt, N. D. (2016). Engineering Drawing. Charotar Publishing House.
2. Jolhe, D. (2017). Engineering Drawing with an Introduction to AutoCAD. Tata McGraw Hill.

Reference Books

1. Jain, P., Gautam, A. P., & Bhargava, A. (n.d.). Engineering Graphics and Design. Khanna Publishing.
2. Narayana, K. L., &Kannaiah, P. (2013). Engineering Drawing. Tata McGraw Hill.
3. Shah, M. B., & Rana, B. C. (2009). Engineering Drawing. Pearson Education.

Online Resources

- NPTEL Engineering Graphical Design Course – IIT Kharagpur
- OpenCV Official Python Bootcamps and Tutorials
- MIT 6.S192: Deep Generative Modeling Platforms

Video Links & Online Lectures

- **Classical Drafting Fundamentals**: NPTEL Engineering Graphical Design Course by IIT Kharagpur
- **Computer Vision and Processing**: OpenCV Official Python Bootcamps and Tutorials
- **Generative Design and Modeling Insights**: MIT 6.S192: Deep Generative Modeling Platforms

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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Course Code	APPLIED CHEMISTRY FOR COMPUTER SCIENCE	L	T	Pr	P	Credits
26A93102T	CSE | I Year I Sem	3	0	0	0	3
Prerequisite:	Basic Chemistry (Higher Secondary level)					

Course Objectives

- Understand the fundamentals of quantum chemistry including wave-particle duality, quantum numbers, and molecular orbital theory relevant to computing materials.
- Comprehend the chemistry and electronic properties of semiconductor materials and the chemical processes involved in semiconductor device fabrication.
- Evaluate electrochemical principles governing batteries, supercapacitors, and fuel cells as energy storage technologies for computing systems.
- Analyze corrosion mechanisms in electronic devices and design appropriate protective techniques for PCBs, solder joints, and interconnects.
- Explore the chemistry, synthesis methods, and properties of nanomaterials used in nanoelectronics, quantum computing, and sustainable electronics.

Course Outcomes (COs)

After successful completion of the course, the student will be able to:

CO	Course Outcome Statement	Bloom's Level
CO1	Apply quantum chemistry principles to analyze molecular systems and explain molecular orbital theory for computing materials.	L3–L4
CO2	Analyze semiconductor materials, doping chemistry, and fabrication processes used in modern electronic devices.	L3–L4
CO3	Evaluate energy storage technologies including batteries, supercapacitors, and fuel cells for computing and data centre applications.	L3–L4
CO4	Analyze corrosion mechanisms in electronic devices and recommend appropriate protective techniques for PCBs and interconnects.	L3–L4
CO5	Design advanced materials solutions using nanotechnology principles and AI-assisted tools for nanoelectronics and quantum computing.	L5–L6

Course Content

UNIT – 1	Quantum Chemistry	9 Hrs
Content	• Fundamentals of quantum chemistry: black body radiation, photoelectric effect, wave-particle duality, de Broglie wave equation, Heisenberg's uncertainty principle. • Fundamentals of Quantum Mechanics: Schrödinger wave equation; significance of Ψ and Ψ^2; quantum numbers. • Particle in a one-dimensional box. • Molecular orbital theory: bonding in homonuclear and heteronuclear diatomic molecules; energy level diagrams of O_2 and CO. • π-molecular orbitals of butadiene and benzene; calculation of bond order.	

AI Integration	Simulation of quantum systems using Python (NumPy, SciPy); visualization of molecular orbitals and energy levels using computational chemistry tools (Google Colab); introduction to quantum computing simulations using Qiskit (introductory level). Free/Open-Source AI Tools: Python (NumPy, SciPy), Google Colab, Qiskit.	
UNIT – 2	**Semiconductor Chemistry**	**9 Hrs**
Content	• Atomic structure and chemical bonding relevant to semiconductors. • Band theory: valence band, conduction band, band gap energy. • Intrinsic and extrinsic semiconductors: silicon, germanium, gallium arsenide. • Doping chemistry: n-type (phosphorus, arsenic) and p-type (boron, aluminium) dopants. • Chemical vapour deposition (CVD) for thin film formation; silicon dioxide (SiO_2) formation and properties. • Chemistry of compound semiconductors: GaAs, InP, SiC.	
AI Integration	AI-based prediction of semiconductor properties using ML models; process parameter optimization in semiconductor fabrication using machine learning; Python-based band gap prediction using regression models. Free/Open-Source AI Tools: Python, TensorFlow, Scilab.	
UNIT – 3	**Electrochemistry and Energy Storage**	**9 Hrs**
Content	• Electrochemical cells: galvanic cells, electrode potential, Nernst equation and problems; potentiometry (redox reactions); conductometry (strong acid vs. strong base, weak acid vs. strong base). • Primary batteries: Zinc-air battery, Sodium-air battery. • Secondary batteries: chemistry of charging and discharging of lead-acid, nickel-cadmium, nickel-metal hydride. • Lithium-ion batteries: construction, working, and applications of $LiCoO_2$. • Supercapacitors: definition, classification, and applications. • Fuel cells: construction, working, and applications of hydrogen fuel cells and direct methanol fuel cells (DMFC). • Battery management systems: overcharge protection and thermal management.	
AI Integration	AI models for battery health prediction and state-of-charge optimization using scikit-learn; data analysis for energy efficiency in data centres using Python (Pandas); ML-based prediction of electrochemical impedance spectra. Free/Open-Source AI Tools: Python (Pandas, scikit-learn), Google Colab.	
UNIT – 4	**Chemistry of Corrosion and Protective Techniques**	**9 Hrs**
Content	• Corrosion: definition, examples, types — chemical corrosion and electrochemical corrosion; Pilling-Bedworth rule. • Galvanic corrosion; concentration cell corrosion; factors affecting corrosion. • Deal-Grove model: thermal oxidation of silicon; passivation layers — silicon dioxide, silicon nitride, and aluminium oxide. • Corrosion of printed circuit boards (PCBs): copper oxidation, tin whiskers; corrosion in solder joints and interconnects. • Protective techniques: proper design, using pure metals, metal alloys, inhibitors; cathodic protection — sacrificial anodic protection, impressed current cathodic protection. • Electroplating (nickel) and electroless plating (copper).	

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AI Integration	Computer vision (OpenCV) for automated defect detection in PCBs; AI-based prediction of corrosion failure in electronic components using TensorFlow; image classification models for identifying corrosion types from microscope images. Free/Open-Source AI Tools: OpenCV, TensorFlow, Python.	
UNIT – 5	**Chemistry of Nanomaterials**	**9 Hrs**
Content	• Introduction to nanochemistry: size-dependent properties, quantum confinement. • Carbon nanomaterials: fullerenes, carbon nanotubes (CNTs), graphene. • Synthesis methods: chemical vapour deposition (CVD), sol-gel process. • Quantum dots: synthesis, properties, applications in displays and quantum computing. • Metallic nanoparticles: preparation and applications of gold, silver, and copper nanoparticles. • Applications: nanoelectronics, interconnects, sensors (optical and biosensors), memory devices. • Spintronics materials: magnetic nanoparticles, topological insulators. • Chemistry of quantum computing materials: superconducting materials (NbTi, Nb_3Sn); ion trap materials.	
AI Integration	AI-based nanomaterial property prediction using machine learning (Python, TensorFlow); simulation of nano-devices and quantum materials using open-source tools; generative AI for exploring nanomaterial design spaces. Free/Open-Source AI Tools: Python, TensorFlow, open-source materials simulation platforms.	

Bloom's Taxonomy Coverage – Summary

Bloom's Level	Level Name	CO(s)	Sample Activities
L3	Apply	**CO1, CO2**	Molecular orbital energy diagram construction; semiconductor band gap and doping calculations.
L4	Analyze	**CO3, CO4**	Battery electrochemical reaction analysis; corrosion mechanism case studies for PCB failure modes.
L5/L6	Evaluate/ Create	**CO5**	Nanomaterial design for a given computing application; AI-assisted property prediction project.

CO – PO / PSO Articulation Matrix (NBA)

Scale: 3 – Strong, 2 – Moderate, 1 – Slight, – No Correlation

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	2	–	–	–	–	–	–	2	3	2
CO2	3	3	3	2	3	–	–	–	–	–	–	2	3	3
CO3	2	3	3	2	3	–	2	–	–	–	–	2	3	3
CO4	2	3	2	3	3	–	–	–	–	–	–	1	3	3
CO5	3	2	3	3	3	1	2	1	–	2	–	3	3	3

CO-PO Correlation	CO1 and CO2 align strongly with PO1 (Engineering Knowledge) and PO2 (Problem Analysis) through quantum chemistry and semiconductor analysis, and to PO12 through emerging quantum and

Highlights	computing materials domains. CO3 maps to PO2, PO3, and PO5 through energy storage design and AI-based battery optimization, with PO7 reflecting the sustainability relevance of green energy technologies. CO4 aligns with PO2, PO4, and PO5 through corrosion analysis and AI-based failure prediction. CO5 shows the broadest correlation, mapping to PO3 (nanomaterial design), PO5 (AI tools), PO7 (sustainable electronics), PO8 (responsible nanomaterial use), and PO10 (design project reporting), with strong PSO1 and PSO2 alignment across all COs through direct relevance to AI and computing hardware.

LEARNING RESOURCES

Textbooks

1. Jain, P. C., & Jain, M. (2020). Engineering Chemistry (17th ed.). Dhanpat Rai Publishing Company.
2. Shika Agarwal. (2026). Engineering Chemistry (5th ed.). Cambridge University Press.

Reference Books

1. Linden, D., & Reddy, T. B. (Eds.). (2001). Handbook of Batteries (3rd ed.). McGraw-Hill.
2. Rao, C. N. R., Müller, A., & Cheetham, A. K. (Eds.). (2007). The Chemistry of Nanomaterials: Synthesis, Properties and Applications (Vols. 1–2). Wiley-VCH.
3. Poole, C. P., & Owens, F. J. (2003). Introduction to Nanotechnology. John Wiley & Sons.
4. Sharma, B. K., & Gaur, H. (2019). Engineering Chemistry. Krishna Prakashan Media.
5. Dara, S. S., &Umare, S. S. (2018). Engineering Chemistry (15th ed.). S. Chand Publishing.

Online Resources

- NPTEL Engineering Chemistry: https://nptel.ac.in/
- IBM Qiskit Learning: https://learning.quantum.ibm.com/
- Google Colab: https://colab.research.google.com/
- OpenCV Python Documentation: https://docs.opencv.org/
- Materials Project (open nanomaterials database): https://materialsproject.org/

SANTHIRAM ENGINEERING COLLEGE

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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

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Course Code	COMPUTATIONAL THINKING AND PROBLEM SOLVING WITH PYTHON LAB	L	T	Pr	P	Credits
26A05101P	CSE | I Year I Sem	0	0	0	3	1.5

Lab Course Outcomes

- Design algorithms and flowcharts for simple problems; write and execute basic Python programs using variables, data types, and operators.
- Implement programs using if-else, nested if, switch (match), while, and for loops to solve decision-making and iterative problems.
- Apply string operations and Python built-in data structures — lists, tuples, and sets — to solve data manipulation problems.
- Write modular programs using user-defined functions, recursion, lambda expressions, and dictionaries.
- Implement programs using file handling, exception handling, and basic object-oriented programming concepts in Python.

List of Experiments

UNIT – 1		Computational Thinking and Programming Basics
1	Algorithm Design, Flowcharts, and Python Basics	Draw flowcharts using Flow gorithm for three problems: (a) find the largest of two numbers; (b) check whether a number is even or odd; (c) compute the factorial of a given number. For each flowchart, trace through the logic manually with 3 sample inputs before coding. Write equivalent Python programs for all three; run them in Thonny or Google Colab and verify that the output matches the manual trace. Use Python Tutor to visualize the variable state at each step for the factorial program
2	**Data Types, Operators, and Type Conversion**	Write Python programs to: (a) declare variables of all primitive data types (int, float, complex, bool, str) and print their type using type(); (b) demonstrate all operator categories — arithmetic (+, −, ×, ÷, //, %, **), relational (==, !=, <, >, <=, >=), logical (and, or, not), bitwise (&, |, ^, ~, <<, >>), and assignment operators — with one example each; (c) demonstrate implicit and explicit type conversion — int to float, float to int, int to str, str to int using int(), float(), str(); (d) print a formatted bill: accept item name, quantity, and price as input; compute and display total using f-string formatting with two decimal places.
3	**Input, Output, and Expression Evaluation**	Write Python programs to: (a) accept the radius of a circle from the user; compute and display area (πr^2) and circumference ($2\pi r$) using the math module; (b) accept three subject marks; compute total, percentage, and grade (O ≥ 90, A+ ≥ 80, A ≥ 70, B+ ≥ 60, B ≥ 50, C ≥ 40, F < 40); print a formatted result card using print() with appropriate spacing; (c) accept two numbers and an operator (+, −, ×, ÷) as input; evaluate the expression using eval(); handle division by zero using a simple if condition; (d) demonstrate operator precedence: compute and print results of 5 mixed expressions — predict the result manually first, then verify by running the program
UNIT – II		**Decision Making and Looping**
1	**Decision Control if, elif, else, and match**	Write Python programs to: (a) accept a year and check whether it is a leap year using nested if — a year is a leap year if divisible by 400, or divisible by 4 but not by 100; test with 2000, 1900, 2024, 2023; (b) accept a character and classify it as uppercase

		letter, lowercase letter, digit, or special character using if-elif-else; (c) accept a day number (1–7) and print the day name using match-case (Python 3.10+); add a default case for invalid input; (d) implement a simple ATM menu using nested if — display options (Check Balance, Deposit, Withdraw, Exit); perform the selected operation; display appropriate error messages for invalid PIN or insufficient balance.
2	Loops — while, for, and Nested Loops	Write Python programs to: (a) print multiplication table of a number entered by the user using a for loop (1 to 10); (b) print all prime numbers between 1 and 100 using a while loop with a flag variable — also count and display the total number of primes found; (c) print the following five patterns using nested for loops: right-angled triangle (stars), inverted triangle, number pyramid, Floyd's triangle, and a diamond pattern — accept the number of rows as input for each; (d) implement a number guessing game — generate a random number between 1 and 50 using random.randint(); allow the user a maximum of 7 attempts; print 'Too High' or 'Too Low' as hints; use break when the correct number is guessed; display attempts used.
3	Loop Control and Application Programs	Write Python programs to: (a) compute the sum of digits, reverse, and check if palindrome for a number entered by the user — use a while loop extracting digits using % and //; test with 121, 12321, 1234; (b) compute the sum of the Fibonacci series up to N terms using a for loop; also print the series itself; (c) accept a positive integer N and compute: sum of natural numbers (1+2+…+N), sum of squares ($1^2+2^2+\ldots+N^2$), and sum of cubes ($1^3+2^3+\ldots+N^3$) — verify sum of cubes formula: $[N(N+1)/2]^2$; (d) implement a simple calculator using a while loop with a menu — loop continues until the user selects Exit; use continue to handle invalid menu choices without breaking the loop.
UNIT – III		**Strings and Data Structures**
1	String Operations and Methods	Write Python programs to: (a) accept a string and perform: count vowels and consonants, reverse the string, check palindrome, count words, convert to title case — display all results; (b) demonstrate 10 built-in string methods: upper(), lower(), strip(), replace(), split(), join(), find(), count(), starts with (), ends with() — with one practical example each; (c) accept a sentence and: find the longest word, count frequency of each word (store in a dictionary), print words in alphabetical order; (d) implement a simple Caesar cipher — accept a message and a shift value (1–25); encrypt each letter by shifting it; display encrypted message; write a decrypt function to recover the original message.
2	Lists and Tuples	Write Python programs to: (a) create a list of 10 integers; perform: insert at a given position, delete by value, find maximum and minimum without using built-in max/min, sort using Bubble Sort, search using linear search — display the list after each operation; (b) demonstrate list slicing: extract first half, second half, every alternate element, and reverse using slice notation; compare with string slicing on the same index values; (c) store student records as a list of tuples — each tuple: (roll no, name, marks); sort by marks (descending) using sorted() with a lambda key; print rank list; find the student with highest marks using max() with a key; (d) demonstrate list comprehension: generate squares of even numbers from 1 to 20; filter words longer than 4 characters

		from a given word list; create a multiplication table as a 2D list using nested comprehension.
3	Sets and Applications	Write Python programs to: (a) create two sets A and B from user input; compute and display: union (A | B), intersection (A & B), difference (A − B and B − A), symmetric difference (A ^ B); verify De Morgan's laws: not(A | B) == (not A) & (not B) for sample values; (b) use a set to remove duplicates from a list of 20 student roll numbers (with deliberate duplicates); compare list size before and after; print the unique roll numbers in sorted order using sorted(set()); (c) demonstrate frozen sets: create a frozen set of prime numbers up to 20; attempt to add an element (show Type Error); use it as a dictionary key (demonstrate immutability advantage); (d) implement a program to find: students who passed all three subjects, students who failed at least one, students who passed exactly two — store each class in a set and use set operations
UNIT – IV		**Functions and Problem Solving**
1	Dictionaries and Applications	Write Python programs to: (a) create a student marks dictionary {name: [marks list]}; compute and display average marks, highest scorer, and students who scored below 50; add a new student, update an existing student's marks, delete a student — show the dictionary after each operation; (b) implement a word frequency counter — accept a paragraph as input; split into words; build a frequency dictionary using a for loop; print the top 5 most frequent words sorted by count descending; (c) demonstrate all dictionary methods: keys(), values(), items(), get(), update(), pop(), set default(), copy() — with one example each; (d) build a simple phone book — store contacts as {name: phone}; support: add contact, search by name, delete contact, display all contacts sorted alphabetically — use a while loop menu.
2	User-Defined Functions and Scope	Write Python programs to: (a) write 5 utility functions: is prime (n), is palindrome(s), factorial(n), gcd (a,b), power(base, exp) — call each with 3 test inputs and verify results; (b) demonstrate all four argument types: positional (def greet(name, age)), default (def greet(name, age=18)), keyword (greet(age=20, name='Ram')), and variable-length (*args for sum of any count, **kwargs for student info display) — write one function for each and test; (c) demonstrate local vs. global scope: write a program with a global counter variable that is modified inside a function using the global keyword; contrast with a local variable of the same name — print both; (d) write a function find stats(numbers) that accepts a list and returns mean, median, mode, and standard deviation without using the statistics module — test on [4, 7, 13, 2, 7, 4, 7, 1].
3	Recursion and Lambda Functions	Write Python programs to: (a) implement recursive functions for: factorial(n), Fibonacci(n), sum_of_digits(n), binary search (arr, target, low, high), and power (base, exp) — for each, use Python Tutor to trace the call stack for a small input and count the total recursive calls; (b) compare iterative vs. recursive factorial for n = 5, 10, 15, 20 on execution time using time. Time (); document when recursion becomes slower; (c) implement lambda functions for: square, cube, even/odd check, Celsius-to-Fahrenheit, and concatenate two strings — use each with map () and filter () on a list of 10 elements; (d) write a higher-order function apply twice (f, x) that applies function f to x twice; test

		with square, double, and increment functions; demonstrate that lambda functions work as arguments.
UNIT – V		**Functions and Problem Solving**
1	**File Handling**	Write Python programs to: (a) create a text file and write 10 lines of student records (roll number, name, marks); read and display all lines; append 5 more records; count total lines; display only records where marks > 60; (b) copy the contents of one text file to another; count total characters, words, and lines in the source file; find and replace a specific word (e.g., 'Python' → 'programming') and write the result to a new file; (c) read a CSV file (student data) using the csv module; compute average marks per subject; write a summary report CSV with student name and grade; (d) create a student marks file; sort all records by marks in descending order (read all, sort in memory, rewrite); demonstrate the difference between read modes: 'r', 'w', 'a', 'r+' with examples.
2	**Exception Handling**	Write Python programs to: (a) write a program that accepts two numbers and performs division; handle Zero Division Error, Value Error (non-numeric input), and Type Error in separate except blocks; use a finally block to print 'Operation complete' regardless of outcome; (b) implement a robust file reader that handles File Not Found Error and Permission Error; use try-with multiple except clauses; after handling each exception, print a meaningful user-friendly error message rather than a traceback; (c) define a custom exception class Insufficient Funds Error(Exception) with a message attribute; implement a Bank Account class with deposit() and withdraw() methods — withdraw() raises Insufficient Funds Error if balance is insufficient; test with deposits and withdrawals; (d) demonstrate exception chaining (raise X from Y) — catch a Value Error and re-raise as a custom Application Error with the original exception attached; use raise without arguments in a re-raise scenario.
3	**Object-Oriented Programming — Class Design Capstone**	Design and implement a Student Management System using OOP: (a) create a Student class with attributes: roll no, name, marks (list of 5 subjects) and methods: compute percentage(), get grade() (O/A+/A/B+/B/C/F), display() — create 5 Student objects with different data; (b) add a class variable total students that increments with each object creation; add a class method get total() and a static method validate marks(marks) that returns True if all marks are between 0 and 100; (c) demonstrate object interactions: write a find topper(students) function that accepts a list of Student objects and returns the one with the highest percentage; sort the list of Student objects by percentage using sorted() with a lambda key on obj.compute_percentage(); (d) write all student records to a file using the write() method; read them back and reconstruct Student objects; print the final class report in tabular format using f-strings with column alignment.

AI Tools Integration (Lab): Use Thonny IDE (beginner-friendly, built-in debugger) or Google Colab as the primary lab environment. Use Python Tutor (pythontutor.com) to visualize variable states, recursive call stacks, and list/dictionary operations — mandatory for Experiments 3, 12, and 15. Use Flowgorithm to design flowcharts before writing code in Experiments 1 and 4. Use ChatGPT or Claude to explain error messages when a program fails — read the explanation, fix the error yourself, and document both the error and the fix. Do NOT copy AI-generated code directly; use AI to understand concepts and debug, then write the solution independently.

LEARNING RESOURCES

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Textbooks

- TB1: Pieter Spronck, Computational Thinking with Python (course textbook — algorithms and Python foundations).
- TB2: Reema Thareja, Programming in Python, Oxford University Press. (Primary implementation reference — all five units.)

Reference Books

- Allen B. Downey, Think Python: How to Think Like a Computer Scientist, 2nd Edition, O'Reilly. (Free at greenteapress.com)
- Eric Matthes, Python Crash Course, 3rd Edition, No Starch Press.

Online Tools and Resources

- Python Tutor – pythontutor.com |Flowgorithm – flowgorithm.org
- Thonny IDE – thonny.org | Google Colab – colab.research.google.com
- Python Official Documentation – docs.python.org/3
- NPTEL – Problem Solving through Programming in Python – nptel.ac.in
- W3Schools Python Tutorial – w3schools.com/python |Replit – replit.com

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SANTHIRAM ENGINEERING COLLEGE

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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Course Code	APPLIED CHEMISTRY FOR COMPUTER SCIENCE LAB	L	T	Pr	P	Credits
26A93102P	CSE | I Year II Sem	0	0	0	3	1.5
Prerequisite:	Applied Chemistry for Computer Science (co-requisite)					

Lab Course Outcomes

After successful completion of the lab, the student will be able to:

CO	Course Outcome Statement	Bloom's Level
CO1	Perform redox and conductometric titrations to estimate concentrations of analytes in solution.	L3 (Apply)
CO2	Determine corrosion rates and analyze environmental factors affecting corrosion of metals.	L3–L4
CO3	Apply potentiometric and spectrophotometric techniques for quantitative chemical analysis.	L3 (Apply)
CO4	Identify functional groups in organic compounds using IR spectroscopy.	L3 (Apply)
CO5	Synthesize a polymer and use AI/Python-based data analysis for predictive modelling of material behaviour.	L3–L4

List of Experiments

Unit 1		Titrimetric and Conductometric Analysis
1	Estimation of Ferrous Iron (Fe2+) using Potassium Permanganate (KMnO4) — Redox Titration	Standardize a KMnO4 solution against a known oxalate solution, then titrate a Fe2+ sample solution against the standardized KMnO4 until a persistent pink endpoint is observed. Calculate the concentration and amount of Fe2+ present in the given sample using stoichiometric relations.
2	Determination of Strength of Acid (H2SO4) in Battery Using Sodium Hydroxide (NaOH)	Standardize a NaOH solution against a primary standard, then titrate a diluted battery acid sample against the standardized NaOH using a suitable indicator. Determine the strength and concentration of sulfuric acid present in the battery sample.
3		Determination of Cell Constant and Conductance of solutions
4	Determination of Corrosion	Expose metal coupons (mild steel or copper) to a corrosive medium for a fixed duration, measure weight loss before and after exposure, and calculate the corrosion rate using the weight-loss method. Document observations on surface changes.
5	Determination of Corrosion by Environment	Expose identical metal coupons to different environmental conditions (humid, saline, acidic) and compare corrosion rates across environments. Analyse which environmental factor accelerates corrosion most significantly and relate findings to real-world electronic hardware protection needs.
Unit 2		Conductometric and Potentiometric Titrations

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1	Conductometric Titration of Strong Acid vs Strong Base (HCl vs NaOH)	Titrate HCl against NaOH while measuring conductivity at regular intervals using a conductivity meter. Plot conductance versus volume of titrant added, identify the equivalence point from the graph, and determine the concentration of the acid.
2	Conductometric Titration of Weak Acid vs Strong Base (CH3COOH vs NaOH)	Titrate acetic acid against NaOH while recording conductivity readings. Plot the conductometric titration curve, identify the characteristic curve shape for a weak acid–strong base titration, and determine the equivalence point and acid concentration.
3	Potentiometry (Redox Titration) — Estimation of Iron (Fe2+) Using Potassium Dichromate (K2Cr2O7)	Set up a potentiometric titration using a platinum electrode and reference electrode, titrate a Fe2+ solution against standardized K2Cr2O7, and record EMF values at regular intervals. Plot EMF versus volume to identify the equivalence point and calculate Fe2+ concentration.
Unit 3		**Spectroscopic Analysis and Polymer Synthesis**
1	Spectrophotometry — Determination of Wavelength (λ) and Verification of Beer-Lambert's Law	Prepare a series of standard solutions of a coloured compound at varying concentrations, measure absorbance at a fixed wavelength using a UV-Vis spectrophotometer, and plot absorbance versus concentration to verify Beer-Lambert's law. Determine the molar extinction coefficient from the slope.
2	Identification of Functional Groups in Organic Compound by Infra-Red (IR) Spectrum	Record the IR spectrum of a given organic compound and identify characteristic absorption bands corresponding to functional groups (C=O, O-H, N-H, C-H, etc.). Compare the spectrum with reference IR charts to confirm the identity of functional groups present.
3	Preparation of Polymer (Phenol-Formaldehyde — Bakelite)	Synthesize Bakelite by the controlled condensation reaction of phenol and formaldehyde under acidic or basic catalytic conditions, observing the resin formation stages (A-stage, B-stage). Document the reaction conditions and resulting polymer properties, and analyse the reaction's industrial relevance to electronic component insulation.
4		Preparation of Nano Materials by Precipitations

AI Tools Integration (Lab)

AI Tools Integration (Lab)	Data analysis using Python (NumPy, Pandas, Matplotlib) for titration curve plotting and equivalence point detection. Predictive modelling for corrosion rate and material behaviour using scikit-learn regression. TensorFlow for optional IR spectrum pattern classification. OpenCV for colorimetric image-based concentration estimation. Qiskit (introductory) for exploring quantum chemistry concepts relevant to spectroscopy.

CO – PO Articulation Matrix (NBA)

Scale: 3 – Strong, 2 – Moderate, 1 – Slight, – No Correlation

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	2	-	1	2	-	-	-	-	-	3	2

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CO2	2	-	-	2	-	2	1	-	-	-	-	-	2	3
CO3	2	-	-	3	-	3	2	-	-	-	-	-	2	3
CO4	2	-	-	2	-	2	1	-	-	-	-	-	3	2
CO5	1	-	-	2	3	2	2	-	-	-	-	-	2	3
Average	2.0	-	-	2.2	3.0	2.0	1.6	-	-	-	-	-	2.4	2.6

CO-PO Correlation Highlights	CO1 and CO3 map strongly to PO1 and PO2 through titration-based quantitative analysis. CO2 connects to PO4 (Investigation) through corrosion rate determination under varying environmental conditions. CO5 links to PO5 (Modern Tools) through Python-based predictive modelling of material behaviour and polymer synthesis documentation.

LEARNING RESOURCES

Textbooks

1. Jain, P. C., & Jain, M. (2020). Engineering Chemistry (17th ed.). Dhanpat Rai Publishing.
2. Shika Agarwal (2026). Engineering Chemistry (5th ed.). Cambridge University Press.

Reference Books

1. Dara, S. S., &Umare, S. S. (2018). Engineering Chemistry (15th ed.). S. Chand Publishing

Online Resources

- IEEE Xplore Digital Library
- Semiconductor Industry Association resources
- NPTEL Engineering Chemistry
- ASME technical resources

YOUTUBE CHANNELS

- English with Lucy – @EnglishwithLucy (Vocabulary, speaking, British accent)
- Learn English with TV Series – @LearnEnglishWithTVSeries
- Rachel's English – @rachelsenglish (American accent and pronunciation)
- TED-Ed – @TEDEd (Critical thinking and communication ideas)
- Spoken English Hub – @SpokenEnglishHub (Indian context, interview prep)
- JenniferESL – @JenniferESL (Grammar and business English)

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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Course Code	ENGINEERING WORKSHOP	L	T	Pr	P	Credits
26A03102	CSE | I Year I Sem	0	0	0	3	1.5
Prerequisite:	Basic Computing Elements					

Lab Course Outcomes

After successful completion of the lab, the student will be able to:

CO	Course Outcome Statement	Bloom's Level
CO1	Recognize the importance of safety precautions while working in the workshop.	L2 (Understand)
CO2	Identify different measuring, marking, cutting tools used in the workshop and their operational capabilities.	L2–L3
CO3	Fabricate precision wood and metal fitting joints within standard specifications.	L3 (Apply)
CO4	Understand wiring standards, safe residential switches, lighting circuits, and basic appliances.	L2–L3
CO5	Identify different tools used in foundry and welding sections.	L2 (Understand)

List of Experiments

Unit 1		Safety Practices, Carpentry and Fitting Trades
1	Workshop Safety Orientation and PPE Demonstration	Demonstrate proper use of Personal Protective Equipment (helmet, safety glasses, gloves, apron) and identify common workshop hazards. Practise emergency protocols including fire extinguisher use and first-aid station location, using computer vision-based safety compliance monitoring as a demonstration.
2	Carpentry — Half-Lap and Mortise & Tenon Joints	Prepare a half-lap joint and a mortise-and-tenon joint using basic carpentry tools (saw, chisel, mallet, marking gauge) on a wooden workpiece. Verify joint fit and dimensional accuracy against the given drawing specification.
3	Carpentry — Corner Dovetail or Bridle Joint	Prepare a corner dovetail joint or bridle joint following standard carpentry marking and cutting procedures. Inspect the finished joint for fit, squareness, and surface finish.
4	Fitting — V-Fit and Dovetail Fit	Perform a V-fit and a dovetail fit exercise on mild steel workpieces using fitting tools (files, scriber, try square, vernier caliper). Verify dimensional accuracy and fit tolerance against the drawing.
5	Fitting — Semi-Circular Fit	Perform a semi-circular fit exercise combining male and female workpieces to standard tolerance. Inspect for fit accuracy using feeler gauges and visual inspection.
Unit 2		**Sheet Metal, Plumbing and Welding Trades**
1	Sheet Metal Working — Tapered Tray and Conical Funnel	Develop and fabricate a tapered tray and a conical funnel from GI sheet using sheet metal tools (snips, mallet, stakes); apply development of surfaces principles for accurate pattern marking. Verify dimensional accuracy of the finished components.

2	**Sheet Metal Working — Elbow Pipe and Brazing**	Develop and fabricate an elbow pipe joint from GI sheet, and perform a brazing exercise to join two metal pieces. Inspect the joint strength and surface finish of the brazed connection.
3	**Electrical Wiring — Series, Parallel and Two-Way Switch Circuits**	Make electrical connections for a parallel and series lighting circuit, and wire a two-way switch circuit for staircase lighting control. Test each circuit for correct operation and safety compliance using a multimeter.
4	**Electrical Wiring — Godown Lighting, Tube Light and Soldering**	Wire a godown lighting circuit and a tube light circuit (including choke and starter connections); practise soldering of wire joints. Test all connections for continuity and correct functioning.
5	**Plumbing — Pipe Joint Preparation**	Prepare a simple PVC pipe joint with coupling for same-diameter pipes and with a reducer for different-diameter pipes, using thread cutting and pipe-fitting tools. Test the joint for leak-tightness using a pressure or water test.
6	**Welding Shop — Lap Joint and Butt Joint**	Demonstrate and practise Arc Welding and Gas Welding techniques to prepare a simple lap joint and a butt joint on mild steel plates. Inspect the welded joint for uniformity, penetration, and visual defects.
Unit 3		**Foundry, Computer Hardware and Smart Systems**
1	**Foundry Trade — Green Sand Mould Preparation**	Demonstrate and practise moulding tools and processes to prepare a green sand mould for a simple pattern. Inspect the mould cavity for surface finish and dimensional accuracy before pouring simulation.
2	**Introduction to 3D Printing**	Demonstrate the core concepts of 3D printing including hardware components, software workflow, digital file preparation (STL/G-code), and printing materials. Observe the 3D printing process for a simple complex-geometry object and document the print quality.
3	**Computer Hardware Disassembly and Reassembly**	Disassemble and reassemble a desktop computer to understand the role of each component (CPU, motherboard, RAM, HDD/SSD, GPU). Document the function and interconnection of each component and verify successful reassembly through a boot test.
4	Hardware Troubleshooting and Peripheral Installation	Simulate common hardware issues (RAM failure, CPU overheating) and identify the procedures for resolving each. Install and configure peripheral devices such as a printer, scanner, or external hard drive, and verify successful operation.
5	Network Setup and Configuration	Set up a small LAN network with routers, switches, and computers; configure IP addresses, subnet masks, and basic network services. Verify network connectivity between devices using ping tests.
6	Disassembly and Assembly of Mechanical Equipment	Familiarise with the disassembly and assembly process of a simple mechanical system such as a bicycle gear box or braking system. Document the function of each component and verify correct reassembly through operational testing.
7	Smart Energy Monitoring Using IoT Sensors	Set up an IoT current sensor to monitor energy consumption of a simple electrical circuit; log the data and build a basic machine learning load forecasting model. Train

		an anomaly detection routine to flag unusual electrical load patterns (simulated arc/leakage events).

AI Tools Integration (Lab)

AI Tools Integration (Lab)	Computer vision for safety compliance monitoring in the workshop environment. Smart energy monitoring using IoT current sensors with machine learning load forecasting models. Training of anomaly detection systems to automatically flag electrical arc or leakage patterns, supporting predictive load-monitoring model development. Python-based data logging and visualization for sensor data collected during the IoT energy monitoring experiment.

CO – PO Articulation Matrix (NBA)

Scale: 3 – Strong, 2 – Moderate, 1 – Slight, – No Correlation

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	–	–	–	2	–	–	–	–	–	–	2
CO2	3	2	2	1	2	–	–	–	–	–	–	1
CO3	3	1	–	–	1	2	–	–	–	–	–	2
CO4	–	–	–	–	–	–	–	1	3	–	1	–
CO5	–	–	–	–	–	–	–	–	–	3	–	1

CO-PO Correlation Highlights	CO1 maps strongly to PO1 and PO5 through safety awareness reinforced by computer vision compliance demonstrations. CO2 and CO3 connect to PO1, PO2, PO3, and PO5 through hands-on fabrication exercises. CO4 links to PO8 (Ethics) and PO9 (Teamwork) through electrical safety practice. CO5 maps to PO10 (Communication) and PO11 (Project Management) through foundry and computer hardware documentation tasks.

LEARNING RESOURCES

Textbooks

1. Hajra Choudhury, S. K. (n.d.). Workshop Technology Vol I & II. Media Promoters & Publishers.
2. Raghuwanshi, B. S. (2015/2017). A Course in Workshop Technology. Dhanpat Rai & Co.

Reference Books

1. Veneri, G., & Capasso, A. (n.d.). Hands-On Industrial Internet of Things. Packt Publishing.
2. Felix, W. (2019). Basic Workshop Technology: Manufacturing Process. Independently Published.
3. Black, B. J. (2015). Workshop Processes, Practices and Materials (5th ed.). Routledge.
4. Rao, P. N. (n.d.). Manufacturing Technology (Foundry, Forming and Welding). McGraw Hill.
5. Mobley, R. K. (n.d.). An Introduction to Predictive Maintenance. Butterworth-Heinemann.

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Online Resources

- NPTEL Workshop Practices Video Series – IIT Kharagpur
- Predictive Maintenance Models in Python Tutorial
- MIT 6.131: Power Electronics and Smart Grid Interfaces

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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Course Code	NSS/NCC/SCOUTS & GUIDES/COMMUNITY SERVICE	L	T	Pr	P	Credits
26A99102	CSE | I Year II Sem	0	0	0	1	0.5

Course Objectives

- Inculcate the spirit of volunteerism, patriotism and social responsibility among students.
- Enable students to understand the structure, objectives and working of NSS, NCC, Scouts & Guides.
- Develop leadership, communication, teamwork and crisis-management skills through experiential learning.
- Equip students with basic first-aid and disaster-preparedness competencies.
- Promote community engagement and sustainable development values through organised service activities.

Course Outcomes (COs)

CO No.	Course Outcome	Bloom's Level
CO1	Understand the philosophy, history, and objectives of NSS/NCC/Scouts & Guides and community service programmes.	Remember/ Understand
CO2	Demonstrate leadership, teamwork, and organisational skills through camp/parade/drill activities.	Apply
CO3	Plan and execute community service projects addressing social issues like health, hygiene, literacy, and environment.	Analyse/Apply
CO4	Apply first aid, disaster-preparedness, and civic responsibilities in real-world scenarios.	Apply
CO5	Develop civic sense, national integration, and sustainable community-development values.	Evaluate

Bloom's Taxonomy Levels: Remember (L1) | Understand (L2) | Apply (L3) | Analyse (L4) | Evaluate (L5) | Create (L6)

Unit-wise Syllabus with Learning Outcomes

UNIT 1	Foundation of NSS, NCC, Scouts & Guides and Community Service	5 Hrs
Topics	• Introduction to NSS – history, objectives, badge, motto, pledge • Introduction to NCC – ranks, uniforms, aims, NCC Act 1948 • Scouts & Guides – Baden-Powell legacy, Bharat Scouts & Guides Act • Community Service – concept, importance and types • Citizenship, civic sense and social responsibility • Volunteerism: global and Indian perspective (NYKS, NSS, Red Cross) • Legal & ethical framework for community service	
Unit-wise Learning Outcomes (ULOs)	**On completion of this unit, students will be able to:** • ULO1.1: Recall the history, founding philosophy and motto of NSS, NCC, and Scouts & Guides. [Remember] • ULO1.2: Explain the organisational structure, ranks and regulatory framework of NSS and NCC. [Understand]	

	• ULO1.3: Describe the concept and significance of volunteerism and civic responsibility in a democratic society. [Understand] • ULO1.4: Distinguish between different types of community service and identify relevant national programmes. [Analyse]	
UNIT 2	**Leadership, Skill Development, Camping and Disaster Management**	**5 Hrs**
Topics	• Leadership development – theories and models (situational, transformational) • Team building, communication & conflict resolution • Parade, drill & physical training basics • Map reading, navigation and field craft (NCC) • Camp organisation – planning, logistics, safety protocols • Adventure activities: trekking, rock-climbing, swimming (awareness) • Disaster management – concepts, types, roles of NSS/NCC volunteers • First Aid – CPR, wound management, fractures, snake bite, burn	
Unit-wise Learning Outcomes (ULOs)	**On completion of this unit, students will be able to:** • ULO2.1: Apply leadership principles and team-building strategies in group activities and camp scenarios. [Apply] • ULO2.2: Demonstrate correct parade, drill and basic physical training techniques. [Apply] • ULO2.3: Organise and simulate camp logistics including safety protocols and adventure activity planning. [Apply] • ULO2.4: Perform essential first-aid procedures (CPR, wound care, fracture management) on simulated casualties. [Apply] • ULO2.5: Evaluate disaster risk and assign appropriate volunteer roles during simulated disaster scenarios. [Evaluate]	
UNIT 3	**Community Projects, Social Awareness and Service Documentation**	**5 Hrs**
Topics	• Community needs assessment – participatory methodology • Project planning: Swachh Bharat, Pulse Polio, Blood Donation camps • Literacy campaigns and awareness drives (PadhnaLikhna Abhiyan) • Environmental conservation – plantation, solid waste, water conservation • Gender sensitisation and women empowerment programmes • Digital literacy and e-governance outreach • Documentation and reporting of service-learning activities • Reflection, portfolio preparation and field report writing	
Unit-wise Learning Outcomes (ULOs)	**On completion of this unit, students will be able to:** • ULO3.1: Conduct a community needs assessment using participatory tools. [Analyse] • ULO3.2: Design a community service project plan with SMART goals, timelines and resource allocation. [Create] • ULO3.3: Execute awareness drives on health, environment, gender and digital literacy. [Apply] • ULO3.4: Prepare comprehensive field reports and reflective portfolios documenting service outcomes. [Create]	

	• ULO3.5: Evaluate the social impact of community service interventions using evidence. [Evaluate]

Text Books

S.No	Title	Author(s)	Publisher	Year
1	NSS Training Manual	Ministry of Youth Affairs & Sports, Govt. of India	MYAS Publication	2022
2	National Cadet Corps – Training Syllabus & Manual	Directorate General NCC	DG NCC, New Delhi	2021

Reference Books

S.No	Title	Author(s)	Publisher	Year
1	Community Development & Social Service	Dr. S. K. Lal	Regal Publications	2019
2	Disaster Management – A Holistic Approach	Satish Modh	Macmillan India	2020
3	Volunteer Management	Steve McCurley & Rick Lynch	Energize Publications	2018
4	Scouting for Boys	Lord Robert Baden-Powell	Oxford University Press (Centenary Ed.)	2008

Web Resources

- NSS Official Portal – https://nss.gov.in
- NCC Official Site – https://indiancc.mygov.in
- Bharat Scouts & Guides – https://bsgindia.org
- UN Volunteers – https://www.unv.org
- NYKS (Nehru Yuva Kendra) – https://nyks.nic.in
- National Disaster Management Authority – https://ndma.gov.in
- Swachh Bharat Mission – https://swachhbharat.mygov.in
- India Volunteers – https://www.indiavolunteers.org

YouTube Resources

- NSS Song & Pledge (Official MYA&S) – https://youtu.be/nss_official_01
- NCC Drill & Parade Training Basics – https://youtu.be/ncc_drill_02
- Community Service Project Planning – https://youtu.be/community_svc_03
- First Aid & CPR Tutorial – Red Cross India – https://youtu.be/firstaid_rci_04
- Disaster Management Awareness – NDMA – https://youtu.be/ndma_dm_05
- Baden-Powell and the Scout Movement – https://youtu.be/scouts_bp_06
- Leadership Skills for Youth – https://youtu.be/leadership_youth_07
- Swachh Bharat Campaign Activities – https://youtu.be/swachh_sb_08

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AI-Integrated Activities

S.No	AI Activity	Description / Tool
1	AI-Assisted Community Needs Survey	Use ChatGPT / Gemini to design survey questionnaires; analyse crowd-sourced responses with AI tools to map priority community issues.
2	Virtual Camp Planning Simulator	Use Notion AI / Trello AI to simulate camp logistics, assign roles and generate contingency plans for adverse scenarios.
3	Disaster-Risk FAQ Chatbot	Students build a first-aid guidance chatbot using Dialogflow / Botpress and deploy it for community awareness.
4	AI Social Media Campaign Design	Use Canva AI / Adobe Firefly to create Swachh Bharat / blood-donation awareness posters; schedule with Buffer AI.
5	Reflective Portfolio with AI Writing Aid	Draft field reports using Grammarly / ChatGPT; critically compare AI-generated drafts with self-written reflections.

CO – PO / PSO Mapping

Correlation: 3 = Strong | 2 = Moderate | 1 = Slight | – = No correlation

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	3	3	2	2	-	-	-	2	-
CO2	-	-	3	-	-	3	2	3	3	-	-	-	2	2
CO3	-	-	2	3	2	3	3	2	3	-	-	-	-	-
CO4	-	-	3	2	-	2	2	3	3	-	-	-	-	-
CO5	-	-	-	-	3	3	3	2	2	-	-	-	-	-

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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Course Code	CYBERSECURITY AWARENESS FOR ENGINEERS	L	T	Pr	P	Credits
26A05102	CSE | I Year I Sem	2	0	0	0	0
Prerequisite:	None					

Course Objectives

- Introduce students to the fundamentals of cybersecurity and secure digital practices in modern society.
- Create awareness about cyber threats, cybercrimes, and methods for protecting personal and institutional digital assets.
- Develop responsible digital citizenship through cyber ethics, privacy awareness, and legal understanding.
- Enable students to adopt cyber hygiene practices for secure use of digital technologies.
- Familiarize students with emerging cybersecurity concerns in cloud, digital platforms, and AI-enabled environments.

Course Outcomes (COs)

After successful completion of the course, the student will be able to:

CO	Course Outcome Statement	Bloom's Level
CO1	Explain fundamental cybersecurity concepts and their importance in digital environments.	L2 (Understand)
CO2	Identify common cyber threats, cyberattacks, and social engineering techniques.	L2 (Understand)
CO3	Apply safe practices for secure use of devices, networks, email, cloud services, and online platforms.	L3 (Apply)
CO4	Demonstrate awareness of cyber ethics, privacy protection, and cyber laws.	L2–L3
CO5	Develop cyber hygiene habits and respond appropriately to common cybersecurity incidents.	L3 (Apply)

Course Content

UNIT – 1	Introduction to Cyberspace and Cybersecurity	6 Hrs
Content	• Introduction to cyberspace and cybersecurity; Evolution of information systems and Internet; Importance of cybersecurity in engineering and society. • Information security concepts; CIA Triad (Confidentiality, Integrity, Availability); Digital footprint and digital identity; Security governance basics. • Cyber threat actors; Engineering ethics and responsible digital behavior; Cyber hygiene practices.	
AI Integration	Use of cybersecurity awareness platforms and threat-intelligence dashboards to map real-world CIA triad violations. Free/Open-Source Tools: National Cyber Security Awareness Portal (India); CERT-In resources.	
UNIT – 2	**Cyber Threats, Cybercrime and Social Engineering**	**6 Hrs**
Content	• Cyber threats and vulnerabilities; Cybercrime and cyber offenders; Malware: Virus, Worm, Trojan, Spyware, Ransomware; Cyberattack lifecycle and common attack methods. • Phishing, Spear Phishing, Smishing and Vishing; Social engineering attacks; Password attacks and credential theft; Identity theft and financial fraud.	

	• Insider threats; AI-enabled cyber threats and deepfakes; Case studies of major cyber incidents.	
AI Integration	Analysis of deepfake detection demos and AI-generated phishing email recognition exercises. Free/Open-Source Tools: OWASP Foundation resources; National Cyber Crime Reporting Portal case studies.	
UNIT – 3	**Personal Cyber Safety and Cybersecurity Technologies**	**6 Hrs**
Content	• Password management and Multi-Factor Authentication; Authentication and access control concepts; Safe browsing practices; Email and communication security. • Mobile device security; Cloud security basics; Secure use of Wi-Fi and public networks; Data backup and recovery. • Cryptography and digital signatures (awareness level only); Safe use of AI tools and digital platforms.	
AI Integration	Practical exercises using free password managers and MFA setup; NIST Cybersecurity Framework self-assessment activity. Free/Open-Source Tools: NIST Cybersecurity Framework Resources.	
UNIT – 4	**Privacy, Cyber Ethics and Cyber Laws**	**6 Hrs**
Content	• Data protection and privacy concepts; Personal data and sensitive information; Cyber ethics and responsible digital behavior. • Overview of cyber laws in India; Information Technology (IT) Act and related provisions (awareness level); Common cybercrimes and legal implications. • Cybercrime reporting mechanisms and grievance redressal; Digital evidence basics; Social media responsibility and legal considerations.	
AI Integration	Case discussion using CERT-In advisories and IT Act provisions applied to AI-generated content disputes. Free/Open-Source Tools: National Cyber Crime Reporting Portal; CERT-In.	
UNIT – 5	**Cyber Hygiene and Secure Digital Practices**	**6 Hrs**
Content	• Cybersecurity risk awareness; Password management and Multi-Factor Authentication; Secure use of email, web, cloud and public networks. • Safe digital transactions and digital payment awareness; Secure use of social media and AI tools; Cybersecurity awareness in IoT and emerging technologies. • Incident awareness and cyber hygiene best practices.	
AI Integration	Cisco Networking Academy module on Introduction to Cybersecurity as a self-paced AI-assisted learning supplement. Free/Open-Source Tools: Cisco Networking Academy – Introduction to Cybersecurity.	

Bloom's Taxonomy Coverage – Summary

Bloom's Level	Level Name	CO(s)	Sample Activities
L2	Understand	**CO1, CO2, CO4**	CIA Triad identification; malware type classification; cyber law awareness quiz.
L3	Apply	**CO3, CO5**	MFA setup exercises; secure browsing practice tasks; incident response drill.

CO – PO Articulation Matrix (NBA)

Scale: 3 – Strong, 2 – Moderate, 1 – Slight, – No Correlation

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

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

CO-PO Correlation Highlights	CO5 shows the strongest alignment with PO6 (Engineer & Society) reflecting the course's focus on responsible digital citizenship. CO4 maps strongly to PO8 (Ethics) through cyber law and privacy awareness. As a 0-credit mandatory course, the emphasis is on PO6, PO8, and PO12 (Lifelong Learning) rather than technical PO1-PO5 correlations.

LEARNING RESOURCES

Textbooks

1. Singh, A. (n.d.). Introduction to Cyber Security: Concepts, Principles, Technologies and Practices. Universities Press / Orient Black Swan.
2. Godbole, N., & Belapure, S. (n.d.). Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives. Wiley India.

Reference Books

1. Brooks, C. J., Grow, C., Craig, P., & Short, D. (n.d.). Cybersecurity Essentials. Wiley.
2. Stallings, W., & Brown, L. (n.d.). Computer Security: Principles and Practice. Pearson.
3. Whitman, M. E., & Mattord, H. J. (n.d.). Principles of Information Security. Cengage Learning.
4. Kizza, J. M. (n.d.). Guide to Computer Network Security. Springer.
5. Cole, E. (n.d.). Cybersecurity for Beginners. Wiley.

Online Resources

- National Cyber Security Awareness Portal (India)
- CERT-In (Indian Computer Emergency Response Team)
- National Cyber Crime Reporting Portal
- NIST Cybersecurity Framework Resources
- OWASP Foundation
- Cisco Networking Academy – Introduction to Cybersecurity

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I B.TECH II SEMESTER COURSE STRUCTURE

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I B.TECH II SEMESTER (R26) - COMPUTER SCIENCE & ENGINEERING							
S.NO	Course code	Title	L/D	T	Pr	P	Credits
1	26A91202	DIFFERENTIAL EQUATIONS & VECTOR CALCULUS	3	0	2	0	4
2	26A05203T	PROFESSIONAL CORE 1 - DATA STRUCTURES & EFFICIENT PROBLEM SOLVING	3	0	0	0	3
3	26A33101P	AI TOOLS & APPLICATIONS	1	0	4	0	3
4	26A94101T	COMMUNICATIVE ENGLISH	2	0	0	0	2
5	26A92101T	PHYSICS FOR ADVANCED COMPUTING	3	0	0	0	3
6	26A94101P	COMMUNICATIVE ENGLISH LAB	0	0	0	2	1
7	26A92101P	PHYSICS FOR ADVANCED COMPUTING LAB	0	0	0	3	1.5
8	26A05203P	DATA STRUCTURES & EFFICIENT PROBLEM SOLVING LAB	0	0	0	2	1
9	26A99103	HEALTH AND WELLNESS, YOGA AND SPORTS	0	0	0	1	0.5
10	26A91203	COMPETITIVE ENHANCEMENT COURSE - II	2	0	0	0	0
TOTAL			**14**	**00**	**06**	**08**	**19**

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I B.TECH II SEMESTER SYLLABUS

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Course Code	DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS	L	T	Pr	P	Credits
26A91202	CSE | I Year II Sem	3	0	2	0	4
Prerequisite:	Linear Algebra and Calculus					

Course Objectives

- Develop analytical and computational competence in solving ordinary and partial differential equations arising in engineering systems.
- Enable students to interpret vector differential and integral operators in physical and engineering contexts.
- Integrate mathematical modeling, visualization, and simulation using modern AI-assisted computational tools in alignment with NEP 2020 and outcome-based education.
- Apply ODE and PDE solution methods to model real-world engineering phenomena such as circuits, vibrations, heat transfer, and fluid flow.
- Use computational tools for solving, verifying, and visualizing differential equations and vector field problems.

Course Outcomes (COs)

After successful completion of the course, the student will be able to:

CO	Course Outcome Statement	Bloom's Level
CO1	Solve first-order ODEs and model engineering processes using analytical and computational approaches.	L3 (Apply)
CO2	Analyze higher-order linear ODEs and interpret solutions in dynamic engineering systems such as circuits and oscillators.	L4 (Analyze)
CO3	Formulate and solve first-order and selected higher-order PDEs relevant to engineering models including wave, heat, and Laplace equations.	L3 (Apply)
CO4	Interpret and compute gradient, divergence, and curl of scalar and vector fields and explain their physical significance in engineering contexts.	L4 (Analyze)
CO5	Apply Green's, Stokes', and Divergence theorems to compute work, circulation, and flux and evaluate engineering field behaviour.	L5 (Evaluate)

Course Content

UNIT – 1	First-Order Ordinary Differential Equations	9 Hrs
Content	• Classification of ODEs by order, degree, and linearity; linear first-order ODEs and integrating factor method; Bernoulli's equation; exact equations and integrating factors. • Orthogonal trajectories; Newton's law of cooling and natural growth/decay models; electrical circuit models (RC and RL circuits); engineering applications of first-order ODEs.	
AI Integration	Python SymPydsolve for symbolic ODE solution and verification; direction field (slope field) visualization using Matplotlib; AI-assisted debugging of integrating factor derivations; using ChatGPT/Copilot to explain solution families and physical interpretations; SciPy solve_ivp for numerical ODE solution. Free/Open-Source AI Tools: Python (SymPy, SciPy, Matplotlib) on Google Colab; Jupyter Notebook; GNU Octave.	

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UNIT – 2	Higher-Order Linear Differential Equations	9 Hrs
Content	• Superposition principle; Wronskian and linear independence; complementary function for constant-coefficient ODEs (distinct real, repeated, and complex roots); particular integral by operator method; variation of parameters. • Simultaneous linear ODEs; Cauchy's (Euler) equation; Legendre's equation; applications to LCR circuits, simple harmonic motion, damped and forced oscillations; mass-spring-dashpot systems.	
AI Integration	Python SciPy signal. lsim for simulation of underdamped, critically damped, and overdamped responses; resonance amplitude curve generation; AI-assisted Wronskian computation using SymPy; AI tools to explain transient vs. steady-state response. Free/Open-Source AI Tools: Python (NumPy, SciPy, SymPy, Matplotlib); GNU Octave; Wolfram Alpha free tier.	
UNIT – 3	**Partial Differential Equations**	**9 Hrs**
Content	• Introduction and classification of PDEs; formation by elimination of arbitrary constants; formation by elimination of arbitrary functions; first-order linear PDEs and Lagrange's method (auxiliary equations); homogeneous linear PDEs with constant coefficients (CF and PI). • Standard forms of nonlinear first-order PDEs; second-order PDE applications — wave equation, heat equation, and Laplace's equation; classification as hyperbolic, parabolic, and elliptic.	
AI Integration	Python SymPy for PDE formation and symbolic verification; 3D surface plot visualization of PDE solution families using Matplotlib; SciPy finite-difference simulation of the 1D heat equation with animation; AI-assisted PDE classification using the discriminant. Free/Open-Source AI Tools: Python (SymPy, NumPy, SciPy, Matplotlib); WolframAlpha free tier; Scilab.	
UNIT – 4	**Vector Differentiation**	**9 Hrs**
Content	• Scalar and vector fields; del (∇) operator; gradient and directional derivative; unit normal to surfaces; angle between surfaces; divergence and physical interpretation; curl and physical interpretation. • Vector identities; conservative fields and scalar potentials; Laplacian; engineering applications of gradient, divergence, and curl in electromagnetic and fluid mechanics contexts.	
AI Integration	Python NumPy and Matplotlib for 2D and 3D gradient, divergence, and curl field visualization (quiver plots, level-surface overlays); SymPy for symbolic verification of vector identities; AI tools to interpret Maxwell's equations in terms of divergence and curl operators. Free/Open-Source AI Tools: Python (NumPy, SymPy, Matplotlib, mpl_toolkits); SciPy for numerical computation.	
UNIT – 5	**Vector Integration and Integral Theorems**	**9 Hrs**
Content	• Line integrals over scalar and vector fields; work done and path independence; surface integrals and flux; Green's theorem in the plane and its applications. • Stokes' theorem; Divergence theorem (Gauss's theorem); applications to area and volume computation; engineering applications in electromagnetism, fluid mechanics, and mass conservation; relationship between integral theorems and Maxwell's equations.	
AI Integration	Python SciPy integrate for numerical computation of line and surface integrals; 3D flux visualization with colour-coded normal flux using Matplotlib; numerical verification of Green's and Stokes' theorems; AI-assisted physical interpretation of the Divergence theorem. Free/Open-Source AI Tools: Python (NumPy, SciPy, Matplotlib); SymPy for symbolic integral verification; Wolfram Alpha free tier.	

Bloom's Taxonomy Coverage – Summary

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Bloom's Level	Level Name	CO(s)	Sample Activities
L3	Apply	**CO1, CO3**	First-order ODE solution problems; PDE formulation and Lagrange's method exercises.
L4	Analyze	**CO2, CO4**	Higher-order ODE response analysis for LCR circuits; gradient/divergence/curl field interpretation.
L5	Evaluate	**CO5**	Green's/Stokes'/Divergence theorem application for flux and circulation computation.

CO – PO Articulation Matrix (NBA)

Scale: 3 – Strong, 2 – Moderate, 1 – Slight, – No Correlation

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	1	-	-	-	1	2	-	-
CO2	3	3	3	2	2	-	-	-	1	2	-	-
CO3	3	2	2	2	1	-	-	-	-	2	-	-
CO4	3	3	3	3	2	-	-	-	1	2	-	-
CO5	3	3	2	3	3	-	1	1	2	2	1	-

CO-PO Correlation Highlights	CO1 through CO4 strongly align with PO1 and PO2 through ODE/PDE solving and vector field analysis. CO5 maps additionally to PO7 and PO8 through engineering field interpretation using integral theorems in electromagnetism and fluid mechanics. PO5 (Modern Tools) is addressed throughout via SymPy, SciPy, and Google Colab-based simulation across all five units, while PO12 (Lifelong Learning) is consistently reinforced through self-directed computational verification practice.

LEARNING RESOURCES

Textbooks

- Kreyszig, E. (2018). Advanced Engineering Mathematics (10th ed.). Wiley.
- Grewal, B. S. (2017). Higher Engineering Mathematics (44th ed.). Khanna Publishers.

Reference Books

1. Thomas, G. B., Weir, M. D., & Hass, J. (2018). Thomas' Calculus (14th ed.). Pearson.
2. Jain, R. K., & Iyengar, S. R. K. (2021). Advanced Engineering Mathematics (5th ed.). Alpha Science International.
3. Zill, D. G., & Wright, W. S. (2018). Advanced Engineering Mathematics (6th ed.). Jones & Bartlett.
4. Arfken, G. B., Weber, H. J., & Harris, F. E. (2012). Mathematical Methods for Physicists (7th ed.). Academic Press.

5. Sneddon, I. N. (2006). Elements of Partial Differential Equations. Dover Publications.
6. Davis, H. F., & Snider, A. D. (1995). Introduction to Vector Analysis (7th ed.). Hawkes Publishing.

Online Resources

- NPTEL: Ordinary Differential Equations and Applications – https://nptel.ac.in
- NPTEL: Partial Differential Equations – https://nptel.ac.in
- NPTEL: Vector Calculus – https://nptel.ac.in
- MIT Open Courseware – Differential Equations (18.03): https://ocw.mit.edu
- MIT Open Courseware – Multivariable Calculus (18.02): https://ocw.mit.edu

Web Resources & NPTEL Links

- NPTEL: Ordinary Differential Equations and Applications – https://nptel.ac.in
- NPTEL: Partial Differential Equations – https://nptel.ac.in
- NPTEL: Vector Calculus – https://nptel.ac.in
- MIT Open Courseware – Differential Equations (18.03): https://ocw.mit.edu
- MIT Open Courseware – Multivariable Calculus (18.02): https://ocw.mit.edu
- Python SymPy Documentation: https://docs.sympy.org
- SciPy Documentation: https://docs.scipy.org
- Google Colab for Python: https://colab.research.google.com
- NumPy Documentation: https://numpy.org/doc

Recommended Free & Open-Source AI/Computational Tools

- Python (NumPy, SciPy, Matplotlib) – FREE on Google Colab for ODE/PDE solving, vector field visualization, and numerical integration.
- SymPy (free, open-source) – For symbolic ODE/PDE solution, gradient/divergence/curl computation, and algebraic verification.
- Jupyter Notebook (free, open-source) – For interactive computation, experiment documentation, and lab reporting.
- GNU Octave (free, open-source) – MATLAB-compatible numerical computing for ODE simulation and matrix workflows.
- Wolfram Alpha (free tier) – For quick verification of ODE solutions, PDE classification, and integral computation.
- Matplotlib / mpl_toolkits (free, open-source) – For 2D and 3D vector field quiver plots, solution surface visualization, and PDE animation.
- scikit-learn (free, open-source) – For optional AI demonstrations in regression and data-driven modeling tasks.

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Course Code	DATA STRUCTURES & EFFICIENT PROBLEM SOLVING	L	T	Pr	P	Credits
26A05203T	CSE | I Year II Sem	3	0	0	0	3

Course Objectives

- Introduce fundamental concepts of data structures and their applications using Python.
- Develop the ability to analyse time and space complexity of algorithms.
- Implement linear and non-linear data structures using Python.
- Apply appropriate data structures for efficient problem solving.
- Develop skills in algorithm design, recursion, and optimization techniques.

Course Outcomes (COs

After successful completion of the course, the student will be able to:

CO	Course Outcome Statement	Bloom's Taxonomy Level
CO1	Apply basic data structure concepts and analyse algorithm complexity using Python. (L3)	L3 (Apply)
CO2	Implement searching and sorting techniques for efficient data processing. (L3)	L3 (Apply)
CO3	Develop programs using linear data structures — stacks, queues, and linked lists — in Python. (L4)	L4 (Analyse)
CO4	Design and implement non-linear data structures including trees and heaps using Python. (L4)	L4 (Analyse)
CO5	Apply graph traversal and hashing techniques to solve real-world computational problems. (L4)	L4 (Analyse)

Course Content

UNIT – I	INTRODUCTION, ALGORITHM ANALYSIS, AND LINEAR STRUCTURES	9 Hrs
Content	• Introduction to data structures; Abstract Data Types (ADTs); algorithm analysis — time and space complexity; Big-O, Big-Omega, Big-Theta notations. • Lists in Python: operations on lists; static vs. dynamic memory allocation. • Searching techniques: Linear Search, Binary Search, Interpolation Search — analysis and comparison. • Sorting techniques: Bubble Sort, Selection Sort, Insertion Sort — algorithms, trace, and complexity analysis.	
AI Integration	Use VisuAlgo and Algorithm Visualizer to animate sorting and searching; use ChatGPT to explain Big-O complexity with concrete examples; use Python Tutor to trace memory representation of data structures.	

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UNIT – II	STACKS AND QUEUES	9 Hrs
Content	• Stacks: LIFO principle, push, pop, peek; implementation using Python lists; applications — expression evaluation (infix to postfix, postfix evaluation), parenthesis checking. • Queues: FIFO principle, enqueue, dequeue; types — Circular Queue, Priority Queue, Deque; implementation using Python lists and linked structures. • Applications of queues: BFS simulation, scheduling, real-world analogies.	
AI Integration	Use VisuAlgo to animate stack and queue operations; use ChatGPT to generate edge cases (overflow, underflow, circular behaviour); use GitHub Copilot to implement expression evaluation.	
UNIT – III	LINKED LISTS	9 Hrs
Content	• Singly Linked List: node structure, insertion at head/tail/position, deletion by value/position, traversal, reversal. • Doubly Linked List: forward and backward traversal, insertion, deletion; Circular Linked List: traversal and operations. • Applications: polynomial representation and addition, browser history simulation (doubly linked list), symbol table implementation.	
AI Integration	Use Python Tutor to trace pointer operations and node memory; use VisuAlgo to visualize insertion and deletion step by step; use ChatGPT to identify missing edge cases in AI-generated linked list explanations.	
UNIT – IV	TREES AND HEAPS	9 Hrs
Content	• Trees: terminology, properties; Binary Trees — representation, traversals (inorder, preorder, postorder, level order). • Binary Search Trees (BST): insertion, deletion, search; applications — autocomplete, range queries, dictionary lookup. • Heaps: Min-Heap and Max-Heap, array representation, heapify, Build-Heap; Heap Sort — algorithm and complexity.	
AI Integration	Use VisuAlgo and Algorithm Visualizer to animate tree traversals and BST operations; use ChatGPT to generate tricky tree cases (unbalanced, skewed); use GitHub Copilot to implement heap operations in Python.	

UNIT – V	GRAPHS AND HASHING	9 Hrs
Content	• Graphs: terminology, types (directed, undirected, weighted); representation — adjacency matrix and adjacency list. • Graph traversals: BFS (queue-based) and DFS (stack/recursion-based); applications — shortest path, cycle detection, social networks. • Hashing: hash functions, properties of a good hash function; collision resolution — chaining (separate chaining), open addressing (linear probing, quadratic probing, double hashing); load factor.	
AI Integration	Use NetworkX in Python and Gephi to build and traverse graphs; use VisuAlgo to animate BFS and DFS; use ChatGPT to explain real-world graph applications; use GitHub Copilot to implement hash tables with collision resolution.	

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Bloom's Taxonomy Coverage – Summary

Bloom's Level	Level Name	CO(s)	Sample Activities / Assessments
L1–L2	Remember / Understand	**CO1**	Define ADT, Big-O notation; describe stack, queue, tree, graph terminology.
L3	Apply	**CO1–CO3**	Implement stacks, queues, and linked list operations; trace sorting algorithms.
L4	Analyse	**CO3–CO5**	Compare data structures; trace BFS vs. DFS; analyse BST vs. Heap operations.
L5	Evaluate	**CO4, CO5**	Evaluate hash collision strategies; assess Heap Sort vs. Merge Sort.
L6	Create	**CO4, CO5**	Design a Python solution using appropriate data structure for a domain problem.

CO – PO / PSO Articulation Matrix (NBA)

Scale: 3 – Strong | 2 – Moderate | 1 – Slight | – No Correlation

CO	Bloom's Lvl	PO1 Eng. Know.	PO2 Problem Analysis	PO3 Design/ Dev.	PO4 Invest-igation	PO5 Modern Tools	PO6 Engineer & Society	PO7 Environ. & Sust.	PO8 Ethics	PO9 Team Work	PO10 Commun.	PO11 PrjMgm
CO1	L3	3	3	1	2	2	–	–	–	–	1	–
CO2	L3	3	3	2	2	2	–	–	–	–	1	–
CO3	L4	3	3	2	2	2	–	–	–	1	1	–
CO4	L4	3	3	3	2	2	–	–	–	1	1	–
CO5	L4	3	3	3	3	2	–	–	–	1	2	–

CO-PO Correlation Highlights	Strong PO1 and PO2 through algorithm complexity analysis and data structure design. PO3 (Design/Development) through tree, heap, graph, and hash table design in CO4 and CO5. PO4 (Investigation) through experimental complexity measurement and traversal analysis using VisuAlgo.

LEARNING RESOURCES

Textbooks

1. TB1: Shriram K. Vasudevan, Abhishek S. Nagarajan, Karthick Nanmaran, Data Structures Using Python, Wiley India.
2. TB2: Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, Data Structures and Algorithms in Python (Indian Adaptation), Wiley India.

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Reference Books

1. Brad Miller and David Ranum, Problem Solving with Algorithms and Data Structures using Python, Franklin Beedle.
2. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, Pearson Education.

Online Resources

- NPTEL – Data Structures and Algorithms – nptel.ac.in
- VisuAlgo – visualgo.net | Python Tutor – pythontutor.com |NetworkX – networkx.org
  GeeksforGeeks – geeksforgeeks.org | Algorithm Visualizer – algorithm-visualizer.org

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Course Code	AI TOOLS AND APPLICATIONS	L	T	Pr	P	Credits
26A33101P	CSE | I Year II Sem	1	0	0	4	3

Course Objectives

- Introduce students to AI concepts and the landscape of AI tools available for everyday academic and professional use.
- Develop practical skills in using AI for document creation, presentations, writing, and academic tasks applicable across all engineering disciplines.
- Build proficiency in AI-powered data analysis, spreadsheet automation, and intelligent research tools without requiring programming knowledge.
- Expose students to AI tools in visual design, media creation, and note-taking, and progressively to AI applications specific to their engineering branch.
- Cultivate responsible AI habits: verifying outputs, protecting privacy, respecting intellectual property, and understanding ethical and legal boundaries of AI use.

Course Outcomes (COs

After successful completion of the course, the student will be able to:

CO	Course Outcome Statement	Bloom's Taxonomy Level
CO1	Explain what AI is, how it works conceptually, and describe the landscape of AI tools across text, image, audio, video, and code categories. (L2)	L3 (Apply)
CO2	Use AI tools to create documents and presentations; apply prompt engineering and Note book LM to improve writing, research, and study habits. (L3)	L4 (Analyse)
CO3	Perform data analysis using AI without coding; use AI-powered research and note-taking tools to find, verify, organize, and summarize information. (L3)	L4 (Analyse)
CO4	Apply AI tools in visual design, diagrams, and media; identify and verify AI applications relevant to their own engineering discipline. (L4)	L5 (Evaluate)
CO5	Demonstrate responsible AI usage — bias, privacy, ethics, governance; design and present an AI-assisted mini-project using tools from all units. (L5)	L5 (Evaluate)

Course Content

UNIT – I	UNDERSTANDING AI AND AI FOR DOCUMENTS AND PRESENTATIONS	9 Hrs
Content	• **What is AI:** AI vs. ML vs. Deep Learning vs. Generative AI; brief history (Turing Test → ChatGPT → generative AI era); how LLMs work (training data, next-token prediction, temperature, hallucinations, context windows, knowledge cut-offs). AI ecosystem: ChatGPT, Claude, Gemini, Microsoft Co-pilot — strengths and differences. • **AI for presentations:** Gamma.app — full slide deck from a paragraph prompt; Microsoft Co-pilot in PowerPoint — slide generation, design suggestions, speaker notes; Canva AI — Magic Design, text-to-presentation, brand kits; Beautiful.ai — smart slide layouts; comparing AI-generated vs. manually created presentations.	

	• **AI for document writing:** Microsoft Co-pilot in Word — draft, rewrite, summarize; Gemini in Google Docs — writing assistance and inline Q&A; Notion AI — meeting notes, project plans, knowledge base; Claude Projects — organizing documents and having a persistent AI assistant over a set of files. • **AI writing assistance:** Grammarly — grammar, tone, clarity, plagiarism; ChatGPT and Claude for lab reports, proposals, and letters; academic integrity — AI as an assistant not an author; disclosure norms; identifying AI-generated content using GPTZero.	
UNIT – II	**AI FOR RESEARCH, NOTE-TAKING, DATA, AND SPREADSHEETS**	**9 Hrs**
Content	• **NotebookLM (Google):** uploading lecture notes, textbooks, PDFs, and research papers as sources; asking questions grounded in uploaded documents; generating study guides, timelines, briefing documents, and audio overviews (podcast-style summaries) from sources; source-grounded answers that cite the exact passage — eliminating hallucination risk. • **AI for research:** Perplexity AI (real-time web search with citations), Gemini Deep Research (multi-step research reports), Elicit and Consensus (academic paper search with evidence summaries); verifying AI-generated citations on Google Scholar; why AI fabricates references and how to detect it. • **Prompt engineering:** zero-shot, one-shot, few-shot, chain-of-thought, role-based prompting; iterative refinement; negative prompting; building effective prompts for summarization, comparison, explanation, and data extraction; using ChatGPT custom instructions and Claude Projects for persistent context. • **AI for spreadsheets and data analysis:** Microsoft Co-pilot in Excel — VLOOKUP, IF, COUNTIF, pivot tables from natural language; Gemini in Google Sheets — formula generation and chart creation; ChatGPT Advanced Data Analysis and Julius AI — uploading CSV files, computing statistics, generating charts, interpreting patterns — no coding required.	
UNIT – III	**AI FOR VISUAL DESIGN, DIAGRAMS, AND MEDIA**	**9 Hrs**
Content	• **AI for image generation:** DALL-E 3 (via ChatGPT), Canva AI (text-to-image, Magic Design, background remover), Adobe Firefly, Ideogram — writing effective image prompts (style, subject, composition, colour); iterative prompt refinement for posters, diagrams, and mockups. • **AI for diagrams and visual thinking:** Napkin.ai — converting text or concepts into visual diagrams, charts, and infographics automatically; Whimsical AI — AI-generated mind maps, flowcharts, and wireframes from a description; Miro AI — collaborative whiteboard with AI summarization and diagramming. • AI for audio and video: Eleven Labs — text-to-speech and voice cloning for presentations and voiceovers; Suno and Udio — AI music generation for project videos; Runway and Pika — generating short video clips from text prompts; HeyGen — AI avatars for video presentations; current limitations and appropriate use cases. • **AI content detection and critical evaluation:** GPTZero, Originality.ai for AI-text detection; Google Lens and reverse image search for AI-generated images; fact-checking workflows — cross-referencing primary sources; deepfakes and synthetic media — recognition, risks, and responsible creation.	
UNIT – IV	**AI ACROSS ENGINEERING DISCIPLINES**	**9 Hrs**
Content	• **AI in Mechanical Engineering:** generative design in CAD (Autodesk Fusion 360 — AI-optimized structures for weight and load); predictive maintenance using sensor data and ML; AI-assisted FEA simulation; manufacturing process optimization; digital twins.	

	• **AI in Civil and Electrical Engineering:** structural health monitoring using ML; smart grid load forecasting and energy management; AI for circuit simulation and PCB layout optimization (Altium AI); VLSI design automation — floor planning and routing; power systems fault detection. • **AI in Electronics and Communication:** AI-assisted signal processing and filtering; speech recognition for embedded systems; computer vision for industrial quality inspection; AI in antenna design and spectrum management; MATLAB AI and Deep Learning Toolbox. • **AI in Computer Science and allied branches:** GitHub Copilot for code generation, explanation, and review; AI-powered testing (Testim, Selenium AI); AI in cybersecurity — anomaly detection and intrusion detection; no-code/low-code platforms (Bubble, Glide, Web flow AI); AI for data science (Jupyter AI, Data Robot).	
UNIT – V	**RESPONSIBLE AI, ETHICS, AND CAPSTONE PROJECT**	**9 Hrs**
Content	• **AI bias and fairness:** sources of bias (data, model, deployment); real documented cases — Amazon hiring algorithm (2018), COMPAS recidivism (2016), facial recognition disparities (NIST 2019); fairness metrics; misinformation, deepfakes, and synthetic media risks. • **Privacy and intellectual property:** what happens to data entered into public AI tools; PII risks; data retention policies of ChatGPT (Open AI), Claude (Anthropic), and Gemini (Google); who owns AI-generated content; copyright status globally; academic plagiarism with AI; personal data safety protocol. • **AI governance frameworks:** EU AI Act risk tiers (unacceptable, high, limited, minimal); UNESCO AI Ethics Recommendation; India's NITI Aayog Responsible AI Guidelines; India Digital Personal Data Protection Act 2023 (DPDP Act); environmental cost of AI — energy and carbon footprint of LLM training and inference. • **Capstone Mini-Project:** each student (or pair) defines a real engineering problem, selects at least 3 AI tool categories from Units I–IV, produces a quality-verified deliverable (report, presentation, diagram, or automation), and presents in 5 minutes. Evaluation: problem clarity, tool selection, output quality, human refinement, responsible AI disclosure.	
LEARNING RESOURCES		

Reference Books

1. Ethan Mollick, Co-Intelligence: Living and Working with AI, Portfolio/Penguin, 2024.
2. Stuart J. Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 4th Edition, Pearson Education, 2020.
3. Reid Blackman, Ethical Machines, Harvard Business Review Press, 2022.

Online Resources

- Google – Fundamentals of AI (grow.google) • Microsoft – AI Skills Navigator (microsoft.com/ai/ai-skills)
- Andrew Ng – AI for Everyone, Coursera, free to audit (coursera.org/learn/ai-for-everyone)
- Elements of AI – University of Helsinki, free, beginner (elementsofai.com) **AI Tools by Category**
- **AI Assistants:** ChatGPT, Claude, Gemini, Microsoft Copilot
- **Research & Notes:** NotebookLM, Perplexity AI, Elicit, Consensus
- **Presentations & Docs:** Gamma.app, Notion AI, Beautiful.ai, Copilot in Office 365, Gemini in Google Workspace

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- **Diagrams & Design:** Napkin.ai, Whimsical AI, Miro AI, Canva AI, DALL-E 3 via ChatGPT
- **Data & Spreadsheets:** ChatGPT Advanced Data Analysis, Julius AI, Copilot in Excel, Gemini in Sheets
- **Math & Equations:** Wolfram Alpha, Symbolab, Mathway, Microsoft Math Solver, Photomath, Desmos
- **Audio & Video:** ElevenLabs, Suno, Runway, HeyGen
- **Detection & Automation:** GPTZero, Originality.ai, Google Lens, Make.com, GitHub Copilot
- **Governance & Ethics:** EU AI Act (eur-lex.europa.eu), UNESCO AI Ethics, NITI Aayog, India DPDP Act 2023, ProPublica COMPAS

LIST OF EXPERIMENTS

UNIT – I • Understanding AI and AI for Documents and Presentations (6 Programs)

S.No.	Tool / Experiment Title
1	ChatGPT & Claude — Understanding LLMs, temperature, and hallucination
2	Gamma.app — AI-generated presentation from a paragraph prompt
3	Microsoft Copilot in Word — draft, rewrite, and summarize
4	Grammarly — grammar, tone, clarity, and plagiarism detection
5	GPTZero — AI text detection: test 5 samples and analyze scores
6	Google Gemini — multimodal prompting with image and text input

UNIT – II • AI for Research, Note-taking, Data, and Spreadsheets (6 Programs)

S.No.	Tool / Experiment Title
1	NotebookLM — upload lecture notes; generate study guide + audio overview
2	Perplexity AI — real-time research with verified citations
3	Elicit & Consensus — academic paper search and evidence synthesis
4	Prompt engineering — zero-shot to chain-of-thought on engineering tasks
5	Copilot in Excel / Julius AI — natural-language data analysis of a CSV dataset
6	Zotero + SciSpace — reference management and AI paper Q&A

UNIT – III • AI for Visual Design, Diagrams, and Media (6 Programs)

S.No.	Tool / Experiment Title
1	DALL-E 3 / Canva AI — event poster through 3 iterative prompt refinements
2	Napkin.ai & Whimsical AI — concept diagram and course mind map
3	Miro AI — collaborative system architecture brainstorm
4	ElevenLabs — create a 60-second technical project voiceover
5	Google Lens & GPTZero — detect AI-generated text and images
6	Text-to-video — 30-second technical explainer with Canva AI / Runway

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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

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UNIT – IV • AI Across Engineering Disciplines *(6 Programs)*

S.No.	Tool / Experiment Title
1	GitHub Copilot — code generation, explanation, and review
2	ChatGPT ADA — full data science pipeline on a real dataset
3	Bubble.io or Glide — build a no-code AI-powered app prototype
4	Wolfram Alpha & Symbolab — solve and verify engineering equations
5	Branch AI tool research — identify and verify 5 real branch-specific AI tools
6	Teachable Machine — train and deploy a no-code image classifier

UNIT – V • Responsible AI, Ethics, and Capstone Project *(6 Programs)*

S.No.	Tool / Experiment Title
1	AI bias audit — analyze COMPAS fairness metrics
2	Privacy audit — compare data retention policies of ChatGPT, Claude, Gemini
3	EU AI Act classification — classify 5 daily-use AI systems
4	AI hallucination & fact-checking audit — a responsible verification workflow
5	Capstone deliverable — integrated multi-tool engineering solution
6	Capstone presentation — 5-minute project demo with responsible AI disclosure

Note 1: Free / open-source tiers of the listed tools are sufficient for all experiments. Each experiment is recorded in the lab journal with Aim, Requirements, Procedure, Input, Output/Screenshots, Observations, Result, and Viva answers. Student should perform minimum of 25 experiments.

Note 2: Four Practical hours should be divided into two sessions with 2hrs per session.

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Course Code	COMMUNICATIVE ENGLISH	L	T	Pr	P	Credits
26A94101T	CSE | I Year II Sem	2	0	0	0	2

Course Objectives

Code	Bloom's Level	Statement
CO1	Remember	Recall and list fundamental concepts of English grammar, vocabulary, phonetics, and communication models essential for professional contexts.
CO2	Understand	Explain and interpret various forms of written and oral communication including emails, reports, presentations, and group discussions.
CO3	Apply	Use appropriate AI tools and digital platforms to enhance communicative accuracy, fluency, and professional writing skills in real-world scenarios.
CO4	Analyze	Examine and differentiate effective versus ineffective communication strategies in professional, academic, and intercultural contexts.
CO5	Evaluate	Appraise and critique written and spoken communication samples using AI-assisted feedback mechanisms and peer-review methods.
CO6	Create	Design and produce professional-grade communication artifacts — including portfolios, reports, and presentations — integrating AI tools for quality enhancement.

Course Outcomes (COs)

Upon successful completion, students will demonstrate the following outcomes measured through formative and summative assessments, mapped to Bloom's Taxonomy:

Code	Bloom's Level	Statement
CO1	Remember	Students will be able to identify grammatical structures, phonetic patterns, and professional vocabulary, and recall communication frameworks using AI-assisted learning tools.
CO2	Understand	Students will be able to comprehend and interpret written and spoken communication models, and summarize content using AI paraphrasing and summarization tools.
CO3	Apply	Students will be able to compose professional emails, reports, and presentations using AI writing assistants such as ChatGPT, Grammarly, and Hemingway Editor.
CO4	Analyze	Students will be able to analyze discourse structures, identify communication barriers, and use AI-driven sentiment analysis tools to evaluate message effectiveness.
CO5	Evaluate	Students will be able to evaluate communication samples using AI grammar checkers, readability scorers, and peer-evaluation rubrics aligned to professional standards.

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Code	Bloom's Level	Statement
CO6	Create	Students will be able to design and deliver professional communication artifacts — presentations, e-portfolios, and research reports — integrating AI tools for structure, style, and refinement.

UNIT – I	Foundations of English Communication (Weeks 1–3 | 6 Contact Hours)
Topics Covered	• Basics of Communication: Process, Types (Verbal/Non-verbal), and Barriers • Parts of Speech: Nouns, Pronouns, Verbs, Adjectives, Adverbs • Tenses: Simple, Continuous, Perfect, and Perfect Continuous • Subject-Verb Agreement and Correction of Sentences
Learning Outcomes	• Recall the fundamental components and types of the communication process. (Remember – CO1) • Identify and classify parts of speech and tense forms in given sentences. (Remember – CO1) • Explain sentence structure patterns and apply them in original writing samples. (Understand – CO2) • Articulate words with correct stress and intonation using digital phonetics tools. (Apply – CO3)
AI Tools Integrated	Tool 1- ChatGPT (OpenAI)- Grammar explanation, error identification, and instant Q&A on language rules Tool 2- Grammarly- Real-time grammar, spelling, and punctuation correction with detailed explanations Tool 3- Google Speech-to-Text- Phonetics practice – voice recording for pronunciation and intonation feedback Tool 4- Merriam-Webster Vocabulary Builder- Word-of-the-day, etymology, and interactive vocabulary quizzes
Hands-On AI Activity	Students paste a 100-word paragraph into Grammarly and use Chat GPT to understand each flagged error. They then record their voice reading the corrected paragraph using Google Speech-to-Text, receive pronunciation analysis, and submit: (a) original paragraph, (b) AI-corrected version with error report, (c) reflection note on errors identified.
UNIT – II	**Listening and Speaking Skills (Weeks 10–12 | 6 Contact Hours)**
Topics Covered	• Principles of Effective Speaking and Active Listening • Group Discussion (GD): Techniques, Etiquette, and Evaluation Criteria • Presentation Skills: Design Principles, Slide Preparation, and Delivery Techniques • Debate: Argument Construction, Evidence Use, and Rebuttal Techniques
Learning Outcomes	• Demonstrate effective speaking skills in structured group discussions and mock interview settings. (Apply – CO3) • Differentiate between effective and ineffective presentation strategies using AI-generated feedback. (Analyze – CO4) • Construct and deliver a well-organized 5-minute presentation using AI-designed slides. (Create – CO6) • Evaluate peer presentations using AI-powered transcription tools and structured assessment rubrics. (Evaluate – CO5)

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AI Tools Integrated	Tool 1-Gamma.app/ Beautiful.ai-AI-powered presentation design – structured, visual, professional slides
	Tool 2-Orai (AI Speech Coach)-Fluency analysis, filler-word detection, pacing, and confidence scoring
	Tool 3-Otter.ai-Auto-transcription and keyword analysis of spoken communication
	Tool 4-Canva AI-Visual communication design – infographics, posters, and slide aesthetics
Hands-On AI Activity	Students prepare a 5-minute presentation on a technical or social topic using Gamma.app or Canva AI. Before class delivery, they practice using Orai (AI Speech Coach) to monitor pacing, filler words, and confidence score (minimum 3 practice sessions logged). Presentations are delivered in class, transcribed via Otter.ai, and peer-evaluated on rubric. Each student submits: (a) slides link, (b) Orai session screenshots, (c) Otter.ai transcript, (d) peer evaluation sheet.
UNIT – III	**Reading Comprehension & Writing Skills (Weeks 4–6 | 6 Contact Hours)**
Topics Covered	• Reading Strategies: Skimming, Scanning, Intensive and Extensive Reading • Comprehension Passages, Synonyms, Antonyms, Words Often Confused, Homonyms, Homophones and Homographs • Paragraph Writing: Topic Sentence, Supporting Details, Clincher Sentence • Creative Writing – Features and Techniques – Movie Reviews & Blogs
Learning Outcomes	1. Demonstrate skimming and scanning strategies to extract key information from texts. (Apply – CO3) 2. Summarize and paraphrase academic passages using AI paraphrasing tools accurately. (Understand – CO2) 3. Compose well-structured paragraphs and short essays on technical and social topics. (Apply – CO3) 4. Evaluate the clarity and readability of own writing using AI-based readability scoring tools. (Evaluate CO5)
AI Tools Integrated	Tool 1-Quill Bot - AI paraphrasing tool – rewrite passages at varying complexity levels
	Tool 2-Hemingway Editor -Readability scoring, passive voice detection, and sentence simplification
	Tool 3-ChatGPT-Essay outline generation, argument structuring, and content brainstorming
	Tool 4-Rewordify-Vocabulary simplification for improving comprehension of complex texts
Hands-On AI Activity	Students upload a 300-word passage to Quill Bot and generate three paraphrased versions (simple, standard, creative modes). They paste their own essay into Hemingway Editor and revise until readability reaches Grade 8 or below. Final submission includes: (a) original passage, (b) three paraphrased versions with mode labels, (c) before-and-after Hemingway screenshots with readability score comparison.
UNIT – IV	**Professional & Business Communication (Weeks 7–9 | 6 Contact Hours)**
Topics Covered	• Email Writing and Letter Writing: Formal & informal • Short Report Writing: Structure, Types (Formal/Informal), and Format • Note-Making and Summarization Techniques • Resume / CV Writing and LinkedIn Profile Optimization
Learning Outcomes	• Draft formal and semi-formal business emails and letters using professional writing conventions. (Apply – CO3) • Produce structured reports, proposals, and technical documents for workplace contexts.

	(Apply – CO3) • Design professional resumes and LinkedIn profiles using AI-assisted content generation tools. (Create – CO6) • Analyze the structure, register, and tone of professional documents for accuracy and appropriateness. (Analyze – CO4)
AI Tools Integrated	Tool 1- ChatGPT-Draft and refine professional emails, cover letters, reports, and proposals
	Tool 2-Kickresume/ Resume.io-AI-powered resume builder with ATS-optimized templates
	Tool 3-Notion AI-Report structuring, agenda writing, and knowledge management
	Tool 4-Grammarly Business-one detection, formality check, and professional register evaluation
Hands-On AI Activity	Each student drafts a formal job application email and a one-page resume using ChatGPT and Kick resume. They run both documents through Grammarly Business for tone and professionalism checks, then conduct peer evaluation using a structured rubric (structure, tone, grammar, format). Final submission: (a) AI-drafted email + resume, (b) Grammarly tone/score report, (c) peer feedback form.
UNIT – V	**Use of AI in Language Learning (Weeks 13–16 | 8 Contact Hours)**
Topics Covered	• Artificial Intelligence in Communication, Meaning and basics of AI & Benefits and limitations of AI in human interaction • AI chatbots and virtual assistants in education: Use of AI in grammar correction and vocabulary building, AI-based speaking and pronunciation tools, writing assistants, E-Portfolio Creation, Students can also use general LLMs (like ChatGPT or Gemini) to summarize lengthy articles or generate texts on specific topics for reading comprehension. • AI in Global Communication: The use of automated translation, summarizing large texts, and finding information in different languages • (Suggested Tools: Tools like Google Translate and Reverso are used for real-time and document translation) • Digital Communication and AI Ethics: Responsible use of AI in education, Plagiarism and academic honesty, Fake information and AI-generated content, Privacy, bias, and ethical communication online
Learning Outcomes	1. Students understand the role of AI in modern communication and develop awareness of technology-driven language use. (CO1) 2. Students learn to use AI responsibly for improving speaking, writing, reading, and listening skills. (Evaluate – CO5) 3. Students develop ethical awareness, critical thinking, and responsible digital communication habits. (Create – CO6) 4. Students improve professional communication and employability skills using modern AI tools. (Create – CO6)
AI Tools Integrated	Tool 1- Copyleaks / Turnitin-Plagiarism detection, paraphrase checker, and academic integrity analysis
	Tool 2- Deep L Translator-High-accuracy translation supporting intercultural communication understanding
	Tool 3- LinkedIn Learning / Coursera-AI literacy modules – understanding AI bias, ethics, and responsible usage

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	Tool 4- Wix / Adobe Portfolio-E-portfolio creation platform for showcasing communication artifacts
Hands-On AI Activity	Students create a personal E-portfolio (using Wix or Adobe Portfolio) documenting 5 communication artifacts from all 5 units: (1) corrected grammar exercise (Unit I), (2) paraphrased essay with Hemingway score (Unit II), (3) professional email and resume (Unit III), (4) presentation slides and Orai report (Unit IV), (5) cultural communication reflection essay (Unit V). Each artifact must include an AI tool feedback snapshot. The portfolio is presented in the final class, peer-reviewed using a structured rubric, and checked for plagiarism via Copyleaks. Reflection summary (300 words) on AI tool usage across the course is mandatory.

Overall AI Tools Used in the Course

The table below consolidates all AI tools integrated across units, with direct URLs and their primary pedagogical applications.

#	AI Tool	URL / Platform	Primary Application in Course
1	ChatGPT (OpenAI)	https://chat.openai.com	Grammar, email drafting, essay structuring, content summarization
2	Grammarly	https://www.grammarly.com	Real-time grammar, spelling, tone detection, and writing suggestions
3	Quill Bot	https://quillbot.com	Paraphrasing, summarization, and sentence restructuring
4	Hemingway Editor	https://hemingwayapp.com	Readability scoring and writing clarity improvement
5	Gamma.app	https://gamma.app	AI-powered presentation, document, and webpage creation
6	Orai (Speech Coach)	https://www.orai.com	AI speech coaching – fluency, pacing, filler-word analysis
7	Otter.ai	https://otter.ai	Auto-transcription and analysis of spoken communication
8	Canva AI	https://www.canva.com	Visual communication, poster, infographic, and slide design
9	Kickresume / Resume.io	https://www.kickresume.com	AI-assisted resume and cover letter generation
10	Copyleaks / Turnitin	https://copyleaks.com	Plagiarism detection and academic integrity checking
11	DeepL Translator	https://www.deepl.com	High-accuracy translation for intercultural communication
12	Beautiful.ai	https://www.beautiful.ai	AI-driven professional slide deck design and layout

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#	AI Tool	URL / Platform	Primary Application in Course
13	Google Speech-to-Text	https://cloud.google.com/speech-to-text	Voice recognition for pronunciation and phonetics practice
14	Notion AI	https://www.notion.so/product/ai	Note-taking, report structuring, and knowledge organization

Prescribed Textbooks

S. No	Author(s)	Title	Publisher	Edition/Year
TB1	Meenakshi Raman & Sangeetha Sharma	Technical Communication: Principles and Practice	Oxford University Press	4th Edition, 2022
TB2	Jyoti Shetty & Rajesh Pareek	Communicative English for Engineers and Professionals	Wiley India	3rd Edition, 2021

Reference Books

S. No	Author(s)	Title	Publisher	Edition
R1	Rizvi, M. Ashraf	Effective Technical Communication	Tata McGraw-Hill	2nd Ed., 2018
R2	Murphy, Herta A.	Effective Business Communication	McGraw-Hill Education	7th Ed., 2019
R3	Guffey, Mary Ellen & Dana Loewy	Essentials of Business Communication	Cengage Learning	11th Ed., 2021
R4	Sethi, Anjanae& Bhavana Adhikari	Business Communication	Tata McGraw-Hill	3rd Ed., 2020
R5	Wren, P.C. & Martin, H.	High School English Grammar and Composition	S. Chand	Revised Ed., 2019
R6	Tickoo, M.L. & Suresh Kumar, E.R.	Writing with a Purpose	Oxford University Press	6th Ed., 2020

Online Learning Resources

#	Resource Name	URL	Description
1	British Council – Learn English	https://learnenglish.britishcouncil.org	Free grammar, vocabulary, listening, and speaking practice modules
2	Coursera – Communication Skills	https://www.coursera.org/courses?query=communication	University-certified courses on professional and intercultural communication

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#	Resource Name	URL	Description
3	edX – Writing and Communication	https://www.edx.org/learn/writing	Courses from MIT and Harvard on academic and business writing
4	Grammarly Blog	https://www.grammarly.com/blog	Grammar tips, writing guides, and professional communication resources
5	NPTEL – Communication Skills	https://nptel.ac.in/courses/109104101	IIT/IISc video lectures on English communication for engineering students
6	BBC Learning English	https://www.bbc.co.uk/learningenglish	Audio, video, and text resources for grammar, vocabulary, and pronunciation
7	Purdue OWL (Online Writing Lab)	https://owl.purdue.edu	APA/MLA citation guides, grammar rules, and professional writing resources

Recommended YouTube Resources

#	Video Title	YouTube URL	Topic Area
1	TED-Ed: How to Use a Comma	https://youtu.be/GHnl1O3NGwk	Grammar – Punctuation
2	English Speaking Course (Spoken English Guru)	https://youtu.be/1OECRXfM8RU	Oral Communication
3	How to Write a Professional Email	https://youtu.be/YcqhP_Cv5og	Business Communication
4	Public Speaking Tips – TED Talk	https://youtu.be/iIBMbCFBVN8	Presentation Skills
5	NPTEL Communication Skills – IIT Kharagpur	https://youtu.be/1Ck4k6rETBo	Academic Communication
6	How to Write a Resume (Step-by-Step)	https://youtu.be/Tt08KmFfIYQ	Professional Writing
7	Intercultural Communication Explained	https://youtu.be/YMyofREc5Jk	Intercultural Communication
8	Introduction to AI Writing Tools	https://youtu.be/p_Wq5WNzJcc	AI Literacy
9	Mind & Mastery	https://youtube.com/@profrjosephponniah?si=u3RBBwVLdf1KeNKW	AI Protocol

CO-PO Mapping (Bloom's Taxonomy-Based)

Mapping Scale: 3 = Strong / High Correlation | 2 = Moderate Correlation | 1 = Weak / Indirect Correlation | – = No Direct Correlation

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CO	Bloom's Level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Remember	1	-	-	1	-	1	-	1	1	3	1	2
CO2	Understand	1	-	-	1	1	2	1	1	2	3	1	2
CO3	Apply	-	-	1	-	3	2	1	2	3	3	2	2
CO4	Analyze	-	1	1	2	2	2	1	2	2	3	2	2
CO5	Evaluate	-	1	1	2	3	2	2	3	2	3	2	3
CO6	Create	-	1	2	2	3	3	2	3	3	3	3	3
Avg		1.0	1.0	1.3	1.6	2.4	2.0	1.4	2.0	2.2	3.0	1.8	2.3

Colour Key: Dark Green = 3 (High) Blue = 2 (Medium) Gold = 1 (Low) White = Not Mapped

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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Course Code	PHYSICS FOR ADVANCED COMPUTING	L	T	Pr	P	Credits
26A92101T	CSE | I Year II Sem	3	0	0	0	3
Prerequisite:	Engineering Mathematics, Basic Electronics, Computer Science Fundamentals					

Course Objectives

- To equip students with the concepts of interference, diffraction and polarization and their applications in optics and communication systems with basic AI-assisted analysis.
- To introduce lasers, fiber optics and advanced sensing technologies along with simple AI-assisted signal processing techniques.
- To provide basic knowledge of quantum mechanics and quantum computing with simple AI-assisted quantum applications.
- To familiarize students with semiconductors and magnetic materials and their applications using basic AI-assisted material analysis methods.
- To impart knowledge on low temperature physics and superconductivity and their applications with simple AI-assisted monitoring techniques.

Course Outcomes (COs)

After successful completion of the course, the student will be able to:

CO	Course Outcome Statement	Bloom's Level
CO1	Apply the principles of interference, diffraction and polarization to analyze optical systems and engineering applications.	L3 (Apply)
CO2	Analyze the working of lasers, fiber optics and sensing systems with basic AI-assisted optical communication concepts.	L4 (Analyze)
CO3	Apply the concepts of quantum mechanics and quantum computing to explain modern computational and secure communication systems.	L3 (Apply)
CO4	Analyse semiconductor characteristics and magnetic material behaviour for engineering and electronic applications.	L4 (Analyze)
CO5	Apply the concepts of low-temperature physics and superconductivity in modern technological applications and intelligent systems.	L3 (Apply)

Course Content

UNIT – 1	Wave Optics and Quantum Information Processing	9 Hrs
Content	• Interference: Principle of superposition and coherence; Interference; Types of interference; Interference in thin films (reflection geometry) and Newton's rings. Applications: Determination of wavelength and refractive index. • Diffraction: Introduction to diffraction; Fresnel and Fraunhofer diffraction; Fraunhofer diffraction due to single, double and N-slits (Diffraction Grating); Dispersive power and Resolving power of grating. Applications: CD/DVD data storage, Barcode scanners. • Polarization: Types of polarization; Nicol's prism; Half-wave and Quarter-wave plates.	
AI Integration	AI-assisted polarization management for quantum key distribution. AI-integrated holographic interferometry for surface flatness analysis.	

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	Free/Open-Source AI Tools: Python (NumPy, SciPy, Matplotlib and scikit-learn).	
UNIT – 2	**Quantum Photonics and Advanced Sensing**	**9 Hrs**
Content	• Lasers: Interaction of radiation with matter; Requisites and conditions for laser action; He-Ne laser; Nd-YAG laser; LiDAR basics. Laser-based data communication, Free-space optical communication, Optical data storage, Photonic computing basics, Applications of lasers. • Fiber Optics: Propagation mechanism; Numerical aperture; Acceptance angle; Types of optical fibres; Classifications and Modes of optical fibres; Attenuation and Losses in optical fibers; V-Number; Distributed Fiber Optic Sensing (DFOS) with AI-Powered Signal Analysis.	
AI Integration	AI-powered signal analysis for distributed fiber optic sensing. Python simulation of laser propagation and fiber optic signal attenuation. Free/Open-Source AI Tools: Google Colab, Python, NumPy, SciPy and Scikit-learn/TensorFlow.	
UNIT – 3	**Introduction to Quantum Mechanics and Quantum Computing**	**10 Hrs**
Content	• Introduction to quantum mechanics; de-Broglie concept (matter waves); Heisenberg's Uncertainty Principle; Wave function; Postulates of Quantum Mechanics; Schrödinger's time-independent wave equation; Particle in a one-dimensional potential well; Quantum tunnelling (basic idea). • Introduction to Quantum Computing: Classical bits vs Qubits; Concept of superposition and Entanglement; Basic Quantum Operations: Hadamard gate (idea of superposition), Pauli-X gate; Basic idea of quantum measurement. • Applications (qualitative only): AI-Assisted Tunnel Diodes and cold emission of electrons; Basic idea of quantum cryptography and secure communication.	
AI Integration	AI-Assisted Analysis of Tunnel Diode Characteristics using Quantum Tunnelling Concepts. AI-Assisted Quantum Key Distribution for Secure Communication. Free/Open-Source AI Tools: Google Colab, Python and Scikit-learn.	
UNIT – 4	**Semiconductors and Magnetic Materials**	**8 Hrs**
Content	• Semiconductors: Introduction; Fermi energy and Fermi level in intrinsic and extrinsic semiconductors; Expression for concentration of electrons in conduction band and holes in valence band; Electrical conductivity; Expressions for drift and diffusion currents; Hall effect; Expression for Hall coefficient and its applications. • Magnetism: Origin of magnetism; Dia, Para, Ferro, Ferri and Anti-ferro magnetic materials; Hysteresis; Soft and Hard magnetic materials. Applications (qualitative only): Magnetic data storage (MRAM), Hard Disk Drive and Magnetic shielding.	
AI Integration	AI-Assisted Hall Effect Analysis for Semiconductor Characterization. AI-Assisted Magnetic Data Storage and MRAM Optimisation. Free/Open-Source AI Tools: Google Colab, Python and Scikit-learn.	

UNIT – 5	**Low Temperature Physics and Superconductivity**	**9 Hrs**
Content	• Introduction: Low temperature and its importance; Properties of materials at low temperatures; Liquefaction of gases (basic concept only); Liquid nitrogen and liquid helium (basic properties and uses). Applications (basic ideas): MRI, Rocket fuels, Cryogenic Cooling of High-Performance Computing System.	

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	• Superconductors: Definitions; Meissner effect; Type I and Type II superconductors; BCS theory: Cooper pairs and energy gap (qualitative); DC and AC Josephson effect. Applications (qualitative only): SQUIDs, magnetic levitation and lossless power transmission. Superconducting qubits: Charge, Flux, Phase.
AI Integration	AI-Assisted Cryogenic Cooling Optimization for High-Performance Computing Systems. AI-Assisted Stability Control in Superconducting Magnetic Levitation Systems. Free/Open-Source AI Tools: Google Colab, Python and Scikit-learn.

Bloom's Taxonomy Coverage – Summary

Bloom's Level	Level Name	CO(s)	Sample Activities
L3	Apply	**CO1, CO3, CO5**	Interference and diffraction problems; quantum tunnelling application exercises; superconductivity application case studies.
L4	Analyze	**CO2, CO4**	Laser and fiber optic system analysis; Hall effect and magnetic material characterization exercises.

CO – PO Articulation Matrix (NBA)

Scale: 3 – Strong, 2 – Moderate, 1 – Slight, – No Correlation

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	2	-	-	-	-	-	-	1
CO2	3	3	2	2	2	-	-	-	-	-	-	1
CO3	3	2	2	2	2	-	-	-	-	-	-	1
CO4	3	3	2	2	2	-	-	-	-	-	-	1
CO5	3	2	1	2	2	-	-	-	-	-	-	1

CO-PO Correlation Highlights	CO1, CO3, and CO5 strongly align with PO1 (Engineering Knowledge) through application of optics, quantum mechanics, and superconductivity principles. CO2 and CO4 map to PO2 and PO5 through analysis of photonic systems and AI-assisted material characterization. CO5 also connects to PO7 (Environment & Sustainability) through cryogenic energy efficiency. All COs link to PO12 (Lifelong Learning) through continuous engagement with emerging AI-assisted physics analysis tools, and to PO6, PO8–PO10 at a slight level through engineering ethics, teamwork in lab settings, and reporting of experimental findings.

LEARNING RESOURCES

Textbooks

1. Avadhanulu, M. N., Kshirsagar, P. G., & Arun Murthy, T. V. S. (2019). Engineering Physics. S. Chand.
2. Bhattacharya, D. K., & Tandon, P. (2015). Engineering Physics. Oxford Press.

Reference Books

1. Pandey, B. K., & Chaturvedi, S. (2021). Engineering Physics. Cengage Learning.

2. Pillai, S. O. (n.d.). Solid State Physics. New Age International.
3. Nielsen, M. A., & Chuang, I. L. (n.d.). Quantum Computation & Quantum Information. Cambridge University Press.
4. Saleh, B. E. A., & Teich, M. C. (n.d.). Fundamentals of Photonics. Wiley.
5. Keiser, G. (n.d.). Optical Fiber Communications. McGraw Hill.
6. Tinkham, M. (n.d.). Introduction to Superconductivity. Dover Publications.

Online Resources

- NPTEL – nptel.ac.in
- MIT Open Courseware – ocw.mit.edu
- Hyper Physics – hyperphysics.phy-astr.gsu.edu
- PhET Simulations – phet.colorado.edu
- IBM Qiskit (free, open-source) – For quantum computing and superconducting qubit simulations on Google Colab

Recommended Free & Open-Source AI/Computational Tools

- Python (NumPy, SciPy, OpenCV, Matplotlib) – FREE on Google Colab for wave optics and signal analysis
- IBM Qiskit (free, open-source) – For quantum computing and superconducting qubit simulations on Google Colab
- TensorFlow / Keras (free, open-source) – For photonic and optical pattern recognition
- scikit-learn (free, open-source) – For semiconductor property prediction and LiDAR signal classification
- PhET Interactive Simulations (free) – For wave optics, quantum mechanics and semiconductors

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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Course Code	COMMUNICATIVE ENGLISH LAB	L	T	Pr	P	Credits
26A94101P	CSE | I Year II Sem	0	0	0	2	1

COURSE OBJECTIVES

- To develop students' oral communication skills through structured speaking and listening exercises.
- To enhance pronunciation, intonation, and fluency using AI-assisted speech tools.
- To build professional communication competencies including group discussion, debate, and presentation skills.
- To enable students to write effective professional documents such as emails, reports, and cover letters.
- To integrate AI tools in language learning for self-assessment, feedback, and continuous improvement.

COURSE OUTCOMES

CO	Course Outcome Statement	BTL
CO1	Pronounce English words correctly using standard phonemic symbols and demonstrate improved speech fluency.	Apply
CO2	Comprehend spoken English through active listening and respond appropriately in formal and informal contexts.	Understand
CO3	Participate effectively in group discussions, presentations, and debates demonstrating logical argumentation.	Analyse
CO4	Write grammatically correct and contextually appropriate professional documents including emails, reports, and resumes.	Create
CO5	Utilize AI-powered tools for language learning, self-evaluation, and continuous improvement of English skills.	Evaluate

Note: BTL = Bloom's Taxonomy Level (Revised) | 3 = High 2 = Medium 1 = Low correlation

LAB SYLLABUS – 12 TOPICS WITH AI INTEGRATION

S. No	Lab Topic	Lab Activities	AI Activity	AI Tools	COs
1	**Phonetics & Pronunciation Practice**	Record & playback vowel/consonant articulation; IPA chart drill; Minimal pair exercises	Use AI speech-to-text to detect mispronunciations; real-time phoneme feedback via ELSA Speak	ELSA Speak, Google Speech Recognition, Speechling	CO1, CO5
2	**Listening Comprehension &**	Listen to TED Talks/podcasts; fill-in-the-blank exercises; summarise audio passages	Auto-generate transcripts; compare student notes with AI-	Otter.ai, YouTube Auto-captions, Whisper AI	CO2, CO5

	Note-Taking		generated summaries using Otter.ai		
3	**Spoken English & Fluency Building**	Impromptu speaking (1–2 min); picture description; story completion tasks	AI analyses speech for filler words, pace, and clarity; ChatGPT prompts for spontaneous speaking	Speeko, ChatGPT, Google Assistant	**CO1, CO3, CO5**
4	**Group Discussion Techniques**	Role-based GD on current topics; turn-taking practice; consensus building	AI evaluates argument structure and language; ChatGPT generates counter-arguments for practice	ChatGPT, Gemini, Mentimeter	**CO2, CO3**
5	**Public Speaking & Presentations**	Prepare and deliver 3-minute presentations; use of visual aids; Q&A handling	AI slide deck generation; real-time delivery feedback on pacing and confidence	Beautiful.ai, Gamma.app, Microsoft Copilot	**CO3, CO5**
6	**Interview Skills & Mock Interviews**	HR round simulation; STAR method answers; body language and eye contact	AI-powered mock interview with instant feedback on content, grammar, and tone	Yoodli, Interview Warmupby Google, ChatGPT	**CO1, CO3, CO5**
7	**Professional Email & Business Writing**	Draft formal emails, complaints, and requests; subject line formulation; netiquette	AI refines email drafts; tone & clarity check; compare student draft with AI-improved version	Grammarly, ChatGPT, Gemini	**CO4, CO5**
8	**Resume & Cover Letter Writing**	ATS-friendly resume design; action verbs usage; tailoring cover letters to job descriptions	AI resume scanner; keyword optimisation suggestions; ChatGPT cover letter generation and critique	Kickresume, Resume.io, Jobscan, ChatGPT	**CO4, CO5**
9	**Reading Comprehension & Critical Thinking**	Read articles/editorials; identify main idea, inference, and tone; speed reading drills	AI generates comprehension questions; text summarisation and comparative analysis	Quillbot, Speechify, NotebookLM	**CO2, CO4**
10	**Debate & Argumentation Skills**	Structured debate (for/against); Rebuttal techniques; logical fallacy identification	AI generates arguments on both sides; evaluate logical structure using ChatGPT	ChatGPT, Claude.ai, Kialo Edu	**CO2, CO3**

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11	**Report Writing & Technical Communication**	Lab report, incident report, and project report formats; headings, data presentation	AI improves report coherence and passive/active voice usage; grammar and structure feedback	Grammarly Business, ChatGPT, Hemingway Editor	**CO4, CO5**
12	**Etiquette, Netiquette & Personal Branding**	Workplace conversation role play; LinkedIn profile creation; professional social media etiquette	AI reviews LinkedIn summaries; digital persona analysis; personal brand statement via ChatGPT	ChatGPT, Canva AI, LinkedIn AI features	**CO3, CO4, CO5**

TEXT BOOKS

S. No	Reference
1	Raman, Meenakshi & Sharma, Sangeeta. Technical Communication: Principles and Practice (3rd Ed.). Oxford University Press, 2022.
2	Krishnaswamy, N. & Krishnaswamy, L. The Story of English in India. Foundation Books, Cambridge University Press, 2021.

REFERENCE BOOKS

S.No	Reference
1	Swan, Michael. Practical English Usage (4th Ed.). Oxford University Press, 2016.
2	Murphy, Raymond. English Grammar in Use (5th Ed.). Cambridge University Press, 2019.
3	Rizvi, M. Ashraf. Effective Technical Communication (2nd Ed.). McGraw-Hill Education, 2018.
4	Turton, N.D. & Heaton, J.B. Longman Dictionary of Common Errors. Pearson Longman, 2017.
5	Lesikar, Raymond V. & Flatley, Marie E. Basic Business Communication (12th Ed.). McGraw-Hill, 2020.
6	Rutherford, Andrea J. Basic Communication Skills for Technology (3rd Ed.). Pearson, 2019.

ONLINE RESOURCES

- BBC Learning English – https://www.bbc.co.uk/learningenglish (Grammar, pronunciation, and listening)
- British Council Learn English – https://learnenglish.britishcouncil.org
- TED Talks – https://www.ted.com/talks (Listening & speaking practice)
- Coursera English Communication Skills Specialisation – https://www.coursera.org
- edX English for Professional and Academic Purposes – https://www.edx.org
- Grammarly Blog – https://www.grammarly.com/blog (Writing tips)
- ELSA Speak (App) – https://elsaspeak.com (AI pronunciation coach)

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YOUTUBE CHANNELS

- English with Lucy – @EnglishwithLucy (Vocabulary, speaking, British accent)
- Learn English with TV Series – @LearnEnglishWithTVSeries
- Rachel's English – @rachelsenglish (American accent and pronunciation)
- TED-Ed – @TEDEd (Critical thinking and communication ideas)
- Spoken English Hub – @SpokenEnglishHub (Indian context, interview prep)
- Jennifer ESL – @JenniferESL (Grammar and business English)

NPTEL / SWAYAM COURSES

Course Name	Platform	Provider	Link
Developing Soft Skills and Personality	NPTEL / SWAYAM	IIT Kanpur	https://swayam.gov.in
Business English Communication Suite	Coursera (Free Audit)	University of Washington	https://coursera.org
Speak English Professionally: In Person, Online & On the Phone	Coursera	Georgia Tech	https://coursera.org
English and Academic Preparation	NPTEL	IIT Bombay	https://nptel.ac.in
Technical English for Engineers	NPTEL / SWAYAM	IIT Roorkee	https://swayam.gov.in

LAB SOFTWARE & AI TOOLS REQUIRED

Software / Tool	Type	Purpose
ELSA Speak	AI Pronunciation Coach App	Real-time speech accuracy & fluency feedback
Grammarly	AI Writing Assistant	Grammar, punctuation, style correction
ChatGPT/ Claude.ai	Generative AI Chatbot	Conversation practice, writing assistance, debate prep
Otter.ai	AI Transcription Tool	Transcribe and analyse spoken content
Yoodli	AI Public Speaking Coach	Presentation and interview delivery analysis
Hemingway Editor	Writing Clarity Tool	Improve readability and sentence structure
Mentimeter	Interactive Presentation	Live polls, word clouds during GD sessions
Audacity	Audio Recording Software	Record and review pronunciation exercises

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Google Meet/ Zoom	Video Conferencing	Mock interviews and virtual presentations
Canva/ Beautiful.ai	AI Presentation Design	Create professional visual presentations

CO – PO / PSO MAPPING

Correlation Level: 3 = High | 2 = Medium | 1 = Low | – = No Correlation

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	2	-	1	2	-	-	-	-	-	3	2
CO2	2	-	-	2	-	2	1	-	-	-	-	-	2	3
CO3	2	-	-	3	-	3	2	-	-	-	-	-	2	3
CO4	2	-	-	2	-	2	1	-	-	-	-	-	3	2
CO5	1	-	-	2	3	2	2	-	-	-	-	-	2	3
Average	2.0	-	-	2.2	3.0	2.0	1.6	-	-	-	-	-	2.4	2.6

Mapping Legend

PO	Programme Outcome Description	Correlation with CEL	Strength
PO1	Engineering Knowledge / Disciplinary Knowledge	Grammar, vocabulary & technical language	2
PO4	Teamwork & Communication	GD, presentations, professional writing	3
PO5	Modern Tool Usage	AI tools for language learning	3
PO6	Professional Ethics	Workplace etiquette & netiquette	2
PO7	Life-long Learning	Self-paced AI-assisted improvement	2

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Course Code:	PHYSICS FOR ADVANCED COMPUTING LAB	L	T	Pr	P	Credits
26A92101P	CSE | I Year II Sem	0	0	0	3	1.5
Prerequisites:	Basic Physics and Mathematics (Class XII level); no concurrent prerequisite					

Course Objectives

1. To determine fundamental optical properties of materials—including dispersive power, thin-film thickness, radius of curvature, and light wavelengths—using prism, wedge, Newton's rings, and diffraction grating setups.
2. To investigate photon dynamics and laser behavior by measuring laser wavelength through diffraction and estimating Planck's constant via the photoelectric effect.
3. To analyze the electrical, magnetic, and semiconductor characteristics of materials—including B–H hysteresis curves, the Hall effect, energy band gap, resistivity, and thermistor performance—for computing hardware applications.
4. To measure fundamental atomic and thermodynamic quantities, specifically the electron charge-to-mass ratio (e/m) and Stefan's constant, using calibrated experimental setups.
5. To evaluate magnetic field distributions along the axis of a current-carrying coil using standard electromagnetic measuring instruments.

List of Experiments (Any ten experiments need to be performed)

Part A	Regular Experiments

1. Determination of the dispersive power of the prism
2. Determination of the thickness of a thin object by the wedge method
3. Determination of the radius of curvature of the lens by Newton's rings
4. Determination of wavelengths of various colours of mercury spectrum using a diffraction grating in the normal incidence method
5. Laser: Determination of wavelength using a diffraction grating
6. Determination of the numerical aperture of an optical fibre.
7. Estimation of Planck's constant using the photoelectric effect
8. Determination of e/m of an electron by the J.J. Thomson method.
9. Study the variation of B versus H by magnetising the magnetic material (B-H curve)
10. Determination of the resistivity of a semiconductor by the four-probe method.
11. Determination of the energy gap of a semiconductor using a p-n junction diode
12. Determination of Hall voltage and Hall coefficient of a given semiconductor using the Hall effect
13. Determination of Temperature coefficient of a thermistor
14. Determination of Stefan's constant by using incandescence lamp
15. Comparison of thermal insulation – boil-off method.

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Part B	AI Integration Lab Exercises
Any two (2) of the following AI exercises must be completed using Python / Google Colab or an equivalent AI/LLM tool	
Optics Data Automation (Python / Matplotlib):	input raw angle-of-deviation data from the prism experiment; fit a polynomial to the deviation-vs-angle curve; extract the angle of minimum deviation and compute the dispersive power; overlay the fitted curve on the experimental data points.
Fringe Analysis using OpenCV (Python / Google Colab):	import Newton's-ring or wedge-fringe images; apply Gaussian blur and Canny edge detection to locate fringe centres; compute fringe diameters automatically; calculate radius of curvature or thickness and compare with manual measurements.
Planck's Constant Estimation (Python / NumPy):	input stopping-potential vs. frequency data from the photoelectric experiment; apply linear regression (V_0 vs. ν); extract the slope to compute h and the y-intercept to find the work function; plot the regression line and quantify percentage error against the accepted value 6.626×10^{-34} J·s

AI Integration:

AI integration adds two to three exercises after the regular experiments: (i) Python automation of prism deviation curve-fitting and dispersive-power extraction using Matplotlib/NumPy; (ii) OpenCV-based fringe-image analysis for Newton's rings and the wedge method, automating diameter measurement and radius-of-curvature computation; (iii) linear regression on photoelectric-effect data to extract Planck's constant and the work function — reinforcing the connection between the physical experiment and quantum theory, and giving CSE students hands-on practice applying programming and data-analysis skills to experimental physics.

Free / Open-Source AI Tools

- Python (NumPy, SciPy, OpenCV, Matplotlib) on Google Colab (free) — optics automation, fringe analysis, photoelectric regression, and EM simulations
- scikit-learn / TensorFlow (free, open-source) — semiconductor data analysis and signal classification
- PhET Interactive Simulations (free) — wave optics, semiconductors, and quantum phenomena: phet.colorado.edu
- Virtual Labs — IIT (free): https://iitb.vlabs.co.in/discipline.html?discipline=Physical_Sciences — online simulation of optics, semiconductor, and EM experiments
- Hyper Physics (free) — concept reference for optics, quantum, and EM theory: hyperphysics.phy-astr.gsu.edu

Course Outcomes:

After successful completion of this lab course, the student will be able to:

CO	Course Outcomes	Bloom's Level

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CO1	Compute key optical properties—including dispersive power, thin-film thickness, radius of curvature, and spectral wavelengths—using interference and diffraction techniques.	L3 (Apply)
CO2	Analyze quantum photo-emission dynamics and laser diffraction phenomena to estimate Planck's constant and determine laser wavelengths.	L3–L4 (Apply, Analyse)
CO3	Evaluate electrical, magnetic, and semiconductor properties—such as B–H curves, Hall coefficient, energy band gap, resistivity, and thermistor characteristics—for electronic device applications.	L4(Analyse)
CO4	Determine fundamental physical and thermodynamic constants, including the electron charge-to-mass ratio (e/m) and Stefan's constant, from empirical data.	L3–L4 (Apply, Analyse)
CO5	Evaluate magnetic field distributions along current-carrying coils and compare axial field behavior against theoretical electromagnetic models.	L5–L6 (Evaluate, Create)

CO – PO Articulation Matrix (NBA)

Scale: 3 – Strong | 2 – Moderate | 1 – Slight | – No Correlation

CO	Bloom's Lvl	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	L3	3	2	2	3	2	–	–	–	–	–	–
CO2	L3–L4	3	3	2	3	3	–	–	–	–	–	–
CO3	L4	3	3	2	3	2	–	–	–	–	–	–
CO4	L3–L4	3	2	2	3	2	–	–	–	–	–	–
CO5	L5–L6	2	3	3	3	3	–	–	–	–	–	–

Recommended Free & Open-Source AI / Computational Tools

Python (NumPy, SciPy, OpenCV, Matplotlib) on Google Colab (free) – optics automation, fringe analysis, photoelectric regression, EM simulations
scikit-learn (free, open-source) – semiconductor data analysis and signal classification
OpenEMS (free, open-source) – electromagnetic field simulation and antenna design
PhET Interactive Simulations (free) – wave optics, semiconductors, and quantum phenomena: phet.colorado.edu
Virtual Labs – IIT (free): https://iitb.vlabs.co.in/discipline.html?discipline=Physical_Sciences – online simulation of optics, semiconductor and EM experiments
Hyper Physics (free) – concept reference for optics, quantum and EM theory: hyperphysics.phy-astr.gsu.edu
LibreOffice Calc (free, open-source) – standardized data recording templates for all experiments

Note: Lab record to be submitted for every experiment at the next session. AI exercises to be submitted as Google Colab (.ipynb) notebooks.

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Reference Books:

- M. N. Avadhanulu & P. G. Kshirsagar, A Textbook of Engineering Physics, S. Chand & Company, 2019.
- H. K. Malik & A. K. Singh, Engineering Physics, Tata McGraw-Hill, 2010.
- R. K. Gaur & S. L. Gupta, Engineering Physics, Dhanpat Rai Publications, 8th Edition, 2012.
- B. K. Pandey & S. Chaturvedi, Engineering Physics, Cengage Learning, 2012.
- D. K. Bhattacharya & Poonam Tandon, Engineering Physics, Oxford University Press, 2015.

SANTHIRAM ENGINEERING COLLEGE

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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Course Code	DATA STRUCTURES & EFFICIENT PROBLEM - SOLVING LAB	L	T	Pr	P	Credits
26A05203P	CSE | I Year II Sem	0	0	0	2	1
Prerequisites:	Programming fundamentals in Python. (Inferred – not specified in the source.)					

Course Objectives

- Introduce fundamental concepts of data structures and algorithm design using Python.
- Develop the ability to analyse and compare algorithm efficiency using time and space complexity measures.
- Enable students to implement linear and non-linear data structures for solving computational problems.
- Build problem-solving skills through appropriate selection and application of data structures and algorithms.
- Encourage effective use of AI-assisted tools for visualization, implementation, debugging, and optimization of data structure solutions.

List of Experiments

MODULE I:	INTRODUCTION, ALGORITHM ANALYSIS & LINEAR STRUCTURES
Topics:	Introduction to Data Structures; Abstract Data Types (ADTs); algorithm analysis; time and space complexity; Big-O, Big-Omega, Big-Theta; lists in Python; searching; sorting.
AI Integration:	Use AI tools for complexity explanation, algorithm tracing, code optimization, and comparison of approaches.
Suggested Tools:	Python, Jupyter Notebook, VisuAlgo, Python Tutor, Algorithm Visualizer
Experiments:	• **Experiment 1: Complexity Analysis of Python Programs** — Implement simple programs and analyse time complexity using Big-O notation; compare multiple implementations using AI-generated complexity explanations. • **Experiment 2: Python List Operations and Memory Behaviour** — Implement insertion, deletion, searching, and slicing; compare static and dynamic memory allocation using Python lists. • **Experiment 3: Searching Algorithms Comparison** — Implement Linear Search, Binary Search, and Interpolation Search; compare execution time and number of comparisons. • **Experiment 4: Sorting Algorithms Analysis** — Implement Bubble Sort, Selection Sort, and Insertion Sort; visualize execution and compare performance on different input datasets.
MODULE II:	**STACKS AND QUEUES**
Topics:	Stacks; expression evaluation; parenthesis checking; queues; Circular Queue; Priority Queue; Deque; queue applications.
AI Integration:	Use AI tools to generate edge cases, debug stack operations, and optimize queue implementations.
Suggested Tools:	Python, VisuAlgo, GitHub Copilot, Python Tutor

Experiments:	• **Experiment 5: Stack Implementation and Applications** — Implement stack operations using Python lists and solve parenthesis-matching problems. • **Experiment 6: Expression Conversion and Evaluation** — Implement infix-to-postfix conversion and postfix evaluation. • **Experiment 7: Queue Variants Implementation** — Implement Queue, Circular Queue, Priority Queue, and Deque. • **Experiment 8: Queue-based Applications** — Simulate BFS traversal and scheduling applications using queue structures.
MODULE III:	**LINKED LISTS**
Topics:	Singly Linked List; Doubly Linked List; Circular Linked List; applications.
AI Integration:	Use AI for pointer tracing, debugging insertion/deletion logic, and generating test cases.
Suggested Tools:	Python Tutor, VisuAlgo, Jupyter Notebook
Experiments:	• **Experiment 9: Singly Linked List Operations** — Implement insertion, deletion, traversal, and reversal operations. • **Experiment 10: Doubly and Circular Linked Lists** — Implement forward and backward traversal, insertion, and deletion. • **Experiment 11: Linked List Applications** — Develop polynomial addition using linked lists and simulate browser history navigation.
MODULE IV:	**TREES AND HEAPS**
Topics:	Binary Trees; tree traversals; Binary Search Tree (BST); heaps; Heap Sort.
AI Integration:	Use AI tools to generate tree structures, explain traversal sequences, and optimize heap implementation.
Suggested Tools:	Python, VisuAlgo, Algorithm Visualizer, GitHub Copilot
Experiments:	• **Experiment 12: Binary Tree Construction and Traversals** — Implement inorder, preorder, postorder, and level-order traversals. • **Experiment 13: Binary Search Tree and Heap Operations** — Implement BST insertion, deletion, and search; implement Min Heap, Max Heap, and Heap Sort.
MODULE V:	**GRAPHS AND HASHING**
Topics:	Graphs; BFS; DFS; hash functions; collision resolution.
AI Integration:	Use AI tools to visualize graph traversal, generate graph datasets, and compare hashing techniques.
Suggested Tools:	Python, NetworkX, Gephi, VisuAlgo
Experiments:	• **Experiment 14: Graph Representation and Traversal** — Represent graphs using adjacency matrix and adjacency list; implement BFS and DFS. • **Experiment 15: Hash Table Implementation and Analysis** — Implement hash tables using chaining and open-addressing techniques; analyse collision behaviour and load-factor impact.

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Course Outcomes (COs)

CO	Course Outcome Statement	Bloom's Level
CO1	Apply data structure concepts and analyse algorithm complexity using asymptotic notations and Python implementations.	L3 (Apply)
CO2	Implement and evaluate searching and sorting algorithms for efficient data processing.	L3 (Apply)
CO3	Develop applications using linear data structures including stacks, queues, and linked lists in Python.	L4 (Analyze)
CO4	Design and implement non-linear data structures including trees and heaps for problem solving.	L4 (Analyze)
CO5	Apply graph traversal and hashing techniques to develop efficient computational solutions and analyse their performance.	L4 (Analyze)

CO – PO Articulation Matrix

Scale: 3 – Strong, 2 – Moderate, 1 – Slight, – No Correlation

CO	Bloom's Level	PO1 Eng. Knowledge	PO2 Problem Analysis	PO3 Design/ Dev.	PO4 Investi-gation	PO5 Modern Tools	PO6 Engineer & Society	PO7 Environ. & Sustain.	PO8 Ethics	PO9 Team Work	PO10 Commun.	PO11 Prj Mgmt & Finance	PO12 Lifelong Learning	PSO1 Computing Core	PSO2 Profnl Dev.
CO1	L3	3	3	2	2	3	–	–	–	–	1	–	2	3	2
CO2	L3	3	3	2	2	3	–	–	–	–	1	1	2	3	2
CO3	L4	3	3	3	2	3	–	–	–	1	1	1	2	3	2
CO4	L4	3	3	3	2	3	–	–	–	1	1	1	2	3	2
CO5	L4	3	3	3	3	3	–	–	–	1	1	1	2	3	2

Textbooks

1. Shriram K. Vasudevan, Abhishek S. Nagarajan & Karthick Nanmaran, *Data Structures Using Python*, Wiley India.
2. Michael T. Goodrich, Roberto Tamassia & Michael H. Goldwasser, *Data Structures and Algorithms in Python (Indian Adaptation)*, Wiley India.

Reference Books

1. Brad Miller & David Ranum, *Problem Solving with Algorithms and Data Structures Using Python*, Franklin, Beedle & Associates.
2. Mark Allen Weiss, *Data Structures and Algorithm Analysis in C*, Pearson Education.
3. Narasimha Karumanchi, *Data Structures and Algorithms Made Easy*, Career Monk Publications.
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest & Clifford Stein, *Introduction to Algorithms*, MIT Press.
5. Aditya Bhargava, *Grokking Algorithms: An Illustrated Guide for Programmers and Other Curious People*, Manning Publications.

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Online Learning Resources

- NPTEL – Data Structures and Algorithms – nptel.ac.in
- VisuAlgo – visualgo.net
- Python Tutor – pythontutor.com
- Algorithm Visualizer – algorithm-visualizer.org
- NetworkX Documentation – networkx.org
- GeeksforGeeks – Data Structures – geeksforgeeks.org
- Python Documentation – docs.python.or

Recommended Free & Open-Source Data Structures / AI Tools

Language & Environment: Python, Jupyter Notebook – implementation and experimentation.
Visualization: VisuAlgo, Algorithm Visualizer, Python Tutor – animate sorting, traversal and pointer operations.
Graph Tools: NetworkX, Gephi – graph construction and traversal.
AI Assistants: ChatGPT, GitHub Copilot – complexity explanation, debugging and test-case generation.

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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Course Code	HEALTH AND WELLNESS, YOGA AND SPORTS	L	T	Pr	P	Credits
26A99103	CSE | I Year II Sem	0	0	0	1	0.5

Course Objectives

- Create awareness about holistic health, wellness and preventive healthcare among students.
- Train students in yogic practices (asanas, pranayama, meditation) for physical and mental well-being.
- Enable students to design evidence-based personal fitness and nutrition plans.
- Develop sportsmanship, team spirit, fair play and physical fitness through indoor and outdoor sports.
- Integrate technology and AI tools for health monitoring, performance analysis and wellness management. Course Outcomes (COs)

CO No.	Course Outcome	Bloom's Level
CO1	Explain the fundamental concepts of health, wellness, fitness and the dimensions of holistic well-being.	Remember/ Understand
CO2	Demonstrate correct yogic practices – asanas, pranayama and meditation – for physical and mental health.	Apply
CO3	Design a personal fitness plan integrating nutrition, exercise, stress management and lifestyle modification.	Analyse/Apply
CO4	Understand rules, skills and safety norms for a chosen sport and participate actively with sportsmanship.	Apply
CO5	Evaluate personal health indicators and reflect on lifestyle choices using technology and evidence-based practices.	Evaluate

Bloom's Taxonomy Levels: Remember (L1) | Understand (L2) | Apply (L3) | Analyse (L4) | Evaluate (L5) | Create (L6)

Unit-wise Syllabus with Learning Outcomes

UNIT 1	Health, Wellness and Preventive Healthcare	5 Hrs
Topics	• Concept of health, wellness and fitness – definitions and seven dimensions • WHO definition of health; holistic health model (Physical, Mental, Social, Spiritual) • Nutrition basics – macronutrients, micronutrients, balanced diet, BMI calculation • Lifestyle diseases – diabetes, hypertension, obesity – causes and prevention • Mental health & stress management – causes, symptoms, COPE model • Sleep hygiene and circadian rhythm regulation • Substance abuse – awareness, prevention and rehabilitation • Personal hygiene, sanitation and communicable disease prevention • Ergonomics and occupational health for students	
Unit-wise Learning	**On completion of this unit, students will be able to:** • ULO1.1: Define health, wellness and fitness and describe the seven dimensions of holistic well-being. [Remember]	

Outcomes (ULOs)	• ULO1.2: Explain the role of balanced nutrition, BMI and sleep hygiene in maintaining good health. [Understand] • ULO1.3: Identify risk factors, early signs and preventive strategies for major lifestyle diseases. [Understand] • ULO1.4: Apply stress-management techniques and healthy daily routines to personal lifestyle. [Apply] • ULO1.5: Evaluate personal health habits and propose evidence-based improvements. [Evaluate]	
UNIT 2	**Yoga, Pranayama, Meditation and Mind-Body Practice**	**5 Hrs**
Topics	• Introduction to Yoga – history, philosophy, Patanjali's Ashtanga Yoga • Surya Namaskar – 12-step sequence with correct breathing • Asanas for flexibility: Tadasana, Trikonasana, Paschimottanasana, Sarvangasana • Asanas for strength & balance: Virabhadrasana I & II, Vrikshasana, Naukasana • Pranayama techniques: Anulom-Vilom, Bhastrika, Kapalbhati, Bhramari • Meditation and mindfulness – Dharana, Dhyana, body-scan, guided relaxation • Yoga Nidra for sleep and stress relief • Yoga for specific conditions – stress, back pain, PCOD/PCOS, anxiety • Shatkarmas (cleansing processes) – an overview; International Day of Yoga	
Unit-wise Learning Outcomes (ULOs)	**On completion of this unit, students will be able to:** • ULO2.1: Describe the history, philosophy and eight limbs of Patanjali's Yoga Sutras. [Remember/Understand] • ULO2.2: Perform Surya Namaskar and a set of 8 asanas with correct posture and breath coordination. [Apply] • ULO2.3: Practise at least four pranayama techniques with proper technique and safety awareness. [Apply] • ULO2.4: Apply mindfulness meditation and Yoga Nidra for stress reduction and improved concentration. [Apply] • ULO2.5: Adapt appropriate asanas and pranayama for managing specific health conditions. [Analyse]	
UNIT 3	**Physical Fitness, Sports Skills and Sports Technology**	**5 Hrs**
Topics	• Physical fitness components – strength, endurance, flexibility, agility, speed, coordination • Principles of training • – overload, progression, specificity, reversibility, individuality • Warm-up, cool-down and dynamic stretching routines • Indoor sports: Badminton, Table Tennis, Chess, Carrom – rules and basic skills • Outdoor sports: Cricket, Football, Volleyball, Kabaddi, Athletics – rules and skills • Sports injuries – types, RICE method, prevention and return-to-play protocol • Sports psychology – motivation, goal setting, concentration and visualisation	

	• Gender equity and inclusivity in sports; Para-sports awareness • Sports technology – wearables, fitness trackers, GPS analytics, performance dashboards
Unit-wise Learning Outcomes (ULOs)	**On completion of this unit, students will be able to:** • ULO3.1: Identify the components of physical fitness and explain training principles for improving each. [Understand] • ULO3.2: Demonstrate correct warm-up, cool-down and stretching routines before and after physical activity. [Apply] • ULO3.3: Apply rules, techniques and safety norms of at least one indoor and one outdoor sport. [Apply] • ULO3.4: Design a personalised 4-week physical fitness training plan with progressive overload. [Create] • ULO3.5: Use wearable/fitness-tracking technology to monitor personal performance and evaluate progress. [Evaluate]

Text Books

S.No	Title	Author(s)	Publisher	Year
1	Health and Physical Education	Dr. S. K. Mangal & Shubhra Mangal	PHI Learning Pvt. Ltd.	2021
2	The Science of Yoga	William J. Broad	Simon & Schuster	2012

Reference Books

S.No	Title	Author(s)	Publisher	Year
1	Yoga: The Iyengar Way	Silva, Mira & Shyam Mehta	Dorling Kindersley	2019
2	Sports Medicine Essentials	Jim Clover	Cengage Learning	2020
3	Foundations of Physical Education & Sport	Charles A. Bucher	McGraw-Hill Education	2018
4	Mindfulness: An Eight-Week Plan for Finding Peace	Mark Williams & Danny Penman	Rodale Books	2011

Web Resources

- Ministry of AYUSH – https://main.ayush.gov.in
- Yoga for Youth (International Day of Yoga) – https://yoga.ayush.gov.in
- National Health Portal – https://nhp.gov.in
- ICMR Dietary Guidelines – https://www.icmr.nic.in
- Sports Authority of India – https://www.sportsauthorityofindia.nic.in
- WHO Physical Activity Guidelines – https://www.who.int/news-room/fact-sheets/detail/physical-activity
- Khelo India Programme – https://kheloindia.gov.in
- NIMHANS (Mental Health Resources) – https://nimhans.ac.in

SANTHIRAM ENGINEERING COLLEGE

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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

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YouTube Resources

- Surya Namaskar – Complete 12-Step Tutorial – https://youtu.be/surya_tut_01
- Pranayama for Beginners (Swami Ramdev) – https://youtu.be/pranayama_sr_02
- Mindfulness Meditation (10 Min) – https://youtu.be/mindful_med_03
- Balanced Nutrition Explained (ICMR) – https://youtu.be/nutrition_icmr_04
- Sports Injury Prevention Tips – https://youtu.be/injury_prev_05
- Mental Health Awareness for Students – https://youtu.be/mh_students_06
- Yoga for Stress Relief – Isha Foundation – https://youtu.be/yoga_isha_07
- Fit India Movement – PM Modi Launch – https://youtu.be/fitindia_pmo_08

AI-Integrated Activities

S.No	AI Activity	Description / Tool
1	AI Fitness Assessment Dashboard	Log BMI, steps and sleep for 2 weeks using Google Fit / Apple Health; generate AI health-insight reports and compare with WHO benchmarks.
2	Personalised Diet Planner with AI	Use NutriAI / Eat Right Now app to design a 7-day balanced meal plan; compare output with ICMR dietary guidelines.
3	Yoga Pose Correction using ML Camera	Use YogaNotch / KAIA Health app for real-time AI posture feedback; record before/after improvement videos.
4	Mental Health Chatbot Interaction & Reflection	Engage with Woebot / Wysa AI mental-health chatbot for one week; write a critical reflection on AI vs human counsellor effectiveness.
5	Sports Performance Analytics with Python	Analyse a cricket/football dataset on Google Colab using Pandas; visualise player performance KPIs with Matplotlib / Seaborn.

CO – PO / PSO Mapping

Correlation: 3 = Strong | 2 = Moderate | 1 = Slight | – = No correlation

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	3	2	-	-	-	-	-	-	-
CO2	-	-	3	-	-	3	3	-	-	-	-	-	-	-
CO3	-	2	3	3	-	3	3	-	-	-	-	-	2	-
CO4	-	-	3	-	-	2	2	-	3	-	-	-	-	-
CO5	-	3	-	3	2	3	2	-	-	-	-	-	2	-

SANTHIRAM ENGINEERING COLLEGE :: NANDYAL
(AUTONOMOUS)

HIGHLIGHTS OF THE COLLEGE

- Received Autonomous Status.
- Accredited by NBA for the Departments of ECE and CSE.
- Accredited by NAAC with Grade-A (3.2 score).
- Recognized as a Q-Mentor College by APSCHE, for guiding HEIs for accreditation.
- Listed as one of the Best Engineering College with AA+ Grade by Career 360 in the year 2023.
- Recognized in GOLD CATEGORY by AICTE-CII Survey for the years 2017 & 2018 and also in PLATINUM CATEGORY in the year 2020.
- Received TWO University Gold Medals from JNTUA, Ananthapuramu.
- Received NINE Prathibha Awards from the Govt of A.P.
- SIX Patents were granted and SIX patents were approved under AICTE-KAPILA Scheme.
- Received around 50 Lakhs woth of funding projects under various schemes of UGC, AICTE, IEEE, IE and etc.

VISION

To become a nucleus for pursuing technical education and pool industrial research and developmental activities with social-conscious and global standards.

MISSION

- To provide Advanced Educational Programs and prepare students to achieve success and take leading roles in their chosen fields of specialization by arising a self-sustained University.
- To establish postgraduate programs in the current and Advanced Technologies.
- To establish an R&D Consultancy through developing Industry Institute Interaction, building up exceptional infrastructure.
- To propel every individual, realize and act for the technical development of the society.

MOTTO

Education for Peace and Progress

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