G. Pullaiah College of Engineering and Technology

(Autonomous)

(Approved by AICTE | NAAC Accreditation with 'A' Grade | Accredited by NBA (ECE &EEE) | Affiliated to JNTUA)

Nandikotkur Road, Venkayapalli (V), Kurnool - 518452, Andhra Pradesh

BACHELOR OF TECHNOLOGY

ACADEMIC REGULATIONS
GPCET – R26

B. Tech Regular Four-Year Degree Programme
(For the batches admitted from the academic year 2026- 2027)
&
B. Tech (Lateral Entry Scheme)
(For the batches admitted from the academic year 2027 - 2028)

Preliminary Definitions and Nomenclature

AICTE: Means All India Council for Technical Education, New Delhi.

Autonomous Institute: Means an institute designated as Autonomous by University Grants Commission(UGC), New Delhi in concurrence with affiliating University (**Jawaharlal Nehru Technological University Anantapur**).

Academic Autonomy: Means freedom to an institute in all aspects of conducting its academic programs, granted by UGC for Promoting Excellence.

Academic Council: The Academic Council is the highest academic body of the institute and is responsible for the maintenance of standards of instruction, education and examination within the institute. Academic Council is an authority as per UGC regulations and it has the right to take decisions on all academic matters including academic research.

Academic Year: It is the period necessary to complete an actual course of study within a year. It comprises two main semesters i.e., one odd and one even.

Branch: Means specialization in a program like B.Tech degree program in Civil Engineering, B.Tech degree program in Computer Science and Engineering etc.

Board of Studies (BOS): BOS is an authority as defined in UGC regulations, constituted by Head of the Organization for each of the departments separately. They are responsible for curriculum design and updating in respect of all the programs offered by a department.

Backlog Course: A course is considered to be a backlog course, if the student has obtained a failure grade in that course.

Basic Sciences: The courses offered in the areas of Mathematics, Physics, Chemistry etc., are considered to be foundational in nature.

Commission: Means University Grants Commission (UGC), New Delhi.

Choice Based Credit System: The credit-based semester system is one which provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching along with provision of choice for the student in the course selection.

Certificate Course: It is a course that makes a student have hands-on expertise and skills required for holistic development in a specific area/field.

Compulsory course: Course required to be undertaken for the award of the degree as per the program.

Internal Examination: It is an examination conducted towards sessional assessment.

Core: The courses that are essential constituents of each engineering discipline are categorized as professional core courses for that discipline.

Course: A course is a subject offered by a department for learning in a particular semester.

Course Outcomes: The essential skills that need to be acquired by every student through a course.

Credit: A credit is a unit that gives weight to the value, level or time requirements of an academic course. The number of 'Contact Hours' in a week of a particular course determines its credit value. One credit is equivalent to one lecture/tutorial hour per week.

Credit point: It is the product of grade point and number of credits for a course.

Cumulative Grade Point Average (CGPA): It is a measure of cumulative performance of a student overall the completed semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places.

Curriculum: Curriculum incorporates the planned interaction of students with instructional content, materials, resources, and processes for evaluating the attainment of Program Educational Objectives.

Department: An academic entity that conducts relevant curricular and co-curricular activities, involving both teaching and non-teaching staff, and other resources in the process of study for a degree.

Detention in a Semester: Student who does not obtain minimum prescribed attendance in a Semester shall be detained in that particular Semester. Also a student can also be detained for lack of required number of credits till II-I/III-I at the end of Second year or Third Year respectively

Elective Course: A course that can be chosen from a set of courses. An elective can be Professional Elective and/or Open Elective.

Evaluation: Evaluation is the process of judging the academic performance of the student in her/his courses. It is done through a combination of continuous internal examinations and semester end examinations.

Grade: It is an index of the performance of the students in a said course. Grades are indicated by alphabets.

Grade Point: It is a numerical weight allotted to each letter grade on a 10 - point scale.

Institute: Means G.Pullaiah College of Engineering and Technology, Kurnool unless indicated otherwise by the context.

Massive Open Online Courses (MOOC): MOOCs inculcate the habit of self-learning. MOOCs would be additional choices in all the elective group courses.

Minor: Minor are coherent sequences of courses which may be taken in addition to the courses required for the B.Tech degree.

Pre-requisite: A specific course or subject, the knowledge of which is required to complete before student registers for another course at the next grade level.

Professional Elective: It indicates a course that is discipline centric. An appropriate choice of minimum number of such electives as specified in the program will lead to a degree with specialization.

Program: Means, UG degree program: Bachelor of Technology (B.Tech); PG degree program: Master of Technology (M.Tech) / Master of Business Administration (MBA).

Program Educational Objectives: The broad career, professional and personal goals that every student will achieve through a strategic and sequential action plan.

Project work: It is a design or research-based work to be taken up by a student during his/her final year to achieve a particular aim. It is a credit-based course and is to be planned carefully by the student.

Registration: Process of enrolling into a set of courses in a semester of a program.

Regulations: The regulations, common to all B.Tech programs offered by Institute, are designated as "GPCET Regulations – R26" and are binding on all the stakeholders.

Semester: It is a period of study consisting of 16 to 18 weeks of academic work equivalent to normally 90 working days. Odd semester commences usually in July and even semester in December of every year.

Semester End Examinations: It is an examination conducted for all courses offered in a semester at the end of the semester.

Program Outcomes: The essential skill sets that need to be acquired by every student during her/his program of study. These skill sets are in the areas of employability, entrepreneurial, social and behavioral.

University: Means Jawaharlal Nehru Technological University Anantapur (JNTUA), Ananthapuramu.

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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

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 programme 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. Secures additional 18 credits fulfilling all the requisites of a B.Tech. programme 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 full filling 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. programme 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

(a) 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
2 Hrs. Practical (Lab) per week	1 credit

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

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

5. Semester/Credits:

a. A semester comprises of 90 working days and an academic year is divided into two semesters.
b. 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.
c. Regular courses may also be completed well in advance through MOOCs satisfying prerequisites

6. Structure of the Undergraduate Programme

All courses offered for the B. Tech programmes 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 Course (MC)	Non-Credit	Non-Credit	_

The total degree credits become 171, including 2 credits for the online examination. 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.

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 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 parent discipline / department / branch of engineering
		Professional Elective Courses (PE)	Includes elective subjects related to the parent discipline/department/ branch of Engineering

3	Elective Courses	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 for developing desired attitude among the learners

8. Programme Pattern

i. Total duration of the 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 90days.
iv. There shall be mandatory Student Induction Program for freshers, with three-week duration before the commencement of first semester. The induction program includes Creative Arts, Universal Human Values, Physical activities, 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 / Scouts & Guides / Community Service Activities are mandatory as credit courses for all the undergraduate programmes.
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. There shall be Five Professional Elective courses and Four Open Elective courses.
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 inter disciplinary /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 hall 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 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 University for the students having good academic records.

xvii. The College shall take measures to implement Virtual Labs (https://www.vlab.co.in) which provides remote access to labs in various B. Tech Programmes and will help students in learning basic and advanced concepts through remote experimentation. Students shall be made to work on virtual lab experiments during the regular labs.

xviii. The college shall assign a faculty advisor / mentor 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 preferably be conducted in the blended mode of learning.

9. Evaluation Process

The performance of a student in each semester shall be evaluated course wise with a maximum of 100 marks for theory and 100 marks for practical courses. 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 course, the distribution shall be 30 marks for Continuous Internal Assessment and 70 marks for the End Examination.

II. For practical course, the distribution shall be 30 marks for Continuous Internal Assessment and 70 marks for the End Examination.

III. If any course contains two different branch subjects, the syllabus shall be 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 has both theory and practical components, they will be evaluated separately as theory subject and practical subject.

a) Continuous Internal Evaluation

i. For theory courses, during the semester, there shall be two sessional examinations. Each sessional examination shall be evaluated for 30 marks of which 05 marks for objective paper (10 minutes duration), 20 marks for subjective paper (90 minutes duration) and 05 marks for assignment.

ii. Objective paper shall contain for 05 short answer questions with 1 mark each or maximum of 10 bits for 05 marks. Subjective papers contain 3 either or type questions (totally six questions from 1 to 6) of which student has to answer each either-or type of questions. Each question carries 10 marks. The marks obtained in the subjective paper are condensed to 20 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 weightageof10 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 a student is absent for the sessional examination, no re-exam shall be conducted and the sessional examination 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

Absent Marks obtained in second mid:25

Final mid semester Marks: (25x0.8) +(0x0.2) =20

b) End Examination Evaluation:

The question paper for the End examination of theory courses shall have the following pattern:

i. There shall be 6 questions and all questions are compulsory.

ii. Question No. 1 shall contain 10 (2 marks each) compulsory short answer questions for a total of 20 marks with 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 Semester Examination Pattern for Theory Courses Consisting of Two Parts of different subjects, such as Basic Electrical & Electronics Engineering, shall follow the pattern:

i. The question paper shall consist of two parts, namely Part-A and Part-B, each carrying 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. Students 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 assessment during the semester for 30 marksand 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 day-to-day work / record, 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/external examiner in the subject

Procedure: 20 Marks

Experimental work & Results: 30 marks

Viva voce: 20 marks.

In a practical course 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. Internal assessment shall be as above for 30 marks in each part and final internal assessment 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 10 marks by the subject teacher concerned 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 30 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 10 marks. The marks obtained in the subjective paper are condensed to 20 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 with zero credits. However, attendance shall be considered while calculating aggregate attendance and students shall be declared to have passed the mandatory course only when he /she secures 40% or more in internal examinations. In case the student fails, a re-examination shall be conducted for failed candidates for 30marks satisfying the conditions mentioned in item 1&2 of the regulations.

v) The laboratory records and mid semester test papers shall be preserved for a minimum of 3 years in the respective institutions as per the University 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 70marks.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 teacher concerned 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 evaluate the grades/marks given for a course by external agencies and convert them to the equivalent marks/grades. 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 them to the equivalent marks/grades.

vi) The recommended courses offered by external agencies, conversions and appropriate grades/marks are to be approved by the University at the beginning of the semester. The principal of the respective college 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 University.

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-approved platforms.

A student may earn up to 40% of the total credits prescribed in a semester through MOOCs, subject to the University's 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. All the courses for Honors and Minors may be 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 university.

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 institution. External 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 Institution prescribed passing marks are higher than SWAYAM's minimum requirements, the institute norms shall prevail. In such cases, even if a student submits a SWAYAM certificate but fails to secure the Institute's 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 Institute may, through 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 Institute question paper pattern for 70 marks, strictly following the Institute-prescribed syllabus and it will be extrapolated to 100.

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

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

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 Institute.

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 Frame work for Online Learning Courses through SWAYAM) Regulation, 2016, the University 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 shall offer credit mobility for MOOCs and give the equivalent credit weightage 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 shall ensure no overlap of MOOC exams with that of the university examination schedule. In case of delay in results, the university will re-issue the marks sheet for such students.
viii) Student pursuing courses under MOOCs shall acquire there quired 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 institution shall submit the following to the examination section of the university:
a) List of students who have passed MOOC courses in the current semester along with the certificate of completion.
b) Undertaking form filled in 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 University 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 of their choice
ii) Provide options to gain 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: Two summer internships either onsite or virtual each with a minimum of 08 weeks duration, 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, supervisor 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% weightage each. It shall be evaluated for 50 marks. 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.

Full Semester Internship and Project work: In the final semester, the student should mandatorily register and undergo internship (onsite/virtual) 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 reportson 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 shall be 200 marks (8 credits) and distribution shall be 60 marks for internal assessment and 140 marks for external evaluation. The supervisor assesses the student for 30 marks (Report: 15marks, Seminar: 15 marks). At the end of the semester, all projects shall be showcased 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 University and is evaluated for 140 marks.

The college 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, JNTUA, Ananthapuramu**, in the prescribed format within the timeline notified by the University.
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 in the subsequent semester, as per the University 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-week 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 or 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 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. B. Tech (Hons.) is the 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 upto2nd year I semester are eligible to register for honors programs.

iii) A studentshallearnadditional18credits (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 per training to the Honors from V Semester onwards.

v) The concerned Principal 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 coursesofferedforMajordegreeinasemesteraretobeconsideredseparately.

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 continues even if the student fails in any of the regular courses after his registration to honors course.

xii) A student who fails in any course of the Honor Programme shall not be permitted to 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

xv) 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 students 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 7.0 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 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 University external examinations if he/she acquires a minimum of 40% attendance in each subject and 75% 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.

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 read mission 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 re admission 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 the 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 courses 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 courses 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 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.,

$$\mathbf{SGPA = \Sigma(Ci \times Gi)/\Sigma Ci}$$

Where, Ci is the number of credits of the i^{th} subject and Gi is the grade point scored by the student in the i^{th} 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.,

$$\mathbf{CGPA = \Sigma(Ci \times Si)/\Sigma Ci}$$

Where "Si" is the SGPA of the i^{th} semester and Ci 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 courses 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 satisfies 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 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 Institution/University shall resolve any issues that may arise in the implementation of MultipleEntry 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 startups. 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. An evaluation committee constituted by the principal 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 in 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:

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 programme (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 be 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 six 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, notebook, 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 sent to the University.
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 University examinations. The continuation of the course by the candidate is subject to the academic 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 University examinations, if his involvement is established. Otherwise, the candidate is 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. 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 University 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 there of 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 colleges 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 University 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 malpractice)
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.

G.PULLAIAH COLLEGE OF ENGINEERING AND TECHNOLOGY (A)

PROGRAMME CURRICULUMSTRUCTURE UNDER R26 REGULATIONS

B. TECH – COMPUTER SCIENCE AND ENGINEERING

INDUCTION PROGRAM

S.no	Course	Category	Periods per Week			Credits
			L	T	P	
1	Physical Activities -- Sports, Yoga and Meditation, Plantation	MC	0	0	6	0
2	Career Counselling	MC	2	0	2	0
3	Orientation to all branches -- career options, tools, etc.	MC	3	0	0	0
4	Orientation on admitted Branch -- corresponding labs, tools and platforms	EC	2	0	3	0
5	Proficiency Modules & Productivity Tools	ES	2	1	2	0
6	Assessment on basic aptitude and mathematical skills	MC	2	0	3	0
7	Remedial Training in Foundation Courses	MC	2	1	2	0
8	Human Values & Professional Ethics	MC	3	0	0	0
9	Communication Skills -- focus on Listening, Speaking, Reading, Writing skills	BS	2	1	2	0
10	Concepts of Programming	ES	2	0	2	0

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I SEMESTER (I YEAR)

Course Code	Title of the Course	Category	Periods per Week				Credits	Scheme of Examination Maximum Marks		
			L	T	Pr	P	C	Internal	External	Total
26MAT101	Linear Algebra and Calculus	BS	3	0	2	0	4	30	70	100
26CHE101	Applied Chemistry for Computer Science	BS	3	0	0	0	3	30	70	100
26CSE101	Computational Thinking and Problem Solving with Python	ES	3	0	0	0	3	30	70	100
26MEC101	Engineering Graphics	ES	1	0	4	0	3	30	70	100
26HSM101	Design Thinking	ES	1	0	4	0	3	30	70	100
26CHE102	Applied Chemistry for Computer Science Lab	BS	0	0	0	3	1.5	30	70	100
26CSE102	Computational Thinking and Problem Solving with Python Lab	ES	0	0	0	3	1.5	30	70	100
26MEC102	Engineering Workshop	ES	0	0	0	3	1.5	30	70	100
26HSM102	NSS/NCC/Scouts & Guides/Community Service	HM	0	0	0	1	0.5	-	100	100
TOTAL			**11**	**0**	**10**	**10**	**21**	**240**	**660**	**900**

II SEMESTER (I YEAR)

Course Code	Title of the Course	Category	Periods per Week				Credits	Scheme of Examination Maximum Marks		
			L	T	Pr	P	C	Internal	External	Total
26MAT201	Differential Equations and Vector Calculus	BS	3	0	2	0	4	30	70	100
26PHY109	Physics for Advanced Computing	BS	3	0	0	0	3	30	70	100
26ENG101	Communicative English	HM	2	0	0	0	2	30	70	100
26CSE201	Data Structures & Efficient Problem Solving	PC	2	0	2	0	3	30	70	100
26CAI101	AI Tools and Applications	ES	1	0	4	0	3	30	70	100
26CSE202	Data Structures & Efficient Problem Solving Lab	PC	0	0	0	2	1	30	70	100
26ENG102	Communicative English Lab	HM	0	0	0	2	1	30	70	100
26PHY110	Physics for Advanced Computing Lab	BS	0	0	0	3	1.5	30	70	100
26HSM103	Health and Wellness, Yoga and Sports	HM	0	0	0	1	0.5	-	100	100
26CSE103	Cybersecurity Awareness for Engineers	MC	2	0	0	0	0	100*	--	100*
TOTAL			**13**	**0**	**8**	**8**	**19**	**240**	**660**	**900**

* The marks for Mandatory Courses are not considered for calculating SGPA

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III SEMESTER (II YEAR)										
Course Code	Title of the Course	Category	Periods per Week				Credits	Scheme of Examination Maximum Marks		
			L	T	Pr	P	C	Internal	External	Total
	Basic Sciences Course	BS	3	0	0	0	3	30	70	100
	Humanities Course	HM	3	1	0	0	3	30	70	100
	Humanities Course	HM	2	0	0	0	2	30	70	100
	Engineering Course	ES	3	0	0	0	3	30	70	100
	Professional Core 2	PC	2	0	2	0	3	30	70	100
	Professional Core 3	PC	2	0	2	0	3	30	70	100
	Engineering Course Lab	ES	0	0	0	2	1	30	70	100
	Professional Core 2 Lab	PC	0	0	0	3	1.5	30	70	100
	Professional Core 3 Lab	PC	0	0	0	3	1.5	30	70	100
	Skill Enhancement course-I	SEC	1	0	0	2	2	30	70	100
	Audit Course	MC	2	0	0	0	-	100*	-	100*
	TOTAL		**18**	**0**	**4**	**10**	**23**	**300**	**700**	**1000**

* The marks for Mandatory Courses are not considered for calculating SGPA

IV SEMESTER (II YEAR)										
Course Code	Title of the Course	Category	Periods per Week				Credits	Scheme of Examination Maximum Marks		
			L	T	Pr	P	C	Internal	External	Total
	Humanities Course	HM	2	0	0	0	2	30	70	100
	Engineering Course	ES	1	0	2	0	2	30	70	100
	Professional Core 4	PC	2	0	2	0	3	30	70	100
	Professional Core 5	PC	2	0	2	0	3	30	70	100
	Professional Core 6	PC	2	0	2	0	3	30	70	100
	Professional Core 7	PC	2	0	2	0	3	30	70	100
	Professional Core 4 Lab	PC	0	0	0	3	1.5	30	70	100
	Professional Core 5 Lab	PC	0	0	0	3	1.5	30	70	100
	Skill Enhancement course-II	SEC	1	0	0	2	2	30	70	100
	Audit Course	MC	2	0	0	0	0	100*	-	100*
	TOTAL		**14**	**0**	**10**	**08**	**21**	**270**	**630**	**900**
Mandatory Community Service Project Internship of 08 weeks duration during summer vacation after II year II semester										

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V SEMESTER (III YEAR)										
Course Code	Title of the Course	Category	Periods per Week				Credits	Scheme of Examination Maximum Marks		
			L	T	Pr	P	C	Internal	External	Total
	Professional Core 8	PC	2	0	2	0	3	30	70	100
	Professional Core 9	PC	2	0	2	0	3	30	70	100
	Professional Core 10	PC	2	0	2	0	3	30	70	100
	Professional Core 11	PC	2	0	2	0	3	30	70	100
	Systems Thinking and Interdisciplinary Engineering	ES	2	0	0	0	2	30	70	100
	Introduction to Quantum Technologies and Applications	SEC	2	0	0	0	2	30	70	100
	Professional Core 8 Lab	PC	0	0	0	3	1.5	30	70	100
	Professional Core 9 Lab	PC	0	0	0	3	1.5	30	70	100
	Skill Enhancement Course III (Soft Skills)	HM	1	0	0	2	2	30	70	100
	Evaluation of Community Service Internship	PW	0	0	0	0	2	100	-	100
	Tinkering Lab	BS	0	0	0	2	1	30	70	100
		TOTAL	13	0	8	10	24	400	700	1100

* The Student Development Program (Workshop) shall be conducted at the end of the III Year I Semester and its outcomes will be reflected in the III Year II Semester
* Mandatory Industry visit in any one of V to VII semester

VI SEMESTER (III YEAR)										
Course Code	Title of the Course	Category	Periods per Week				Credits	Scheme of Examination Maximum Marks		
			L	T	Pr	P	C	Internal	External	Total
	Professional Core 12	PC	2	0	2	0	3	30	70	100
	Professional Core 13	PC	2	0	2	0	3	30	70	100
	Professional Elective I	PE	3	0	0	0	3	30	70	100
	Professional Elective II	PE	3	0	0	0	3	30	70	100
	Open Elective I	OE	3	0	0	0	3	30	70	100
	Professional Core 12 Lab	PC	0	0	0	3	1.5	30	70	100
	Professional Core 13 Lab	PC	0	0	0	3	1.5	30	70	100
	Skill Enhancement Course IV	SEC	1	0	0	2	2	30	70	100
	Entrepreneurship and Ecosystem	HM	2	0	0	0	2	30	70	100
	Indian Knowledge System	MC	2	0	0	0	0	100*	-	100*
	Student Development Program (Workshop)	PC	0	0	0	0	0	30	70	100
		TOTAL	18	0	4	08	22	270	630	900
Mandatory Industry Internship of 08 weeks duration during summer vacation										

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VII SEMESTER (IV YEAR)										
Course Code	Title of the Course	Category	Periods per Week				Credits	Scheme of Examination Maximum Marks		
			L	T	Pr	P	C	Internal	External	Total
	Professional Core 14	PC	2	0	2	0	3	30	70	100
	Management Course	HM	2	0	0	0	2	30	70	100
	Professional Elective III	PE	3	0	0	0	3	30	70	100
	Professional Elective IV	PE	3	0	0	0	3	30	70	100
	Open Elective II	OE	3	0	0	0	3	30	70	100
	Open Elective III	OE	3	0	0	0	3	30	70	100
	Skill Enhancement Course V	SEC	1	0	0	2	2	30	70	100
	Audit Course Gender Sensitization	MC	2	0	0	0	0	100*	-	100*
	Evaluation of Industry Internship	PR	0	0	0	0	2	-	100	100
	Online Examination	PC	0	0	0	0	2	-	100	100
		TOTAL	19	0	2	2	23	210	690	900

* The marks for Mandatory Courses are not considered for calculating SGPA

VIII SEMESTER (IV YEAR)										
Course Code	Title of the Course	Category	Periods per Week				Credits	Scheme of Examination Maximum Marks		
			L	T	Pr	P	C	Internal	External	Total
	Professional Elective V (MOOCS)	PE	3	0	0	0	3	30	70	100
	Open Elective IV (MOOCS)	OE	3	0	0	0	3	30	70	100
	Internship	PR	0	0	0	0	4	-	100	100
	Project	PR	0	0	0	0	8	60	140	200
		TOTAL	6	0	0	0	18	120	380	500

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I SEMESTER (I YEAR)

Course Code	Title of the Course	Category	Periods per Week				Credits	Scheme of Examination Maximum Marks		
			L	T	Pr	P	C	Internal	External	Total
26MAT101	Linear Algebra and Calculus	BS	3	0	2	0	4	30	70	100
26CHE101	Applied Chemistry for Computer Science	BS	3	0	0	0	3	30	70	100
26CSE101	Computational Thinking and Problem Solving with Python	ES	3	0	0	0	3	30	70	100
26MEC101	Engineering Graphics	ES	1	0	4	0	3	30	70	100
26HSM101	Design Thinking	ES	1	0	4	0	3	30	70	100
26CHE102	Applied Chemistry for Computer Science Lab	BS	0	0	0	3	1.5	30	70	100
26CSE102	Computational Thinking and Problem Solving with Python Lab	ES	0	0	0	3	1.5	30	70	100
26MEC102	Engineering Workshop	ES	0	0	0	3	1.5	30	70	100
26HSM102	NSS/NCC/Scouts & Guides/Community Service	HM	0	0	0	1	0.5	-	100	100
TOTAL			**11**	**0**	**10**	**10**	**21**	**240**	**660**	**900**

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Linear Algebra and Calculus

(COMMON TO ALL)

Hours Per Week				Hours Per Semester				Credits	Assessment Marks		
L	T	P	Pr	L	T	P	Pr	C	CIE	SEE	Total
3	0	0	2	42	0	0	30	4	30	70	100

1. 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.

2. Course Outcomes (COs)

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

CO1 Apply matrix algebra techniques to Solve systems of linear equations using matrix algebra, elimination techniques, and iterative methods, while leveraging computational tools for large-scale systems.

CO2 Analyze eigenvalue problems, diagonalization, and quadratic forms to interpret linear transformations and engineering systems.

CO3 Apply mean value theorems and polynomial approximations (Taylor and Maclaurin series) to evaluate functions and estimate errors.

CO4 Analyze multivariable functions using partial derivatives, Jacobians and optimization techniques.

CO5 Evaluate areas, volumes, and coordinate transformations using multiple integrals in engineering contexts.

3. Course Syllabus

UNIT I: Matrix Algebra and Linear Systems

Core Content: Matrices, types of matrices, operations, transpose, inverse, symmetric and skew-symmetric 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; Cramer's rule; matrix inversion method.

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 Collab; SymPy for symbolic matrix operations; Jupyter Notebook; Scilab.

UNIT II: Eigenvalues, Eigenvectors, Diagonalization & Quadratic Forms

Core Content: Eigenvalues and eigenvectors; characteristic equation; Cayley-Hamilton theorem; powers and inverse of matrices using Cayley-Hamilton theorem; diagonalization; similarity transformation; quadratic forms; canonical form; reduction by orthogonal transformation; rank, index, signature; positive definite forms; orthogonal, Hermitian, skew-Hermitian and unitary matrices.

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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 III: Single Variable Calculus and Series Expansions

Core Content: Rolle's theorem; Lagrange's mean value theorem; Cauchy's mean value theorem; Taylor's and Maclaurin's series with remainder; approximation of functions; error estimation.

AI Integration: SymPy-based Taylor and Maclaurin expansion generation; plotting truncation error and convergence; AI-supported derivation checking for mean value theorems.

Free/Open-Source AI Tools: Python (SymPy, NumPy, Matplotlib); Google Colab; Jupyter Notebook; Wolfram Alpha free tier for verification.

UNIT IV: Multivariable Differentiation and Optimization

Core 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: Series expansion 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 V: Multiple Integrals and Coordinate Transformations

Core 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; area and volume computation.

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.

4. Books and Materials

Textbook (s)

1. B. S. Grewal, Higher Engineering Mathematics, 44th Edition, Khanna Publishers, 2017.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley, 2018.
3. G. B. Thomas, M. D. Weir, J. Hass, Thomas' Calculus, 14th Edition, Pearson, 2018.
4. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 5th Edition, Alpha Science International, 2021.

Reference Book(s)

1. Gilbert Strang, Introduction to Linear Algebra, 5th Edition, Wellesley-Cambridge Press, 2016.
2. David C. Lay, Steven R. Lay, Judi J. McDonald, Linear Algebra and Its Applications, 5th Edition, Pearson, 2015.
3. George B. Arfken, Hans J. Weber, Frank E. Harris, Mathematical Methods for Physicists, 7th Edition, Academic Press, 2012.
4. Dennis G. Zill and Warren S. Wright, Advanced Engineering Mathematics, 6th Edition, Jones & Bartlett, 2018.
5. E. Kreyszig, Elementary Linear Algebra, 2nd Edition, Wiley, 1983.

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Online Learning Resources

1. NPTEL: Linear Algebra – https://nptel.ac.in
2. MIT OpenCourseWare – Linear Algebra: https://ocw.mit.edu
3. MIT OpenCourseWare – Multivariable Calculus: https://ocw.mit.edu
4. Python SymPy Documentation: https://docs.sympy.org
5. Google Colab for Python: https://colab.research.google.com
6. SciPy Documentation: https://docs.scipy.org
7. NumPy Documentation: https://numpy.org/doc

Recommended Free & Open-Source AI/Computational Tools

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

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Applied Chemistry for Computer Science

(COMMON TO CSE & CAI)

Hours Per Week				Hours Per Semester				Credits	Assessment Marks		
L	T	P	Pr	L	T	P	Pr	C	CIE	SEE	Total
3	0	0	0	42	0	0	0	3	30	70	100

1. 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, super capacitors, 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 Pre/co requisites

Basic Chemistry (Higher Secondary level)

2. Course Outcomes (COs)

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

CO1 Apply quantum chemistry principles to analyze molecular systems and explain molecular orbital theory for computing materials.

CO2 Analyze semiconductor materials, doping chemistry, and fabrication processes used in modern electronic devices..

CO3 Evaluate energy storage technologies including batteries, supercapacitors, and fuel cells for computing and data centre applications.

CO4 Analyze corrosion mechanisms in electronic devices and recommend appropriate protective techniques for PCBs and interconnects.

CO5 Design advanced materials solutions using nanotechnology principles and AI-assisted tools for nanoelectronics and quantum computing.

3. Course Syllabus

UNIT I: Quantum Chemistry

Core 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),GoogleColab,Qiskit.

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UNIT II: Semiconductor Chemistry

Core 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

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 prediction using regression models. Free/Open-Source AI Tools: Python, TensorFlow, Scilab.

UNIT III: Electrochemistry and Energy Storage

Core 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 IV: Chemistry of Corrosion and Protective Techniques

Core Content: Corrosion: definition, examples, types — chemical corrosion and electrochemical corrosion; Pilling-Bedworth rule;Galvanic corrosion; factors affecting corrosion;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).

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 V: Chemistry of Nanomaterials

Core Content: Introduction to nanochemistry: size-dependent properties, quantum confinement; Carbon nanomaterials: 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 material (Gold) **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

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4. Books and Materials

Textbook (s)

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 Book(s)

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.

3Poole, C. P., & Owens, F. J. (2003). Introduction to Nanotechnology. John Wiley & Sons.

4Sharma, B. K., & Gaur, H. (2019). Engineering Chemistry. Krishna Prakashan Media.

5Dara, S. S., &Umare, S. S. (2018). Engineering Chemistry (15th ed.). S. Chand Publishing.

Online Learning Resources

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

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COMPUTATIONAL THINKING AND PROBLEM SOLVING WITH PYTHON

(COMMON TO ALL)

Hours Per Week				Hours Per Semester				Credits	Assessment Marks		
L	T	P	Pr	L	T	P	Pr	C	CIE	SEE	Total
3	0	0	0	42	0	0	0	3	30	70	100

1. 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.

2. Course Outcomes (COs)

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

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

3. Course Syllabus

UNIT I: Computational Thinking And Programming Basics

Core 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 (Spronck — computational thinking, algorithms, flowcharts, Python basics); TB2: Chapters 1–2 (Thareja — introduction to programming, Python fundamentals)

AI Integration: Use Flowgorithm to design and simulate algorithms (e.g., largest of 3 numbers); draw flowcharts using Lucidchart; use Algorithm Visualizer to trace algorithm execution; use ChatGPT to convert pseudocode to Python and verify output.

UNIT II: Decision Making And Looping

Core 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

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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 Integration: Use Python Tutor to visualize if-else and loop execution step by step; use Thonny to debug loop-based programs; use Replit 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;for online coding practice; use ChatGPT to generate test cases for control flow programs.

UNIT III: Strings And Data Structures

Core Content: Strings: representation, indexing, slicing, operations, built-in functions and methodsLists: 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 Integration: Use NLTK and TextBlob 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 IV: Functions And Problem Solving

Core 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 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 V: File Handling, Exception Handling, And Oop

Core 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 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.

4. Books and Materials

Textbook (s)

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

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Reference Book(s)

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

Online Learning Resources

1. Algorithm & Flowchart: Flowgorithm – flowgorithm.org | Lucidchart – lucidchart.com | Algorithm Visualizer – algorithm-visualizer.org
2. Programming & Debugging: Python Tutor – pythontutor.com | Thonny – thonny.org | Replit – replit.com
3. Data & Scientific: Pandas – pandas.pydata.org | NumPy – numpy.org | SymPy – sympy.org
4. NLP & Text: NLTK – nltk.org | TextBlob – textblob.readthedocs.io
5. Development: Jupyter Notebook – jupyter.org | PyCharm – jetbrains.com/pycharm | OpenPyXL – openpyxl.readthedocs.io
6. NPTEL – Problem Solving through Programming in C / Python – nptel.ac.in

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ENGINEERING GRAPHICS

(COMMON TO ALL)

Hours Per Week				Hours Per Semester				Credits	Assessment Marks		
L	T	P	Pr	L	T	P	Pr	C	CIE	SEE	Total
1	0	0	4	14	0	0	56	3	30	70	100

1. Course Objectives

- Familiarise with the BIS conventions, geometric construction standards, and engineering scales.
- Develop visualization skills to interpret and project points, lines, and regular planes into 2D drawing sheets.
- Impart foundational knowledge on projecting regular 3D solids and reading directional geometric orientations.
- Enable the spatial reconstruction of sliced solids and flat unfolded developments of various structural shells.
- Introduce CAD tools combined with generative AI software to construct multi-view isometric representations from 3D models.

Course Pre/corequisites:

Basic Geometry,
Fundamental Python Programming

2. Course Outcomes (COs)

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

CO1 Construct engineering curves and scales using traditional drafting geometry validated by automated algorithmic paths.

CO2 Solve multi-planar projection instances of linear points, segments, and standard regular planar silhouettes.

CO3 Render projections of standard 3D solids and identify variations using structural boundary algorithms.

CO4 Draft complex cross-sectional geometries and mapped surface extensions of sliced geometric forms.

CO5 Produce composite isometric layouts alongside generative text-to-CAD system alternatives for dynamic prototyping.

3. Course Syllabus

UNIT I: Introduction to Engineering Graphics, Curves, and Scales

Introduction: Principles of Engineering Graphics, signboards, BIS conventions, and lettering.

Curves: Construction of Polygons. Conic sections: Ellipse, Parabola, and Hyperbola using eccentricity/general methods. Cycloidal curves and Involutes.

Scales: Plain, Diagonal, and Vernier scales.

- **AI Integration Module**: AI prompt engineering for generating geometric profiles; algorithmic generation of conic curves using mathematical code blocks; parsing hand-drawn geometric sketches into clean vector shapes using Computer Vision (CV) edge detection (Canny Edge/Hough Transform).

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UNIT II: Orthographic Projections of Points, Lines

Principles of orthographic projections, projection of points in all four quadrants. Projection of straight lines inclined to one or both reference planes, determination of true lengths and true inclinations.

Projections of Planes: regular planes Perpendicular to both reference planes, parallel to one reference plane and inclined to the other reference plane; plane inclined to both the reference planes.

AI Integration Module: Machine learning pipelines for 3D coordinate estimation from 2D views; multi-view structural tracking; training neural models to predict true line length and orientation angles based solely on coordinate projections.

UNIT III: Projection of Regular Solids

Projection of Regular Solids: Types of solids: Polyhedra and Solids of revolution. Projections of solids in simple positions: Axis perpendicular to horizontal plane, Axis perpendicular to vertical plane and Axis parallel to both the reference planes, Projection of Solids with axis inclined to one reference plane and parallel to another plane.

AI Integration Module: Object recognition models (e.g., YOLO / Mobile Net) trained to identify standard solid geometries; automated multiview projection generation from 3D CAD meshes using programmatic render layers.

UNIT IV: Sections of Solids, Development of Surfaces, and AI Generative Design

Sections of Solids: Perpendicular and inclined section planes, Sectional views and True shape of section, Sections of solids in simple position only. **Development of Surfaces:** Methods of Development: Parallel line development and radial line development. Development of a cube, prism, cylinder, pyramid and cone.

AI Integration Module: Generative Adversarial Networks (GANs) for generating flat-pattern configurations; algorithmic optimization of surface layouts to minimize sheet manufacturing scrap; predictive toolpath generation using physics-guided heuristic networks.

UNIT V: Isometric Projections, Conversions, and 2D-to-3D Deep Reconstruction

Principles of isometric projection, isometric scale, isometric views/projections of planes, simple and compound solids. Conversion of isometric views to orthographic views and vice-versa.

Computer graphics: Creating 2D&3D drawings of objects including PCB and Transformations using Auto CAD (*Not for end examination*).

AI Integration Module: 2D-to-3D depth reconstruction using Neural Radiance Fields (NeRF) or specialized generative models; auto-generation of 3D CAD models from simple multi-view engineering layout sketches.

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4. Books and Materials

Textbook (s)

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

Reference Book(s)

1. Engineering Graphics and Design by Pradeep Jain, A.P. Gautam, Abhishek Bhargava, Khanna Publishing.
2. Engineering Drawing, K.L. Narayana and P. Kannaiah, Tata McGraw Hill, 2013.
3. Engineering Drawing, M.B.Shah and B.C. Rana, Pearson Education Inc,2009.

Online Learning Resources

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

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DESIGN THINKING

(COMMON TO ALL)

Hours Per Week				Hours Per Semester				Credits	Assessment Marks		
L	T	P	Pr	L	T	P	Pr	C	CIE	SEE	Total
1	0	0	4	14	0	0	56	3	30	70	100

1. 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.

1. Course Outcomes (COs)

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

CO1 Recall and understand the philosophy, principles, and stages of the Design Thinking process and its relevance to human-centred problem solving.

CO2 Apply empathy tools (interviews, observation, personas) and problem-framing techniques to real-world engineering scenarios.

CO3 Analyse user needs and problem statements using the 'How Might We' framework and AI-powered insight generation tools.

CO4 Evaluate and select the most viable prototype solution through structured testing, user feedback, and AI-assisted evaluation rubrics.

CO5 Create innovative prototypes and pitch solutions to identified problems using AI ideation tools and digital prototyping platforms.

Course Pre/co requisites: None

2. Course Syllabus

UNIT I: Design Thinking

Core 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: MindMeister (free, open-source alternative: FreeMind) to create a mindmap of the 5-stage process. AI Video Analysis: summarise key DT principlesfromdocumentarycasestudies.

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UNIT-2: Empathise and Define Stages

Core 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

Core 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

Core 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

Core 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.

3. Books and Materials

Textbook (s)

1. T1. Brown, Tim. (2019). Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation. HarperBusiness, New York.

2. T2. Lewrick, Michael, Link, Patrick & Leifer, Larry. (2018). The Design Thinking Playbook. Wiley, New Jersey.

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Reference Book(s)

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.

Online Learning Resources

1. Stanford d.school Resources: dschool.stanford.edu/resources
2. IDEO Design Kit: www.designkit.org/methods
3. MIT OpenCourseWare – Design Thinking: ocw.mit.edu
4. Interaction Design Foundation: www.interaction-design.org
5. NPTEL Design Thinking: swayam.gov.in

YouTube / Video Resources

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

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Applied Chemistry for Computer Science Lab

(COMMON TO CSE & CAI)

Hours Per Week				Hours Per Semester				Credits	Assessment Marks		
L	T	P	Pr	L	T	P	Pr	C	CIE	SEE	Total
0	0	3	0	0	0	42	0	1.5	30	70	100

1. Course Outcomes (COs)

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

CO1 Perform redox and conductometric titrations to estimate concentrations of analytes in solution.

CO2 Determine corrosion rates and analyze environmental factors affecting corrosion of metals.

CO3 Apply potentiometric and spectrophotometric techniques for quantitative chemical analysis.

CO4 Identify functional groups in organic compounds using IR spectroscopy.

CO5 Synthesize a polymer and use AI/Python-based data analysis for predictive modelling of material behaviour.

List of Experiments

Unit 1 Titrimetric and Conductometric Analysis

1. Estimation of Ferrous Iron (Fe^{2+}) using Potassium Permanganate ($KMnO_4$) — Redox Titration

Standardize a $KMnO_4$ solution against a known oxalate solution, then titrate a Fe^{2+} sample solution against the standardized $KMnO_4$ until a persistent pink endpoint is observed. Calculate the concentration and amount of Fe^{2+} present in the given sample using stoichiometric relations.

2. Determination of Strength of Acid (H_2SO_4) 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 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.

4. 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 relates findings to real-world electronic hardware protection needs.

Unit 2 Conductometric and Potentiometric Titrations

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.

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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.

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.

1. Books and Materials

Textbook (s)

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 Book(s)

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

Online Learning Resources

1. IEEE Xplore Digital Library
2. Semiconductor Industry Association resources
3. NPTEL Engineering Chemistry
4. ASME technical resources

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COMPUTATIONAL THINKING AND PROBLEM SOLVING WITH PYTHON LAB

Hours Per Week				Hours Per Semester				Credits	Assessment Marks		
L	T	P	Pr	L	T	P	Pr	C	CIE	SEE	Total
0	0	3	0	0	0	30	0	1.5	30	70	100

1. 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 including data types, operators, and input/output.
- Enable students to implement logic using control structures and Python data structures.
- Develop skills in modular programming, file handling, and basic object-oriented programming.

Course Pre/co requisites: Python Programming

2. Course Outcomes (COs)

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

CO1	Apply computational thinking concepts to design algorithms, flowcharts, and Python programs
CO2	Develop programs using decision-making and looping constructs to solve logical problems.
CO3	Analyse and manipulate data using strings, lists, tuples, and sets.
CO4	Design modular programs using functions, recursion, and dictionaries.
CO5	Implement file handling, exception handling, and object-oriented concepts in Python applications.

3. List of Experiments

MODULE I: COMPUTATIONAL THINKING & PROGRAMMING BASICS

Topics: Computational thinking — decomposition and abstraction; algorithms, flowcharts, and pseudocode; Python environment setup; variables, data types, input/output, and operators; basic computational problems.

AI Integration: Generate alternate solutions and test inputs; verify flowchart correctness; compare solution efficiency; explain type conversion.

Suggested Tools: Python, Flowgorithm, draw.io AI, ChatGPT, Microsoft Copilot

Experiments:

- **Experiment 1: Problem Solving using Computational Thinking —** Select three daily-life problems; apply decomposition and abstraction; write algorithms, draw flowcharts, and convert them into pseudocode.
- **Experiment 2: Flowchart Design and Algorithm Simulation —** Design flowcharts for largest of three numbers, student grade calculation, and electricity-bill generation; simulate execution and verify outputs.
- **Experiment 3: Python Programming Fundamentals —** Install the Python environment; write programs using variables, data types, input/output, and operators; solve simple interest, area, and unit-conversion problems.

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MODULE II: DECISION MAKING & LOOPING

Topics: Decision-control statements; looping and iterative problem solving; nested loops and pattern generation.

AI Integration: Generate boundary and test cases; verify decision logic; trace loop execution; compare loop alternatives; optimize nested loops.

Suggested Tools: Python, Python Tutor, ChatGPT, Microsoft Copilot

Experiments:

- **Experiment 4: Decision Control Statements —** Develop Python programs for largestamong three numbers, grade calculation, leap-year checking, and a menu-driven calculator.
- **Experiment 5: Looping and Iterative Problem Solving —** Implement programs for prime-number generation, Armstrong numbers, factorial computation, and multiplication tables.
- **Experiment 6: Nested Loops and Pattern Generation —** Generate number, pyramid, diamond, and character patterns.

MODULE III: STRINGS & DATA STRUCTURES

Topics: String processing; lists and nested lists; tuples and sets.

AI Integration: Generate string test cases and sample datasets; explain slicing and immutable structures; compare list approaches and suggest optimizations.

Suggested Tools: Python, Python Tutor, Algorithm Visualizer, ChatGPT

Experiments:

- **Experiment 7: String Processing Applications —** Develop programs for string reversal, palindrome checking, frequency counting, and word-occurrence analysis.
- **Experiment 8: List and Nested List Operations —** Perform sorting, searching, list merging, and matrix operations using nested lists.
- **Experiment 9: Tuple and Set Applications —** Implement tuple packing/unpacking, student-record storage, and set union, intersection, and difference operations.

MODULE IV: FUNCTIONS & PROBLEM SOLVING

Topics: User-defined functions; recursion; dictionaries and lambda functions.

AI Integration: Generate function examples and datasets; verify outputs; generate recursion trees; compare iterative and recursive solutions; explain lambda execution.

Suggested Tools: Python, Python Tutor, Algorithm Visualizer, ChatGPT

Experiments:

- **Experiment 10: User-Defined Functions —** Implementpositional, keyword, default, and variable-length arguments.
- **Experiment 11: Recursive Problem Solving —** Develop recursive solutions for factorial, Fibonacci, GCD, and Tower of Hanoi.
- **Experiment 12: Dictionary and Lambda Applications —** Implement a student database, dictionary operations, dictionary sorting, and lambda-based computations.

MODULE V: FILE HANDLING, EXCEPTION HANDLING & OOP

Topics: File processing and data storage; exception handling and testing; object-oriented programming — classes, objects, constructors, methods.

AI Integration: Generate datasets and error scenarios; verify file outputs; recommend exception strategies; generate class diagrams and suggest object interactions.

Suggested Tools: Python, ChatGPT, Microsoft Copilot

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Experiments:

- **Experiment 13: File Processing and Data Storage —** Develop programs to create and read text files, count words, and process CSV data.
- **Experiment 14: Exception Handling and Testing —** Implement try-except, finally, and custom exceptions; apply exception handling to division operations, file access, and input validation.
- **Experiment 15: Object-Oriented Programming Mini Project —** Develop a Python application using classes, objects, constructors, and methods.

Suggested Mini Projects:

1. Student Management System
2. Library Management System
3. Banking System

4. Books and Materials

Textbook (s)

1. Pieter Spronck, *Computational Thinking with Python*.
2. Reema Thareja, *Programming in Python*, Oxford University Press.

Reference Book(s)

1. Allen B. Downey, *Think Python: How to Think Like a Computer Scientist*.
2. Eric Matthes, *Python Crash Course*.
3. John Zelle, *Python Programming: An Introduction to Computer Science*.

Recommended AI / Computational Tools

.AI Assistants: ChatGPT, Microsoft Copilot – code generation, explanation and test-case generation.

.Flowchart & Diagramming: Flowgorithm, Lucidchart AI, draw.io AI – algorithm and flowchart design.

.Visualization: Algorithm Visualizer, Python Tutor – execution tracing and recursion visualization.

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ENGINEERING WORKSHOP

Hours Per Week				Hours Per Semester				Credits	Assessment Marks		
L	T	P	Pr	L	T	P	Pr	C	CIE	SEE	Total
0	0	3	0	0	0	30	0	1.5	30	70	100

1. Course Outcomes (COs)

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

CO1 Recognize the importance of safety precautions while working in the workshop.

CO2 Identify different measuring, marking, cutting tools used in the workshop and their operational capabilities.

CO3 Fabricate precision wood and metal fitting joints within standard specifications.

CO4 Understand wiring standards, safe residential switches, lighting circuits, and basic appliances.

CO5 Identify different tools used in foundry and welding sections.

2. Course Syllabus

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.

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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 sandmould 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).

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AI Tools Integration (Lab)

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.

3. Books and Materials

Textbook (s)

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 Book(s)

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.

Online Resources

- NPTEL Workshop Practices Video Series – IIT Kharagpur
- Predictive Maintenance Models in Python Tutorial

MIT 6.131: Power Electronics and Smart Grid Interfaces

G.PULLAIAH COLLEGE OF ENGINEERING AND TECHNOLOGY (A)

COURSE STRUCTURE

NSS / NCC / SCOUTS & GUIDES / COMMUNITY SERVICE

Hours Per Week				Hours Per Semester				Credits	Assessment Marks		
L	T	P	Pr	L	T	P	Pr	C	CIE	SEE	Total
3	0	0	0	45	0	0	0	1	100	0	100

1. 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.

2. Course Outcomes (COs)

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

CO1	Understand the philosophy, history, and objectives of NSS/NCC/Scouts & Guides and community service programmes.
CO2	Demonstrate leadership, teamwork, and organisational skills through camp/parade/drill activities.
CO3	Plan and execute community service projects addressing social issues like health, hygiene, literacy, and environment.
CO4	Apply first aid, disaster-preparedness, and civic responsibilities in real-world scenarios.
CO5	Develop civic sense,national integration and sustainable community-development values.

3. Course Syllabus

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 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

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- 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 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 (Padhna Likhna 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

4. Books and Materials

Textbook (s)

1. Ministry of Youth Affairs & Sports, Govt, of India.NSS Training Manual,MYAS Publication-2022
2. Directorate General NCC,National Cadet Corps – Training Syllabus & Manua,DG NCC, New Delhi-2021

Reference Book(s)

1. Dr. S. K. Lal, *Community Development & Social Service*, Regal Publications, 2019.
2. Satish Modh, *Disaster Management – A Holistic Approach*, Macmillan India, 2020.
3. Steve McCurley & Rick Lynch, *Volunteer Management*, Energize Publications, 2018.
4. Lord Robert Baden-Powell, *Scouting for Boys*, Oxford University Press (Centenary Edition), 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
- IndiaVolunteers – 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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II SEMESTER (I YEAR)

Course Code	Title of the Course	Category	Periods per Week				Credits	Scheme of Examination Maximum Marks		
			L	T	Pr	P	C	Internal	External	Total
26MAT201	Differential Equations and Vector Calculus	BS	3	0	2	0	4	30	70	100
26PHY109	Physics for Advanced Computing	BS	3	0	0	0	3	30	70	100
26ENG101	Communicative English	HM	2	0	0	0	2	30	70	100
26CSE201	Data Structures & Efficient Problem Solving	PC	2	0	2	0	3	30	70	100
26CAI101	AI Tools and Applications	ES	1	0	4	0	3	30	70	100
26CSE202	Data Structures & Efficient Problem Solving Lab	PC	0	0	0	2	1	30	70	100
26ENG102	Communicative English Lab	HM	0	0	0	2	1	30	70	100
26PHY110	Physics for Advanced Computing Lab	BS	0	0	0	3	1.5	30	70	100
26HSM103	Health and wellness, Yoga and Sports	HM	0	0	0	1	0.5	-	100	100
26CSE103	Cybersecurity Awareness for Engineers	MC	2	0	0	0	0	100*	--	100*
TOTAL			**13**	**0**	**8**	**8**	**19**	**240**	**660**	**900**

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DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS
(COMMON TO ALL)

Hours Per Week				Hours Per Semester				Credits	Assessment Marks		
L	T	P	Pr	L	T	P	Pr	C	CIE	SEE	Total
3	0	0	2	42	0	0	28	4	30	70	100

1. 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 Pre/co requisites: Linear Algebra and Calculus

2. Course Outcomes (COs)

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

CO1 Apply analytical techniques and computational tools to solve first-order differential equations and simulate real-world engineering systems.

CO2 Analyze higher-order linear ODEs and interpret solutions in dynamic engineering systems such as circuits and oscillators.

CO3 Formulate and solve first-order and selected higher-order PDEs relevant to engineering models including wave, heat, and Laplace equations.

CO4 Interpret and compute gradient, divergence, and curl of scalar and vector fields and explain their physical significance in engineering contexts.

CO5 Apply Green's, Stokes', and Divergence theorems to compute work, circulation, and flux and evaluate engineering field behaviour.

3. Course Syllabus

UNIT I: First-Order Ordinary Differential Equations

Core 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;engineering applications of first-order ODEs:Newton's law of cooling and natural growth/decay models; electrical circuit models (RC and RL circuits).

AI Integration: Python SymPy dsolve 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 with initial conditions. **Free/Open-**

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Source AI Tools: Python (SymPy, SciPy, Matplotlib) on Google Colab; Jupyter Notebook; Wolfram Alpha free tier for solution verification; GNU Octave for ODE routines.

UNIT II: Higher-Order Linear Differential Equations

Core 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 and verification using SymPy; using AI tools to explain transient vs. steady-state response, resonance and Q-factor interpretation.

Free/Open-Source AI Tools: Python (NumPy, SciPy, SymPy, Matplotlib) on Google Colab; Jupyter Notebook; GNU Octave / MATLAB (optional) for LCR and mechanical system simulation; WolframAlpha free tier.

UNIT III: Partial Differential Equations

Core 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); second-order PDE applications — wave equation, heat equation, and Laplace's equation.

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; prompting AI to classify mixed-derivative PDEs and student verification of AI reasoning.

Free/Open-Source AI Tools: Python (SymPy, NumPy, SciPy, Matplotlib) on Google Colab; Jupyter Notebook; WolframAlpha free tier for PDE classification verification; Scilab.

UNIT IV: Vector Differentiation

Core 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.

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; using AI tools to interpret Maxwell's equations in terms of divergence and curl operators; AI-assisted explanation of irrotational and solenoidal field classification.

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Free/Open-Source AI Tools: Python (NumPy, SymPy, Matplotlib, mpl_toolkits) on Google Colab; Jupyter Notebook; SciPy for numerical gradient computation; GNU Octave.

UNIT V: Vector Integration and Integral Theorems

Core 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).

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 in terms of source density; prompting AI to explain connections to Gauss's law and student evaluation of AI explanations.

Free / Open-Source AI Tools: Python (NumPy, SciPy, Matplotlib) on Google Colab; Jupyter Notebook; SymPy for symbolic integral verification; WolframAlpha free tier; 3D plotting tools.

4. Books and Materials

Textbook (s)

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley, 2018
2. B. S. Grewal, Higher Engineering Mathematics, 44th Edition, Khanna Publishers, 2017.
3. G. B. Thomas, M. D. Weir, J. Hass, Thomas' Calculus, 14th Edition, Pearson, 2018.
4. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 5th Edition, Alpha Science International, 2021.

Reference Book(s)

1. Dennis G. Zill and Warren S. Wright, Advanced Engineering Mathematics, 6th Edition, Jones & Bartlett, 2018.
2. George B. Arfken, Hans J. Weber, Frank E. Harris, Mathematical Methods for Physicists, 7th Edition, Academic Press, 2012.
3. Ian N. Sneddon, Elements of Partial Differential Equations, Dover Publications, 2006.
4. H. F. Davis and A. D. Snider, Introduction to Vector Analysis, 7th Edition, Hawkes Publishing, 1995.

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 OpenCourseWare – Differential Equations (18.03): https://ocw.mit.edu
- MIT OpenCourseWare – Multivariable Calculus (18.02): https://ocw.mit.edu
- Python SymPy Documentation: https://docs.sympy.org
- SciPy Documentation: https://docs.scipy.org

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- 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.
- WolframAlpha (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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PHYSICS FOR ADVANCED COMPUTING

Hours Per Week				Hours Per Semester				Credits	Assessment Marks		
L	T	P	Pr	L	T	P	Pr	C	CIE	SEE	Total
3	0	0	0	45	0	0	0	3	30	70	100

1. 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 provide basic knowledge of quantum mechanics and quantum computing with simple AI-assisted quantum applications.

  To introduce lasers, fiber optics and advanced sensing technologies along with simple AI-assisted signal processing techniques.

  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 Pre/requisites

Engineering Mathematics, Basic Electronics, Computer Science Fundamentals

2. Course Outcomes (COs)

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

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

3. Course Syllabus

UNIT I: Wave Optics and Quantum Information Processing

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 slit, 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. Free/Open-Source AI Tools: Python (NumPy, SciPy, Matplotlib and scikit-learn).

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UNIT II: Introduction to Quantum Mechanics and Quantum Computing

Content: Introduction to quantum mechanics; de-Broglie concept (matter waves); Heisenberg's Uncertainty Principle; Postulates of Quantum Mechanics; Physical Significance of wave function, 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 III: Quantum Photonics and Advanced Sensing

Content: Lasers: Interaction of radiation with matter; Requisites and conditions for laser action; He-Ne laser; Nd-YAG laser;. Laser-based data 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; V-Number, Attenuation in optical fibers; 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 IV: Semiconductors and Magnetic Materials

Content: Semiconductors: Introduction, Fermi level in intrinsic and extrinsic semiconductors; Expression for concentration of electrons in conduction band, holes in valence band and Charge carrier concentration in intrinsic semiconductors, Electrical conductivity in intrinsic semiconductors, 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 V: Low Temperature Physics and Superconductivity

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.

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.

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4. Books and Materials

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

1. NPTEL – nptel.ac.in
2. MIT OpenCourseWare – ocw.mit.edu
3. HyperPhysics – hyperphysics.phy-astr.gsu.edu
4. PhET Simulations – phet.colorado.edu
5. IBM Qiskit (free, open-source) – For quantum computing and superconducting qubit simulations on Google Colab

Recommended Free & Open-Source AI/Computational Tools

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

G.PULLAIAH COLLEGE OF ENGINEERING AND TECHNOLOGY (A)

COMMUNICATIVE ENGLISH
(COMMON TO ALL)

Hours Per Week				Hours Per Semester				Credits	Assessment Marks		
L	T	P	Pr	L	T	P	Pr	C	CIE	SEE	Total
2	0	0	0	28	0	0	0	2	30	70	100

1. Course Objectives

- Build a solid foundation in core English grammar, vocabulary, phonetics, and communication frameworks tailored for the workplace.
- Strengthen listening, speaking, reading, and writing abilities through interactive exercises and AI-driven platforms.
- Craft polished professional emails, reports, and presentations with the assistance of AI writing tools.
- Analyse communication patterns, structural barriers, and discourse using AI analytical tools.
- Practice ethical AI use by fact-checking generated content, upholding academic honesty, and leveraging AI as a learning aid rather than a replacement for critical thought

Course Pre/co requisites

There are no Pre/co requisites

2. Course Outcomes (COs)

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

CO1 Apply fundamental rules of English grammar, syntax, and communication dynamics, utilizing AI-driven tools to enhance language accuracy, real-time feedback, and vocabulary acquisition.

CO2 Demonstrate effective oral communication, active listening, and persuasive presentation skills in group discussions, debates, and public speaking, while leveraging AI tools for real-time speech analysis and dynamic visual content creation.

CO3 Apply diverse reading strategies, expand academic vocabulary, and draft structured written texts—ranging from paragraphs to creative reviews—while utilizing AI tools to analyze readability, optimize sentence structure, and generate content outlines.

CO4 Construct professional workplace communications—including business emails, short reports, resumes, and digital profiles—while leveraging AI tools to refine tone, optimize for ATS filters, and streamline document structure.

CO5 Evaluate the role, benefits, and ethical implications of Artificial Intelligence in modern communication, using AI tools responsibility for language learning, cross-cultural translation, content creation, and e-portfolio development while adhering to academic integrity.

3. Course Syllabus

UNIT I: Foundations of English Communication

Core Content: 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.

AI Integration: Grammar explanation, error identification, and instant Q&A on language rules, Real-time grammar, spelling, and punctuation correction with detailed explanations, Phonetics practice – voice recording for pronunciation and intonation feedback, Word-of-the-day, etymology, and interactive vocabulary quizzes.

Free/Open-Source AI Tools: Grammarly (free); ChatGPT / Gemini (free tiers); Google Speech-to-Text (free); Merriam-Webster Vocabulary Builder (free)

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UNIT II: Listening and Speaking Skills

Core Content: 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.

AI Integration: AI-powered presentation design – structured, visual, professional slides, Fluency analysis, filler-word detection, pacing, and confidence scoring, Auto-transcription and keyword analysis of spoken communication, Visual communication design – infographics, posters, and slide aesthetics

Free/Open-Source AI Tools: Gamma.app (free); Orai AI Speech Coach (free); Otter.ai (free tier); Canva AI (free)

UNIT III: Reading Comprehension & Writing Skills

Core Content: 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 and blogs.

AI Integration: AI paraphrasing tool – rewrite passages at varying complexity levels, Readability scoring, passive voice detection, and sentence simplification, Essay outline generation, argument structuring, and content brainstorming, Vocabulary simplification for improving comprehension of complex texts

Free/Open-Source AI Tools: QuillBot (free); Hemingway Editor (free online); ChatGPT (free); Rewordify (free).

UNIT IV: Professional & Business Communication

Core Content: Email Writing and Letter Writing: formal and informal. Short Report Writing: structure, types (formal/informal), and format. Note-Making and Summarization Techniques. Resume / CV Writing and LinkedIn Profile Optimization.

AI Integration: Draft and refine professional emails, cover letters, reports, and proposals, AI-powered resume builder with ATS-optimized templates, Report structuring, agenda writing, and knowledge management, Tone detection, formality check, and professional register evaluation

Free/Open-Source AI Tools: ChatGPT (free); Kickresume (free tier); Grammarly (free); Notion AI (free tier).

UNIT V: Use of AI in Language Learning

Core Content: Artificial Intelligence in Communication: meaning, basics, benefits and limitations of AI in human interaction. AI chatbots and virtual assistants in education: grammar correction, vocabulary building, AI-based speaking and pronunciation tools, writing assistants, e-portfolio creation. AI in Global Communication: automated translation, summarizing large texts, finding information in different languages. 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.

AI Integration: Plagiarism detection, paraphrase checker, and academic integrity analysis, High-accuracy translation supporting intercultural communication understanding, AI literacy modules – understanding AI bias, ethics, and responsible usage, E-portfolio creation platform for showcasing communication artifacts

Free/Open-Source AI Tools: Copyleaks / Turnitin (institutional access); DeepL Translator (free); Wix (free); Adobe Portfolio (free for students); ChatGPT / Gemini (free tiers).

4. Books and Materials

Textbook (s)

1. Raman M. and Sharma S., Technical Communication: Principles and Practice, Oxford University Press, 4th Edition, 2022.
2. Shetty J. and Pareek R., Communicative English for Engineers and Professionals, Wiley India, 3rd Edition, 2021.

Reference Book(s)

1. Rizvi M.A., Effective Technical Communication, Tata McGraw-Hill, 2nd Edition, 2018.
2. Murphy H.A., Effective Business Communication, McGraw-Hill Education, 7th Edition, 2019.
3. Wren P.C. and Martin H., High School English Grammar and Composition, S. Chand, Revised Edition, 2019

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Online Learning Resources

- British Council – Learn English – https://learnenglish.britishcouncil.org
- NPTEL – Communication Skills – https://nptel.ac.in/courses/109104101
- Purdue OWL (Online Writing Lab) – https://owl.purdue.edu
- BBC Learning English – https://www.bbc.co.uk/learningenglish

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DATA STRUCTURES & EFFICIENT PROBLEM SOLVING

Hours Per Week				Hours Per Semester				Credits	Assessment Marks		
L	T	P	Pr	L	T	P	Pr	C	CIE	SEE	Total
2	0	0	2	28	0	0	28	3	30	70	100

1. 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.

2. Course Outcomes (COs)

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

CO1 Apply basic data structure concepts and analyse algorithm complexity using Python.

CO2 Implement searching and sorting techniques for efficient data processing. **CO1**

CO3 Develop programs using linear data structures — stacks, queues, and linked lists — in Python.

CO4 Design and implement non-linear data structures including trees and heaps using Python.

CO5 Apply graph traversal and hashing techniques to solve real-world computational problems.

3. Course Syllabus

UNIT I: Complex Functions and Analyticity

Core 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 Visual go 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.

UNIT II: Complex Integration

Core 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 principle..

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UNIT III: Series Expansions and Residues

Core 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: Probability and Random Variables

Core 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: Probability Distributions

Core 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. **F**

4. Books and Materials

Textbook (s)

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 Book(s)

1. Brad Miller & 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 Learning 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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Recommended Free & Open-Source AI/Computational Tools

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

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AI TOOLS AND APPLICATIONS

Hours Per Week				Hours Per Semester				Credits	Assessment Marks		
L	T	P	Pr	L	T	P	Pr	C	CIE	SEE	Total
3	0	0	4	45	0	0	60	3	30	70	100

1. 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.

2. Course Outcomes (COs)

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

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

3. Course Syllabus

UNIT – I UNDERSTANDING AI AND AI FOR DOCUMENTS AND PRESENTATIONS

Core 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 cutoffs). AI ecosystem: ChatGPT, Claude, Gemini, Microsoft Copilot — strengths and differences.AI for presentations: Gamma.app — full slide deck from a paragraph prompt; Microsoft Copilot 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 Copilot 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.

AI Integration: Use Gamma.app to generate a presentation on an engineering topic in under 2 minutes; use Copilot in Word or Gemini in Docs to draft and improve a report; compare ChatGPT, cloud, gemini and Microsoft Copilot on the same writing task; use Grammarly to review your own writing.

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UNIT II: AI FOR RESEARCH, NOTE-TAKING, DATA, AND SPREADSHEETS

Core 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 Copilot 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.

AI Integration: Upload your own lecture notes to NotebookLM and generate a study guide and audio overview; use Perplexity AI and Gemini Deep Research to research a topic; verify citations on Google Scholar; use Wolfram Alpha or Symbolab to solve and verify equations from your current semester subjects; use Copilot in Excel or ChatGPT ADA to analyse a real dataset

UNIT III: AI FOR VISUAL DESIGN, DIAGRAMS, AND MEDIA

Core ContentAI 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: ElevenLabs — 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.

AI Integration: Use Napkin.ai to convert a paragraph of text into a diagram; use Whimsical AI to generate a mind map of a course topic; use DALL-E 3 or Canva AI to create an event poster through 3 prompt iterations; use ElevenLabs to create a voiceover; test GPTZero on 5 samples And analyse confidence scores.

UNIT IV: AI ACROSS ENGINEERING DISCIPLINES

Core 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

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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, Webflow AI); AI for data science (Jupyter AI,DataRobot).

AI Integration: Each student identifies 5 real AI tools in their own engineering branch using Claude or ChatGPT and verifies each using official product pages or research publications; present findings in a 3-minute class presentation with a structured comparison table.

UNIT V: RESPONSIBLE AI, ETHICS, AND CAPSTONE PROJECT

Core 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 (OpenAI), 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.

AI Integration: Read and compare data retention policies of ChatGPT, Claude, and Gemini; classify 5 daily-use AI systems using EU AI Act risk tiers; use GPTZero and Google Lens to detect AI-generated content; design and present the Capstone Mini-Project integrating tools from all five units.

4. Books and Materials

Textbook (s) and Reference Book(s)

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.
4. Google – Fundamentals of AI – grow.google/intl/en_in/ai-learning-resources
5. Microsoft – AI Skills Navigator – microsoft.com/en-us/ai/ai-skills
6. Andrew Ng – AI for Everyone (Coursera, free to audit) – coursera.org/learn/ai-for-everyone
7. Elements of AI – University of Helsinki (free, beginner) – elementsofai.com
8. AI Assistants: ChatGPT – chat.openai.com | Claude – claude.ai | Gemini – gemini.google.com | Microsoft Copilot – copilot.microsoft.com
9. Research & Notes: NotebookLM – notebooklm.google.com | Perplexity AI – perplexity.ai | Elicit – elicit.org | Consensus – consensus.app
10. Presentations & Docs: Gamma.app | Notion AI – notion.so | Beautiful.ai | Copilot in Office 365 | Gemini in Google Workspace
11. Diagrams & Design: Napkin.ai | Whimsical AI – whimsical.com | Miro AI – miro.com | Canva AI – canva.com | DALL-E 3 via ChatGPT
12. Data & Spreadsheets: ChatGPT Advanced Data Analysis | Julius AI – julius.ai | Copilot in Excel | Gemini in Sheets

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13. Math & Equations: Wolfram Alpha – wolframalpha.com | Symbolab – symbolab.com | Mathway – mathway.com | Microsoft Math Solver – math.microsoft.com | Photomath – photomath.com | Desmos – desmos.com | GeoGebra – geogebra.org
14. Audio & Video: ElevenLabs – elevenlabs.io | Suno – suno.com | Runway – runwayml.com | HeyGen – heygen.com
15. Detection & Automation: GPTZero – gptzero.me | Originality.ai | Google Lens | Make.com | GitHub Copilot.

Online Learning Resources

- https://www.youtube.com/@JoyofLearningCSE/featured
- EU AI Act – eur-lex.europa.eu | UNESCO AI Ethics – unesco.org | NITI Aayog – niti.gov.in
- India DPDP Act 2023 – meity.gov.in | ProPublica COMPAS – propublica.org | MIT Technology Review – technologyreview.com |

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DATA STRUCTURES & EFFICIENT PROBLEM SOLVING LAB

Hours Per Week				Hours Per Semester				Credits	Assessment Marks		
L	T	P	Pr	L	T	P	Pr	C	CIE	SEE	Total
0	0	2	0	0	0	28	0	1	30	70	100

1. 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.

Course Pre/co requisites: Data Structures

2. Course Outcomes (COs)

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

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

Course Syllabus

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

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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:

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- **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

3. Books and Materials

Textbook (s)

1. Shriram K. Vasudevan, Abhishek S. Nagarajan & Karthick Nanmaran, *Data Structures Using Python*, Wiley India.

Michael T. Goodrich, Roberto Tamassia & Michael H. Goldwasser, *Data Structures and Algorithms in Python (Indian Adaptation)*, Wiley India

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COMMUNICATIVE ENGLISH LAB

Hours Per Week				Hours Per Semester				Credits	Assessment Marks		
L	T	P	Pr	L	T	P	Pr	C	CIE	SEE	Total
0	0	2	0	0	0	28	0	1	30	70	100

1. Course Objectives

- Build strong oral communication abilities through targeted speaking and listening activities.
- Refine pronunciation, tone, and spoken fluency using AI-driven voice tools.
- Develop key career-ready skills in group discussions, debates, and public speaking.
- Train students to produce high-quality workplace documents, including emails, formal reports, and cover letters.
- Utilize AI technology for self-evaluation, real-time feedback, and ongoing skill development

Course Pre/corequisites

A50002 – Communicative English

2. Course Outcomes (COs)

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

CO1 To speak English with proper pronunciation using phonetic standards while displaying smooth, natural vocal fluency.

CO2 To demonstrate strong listening comprehension in English and communicate appropriately across various social and professional settings

CO3 To present well-reasoned arguments confidently during group discussions, debates, and formal presentations.

CO4 To compose well-structured, error-free professional documents—including emails, reports, and resumes—tailored to specific audience needs.

CO5 To apply AI-driven tools to support language learning, assess personal progress, and continuously refine English skills.

3. Course Syllabus

Lab Syllabus – 12 TOPICS WITH AI INTEGRATION

S.No	Lab Topic	Lab Activities	AI Activity	AI Tools
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
2	**Listening Comprehension & Note-Taking**	Listen to TED Talks/podcasts; fill-in-the-blank exercises; summarise audio passages	Auto-generate transcripts; compare student notes with AI-generated summaries using Otter.ai	Otter.ai, YouTube Auto-captions, Whisper 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

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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
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
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 Warmup by Google, ChatGPT
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
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
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
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
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
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

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4. Books and Materials

Textbook (s)

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 Book(s)

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 Learning 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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PHYSICS FOR ADVANCED COMPUTING LAB

Hours Per Week				Hours Per Semester				Credits	Assessment Marks		
L	T	P	Pr	L	T	P	Pr	C	CIE	SEE	Total
0	0	3	0	0	0	42	0	1.5	30	70	100

1. Course Objectives

- Provide hands-on experimental verification of the physical principles underlying optics, electromagnetism, and semiconductor behaviour.
- Develop skill in the use of standard laboratory instruments for measuring optical, electrical, and magnetic quantities.
- Train students to record, analyse, and interpret experimental data with appropriate error estimation.
- Introduce AI/ML and Python-based computational tools for simulation and analysis of physics experiments.

Course Pre/co requisites: Physics for Advanced Computing (Theory)

2. Course Outcomes (COs)

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

CO1 Determine the dispersive power of a prism, thickness by the wedge method, radius of Curvature by Newton's rings, and wavelengths of the mercury spectrum and a LASER using a diffraction grating; record, tabulate, and interpret optical measurement data.

CO2 Estimate Planck's constant from photoelectric-effect data relating results to quantum concepts relevant to computing devices.

CO3 Trace B–H curves of magnetic materials, measure resistivity by the four-probe method, determine the energy gap of a semiconductor using a p–n junction diode, and analyse and compare experimental values with theoretical/standard values.

CO4 Determine the temperature coefficient of a thermistor, Stefan's constant, and the magnetic field along a coil axis by Stewart & Gee's method; evaluate results against theoretical predictions.

CO5 Automate optical fringe analysis using OpenCV, extract Planck's constant by regression on photoelectric data, and perform dispersive-power curve fitting with Matplotlib/NumPy; evaluate computational-model accuracy using percentage error and R2.

Course Content

PART A - List of Experiments

Any 10 of the following experiments

1. Determination of the thickness of a thin object by the wedge method.
2. Determination of the radius of curvature of the lens by Newton’s rings.
3. Determination of wavelengths of various colours of mercury spectrum using a diffraction grating in the normal incidence method.
4. Determination of the dispersive power of the prism.
5. Determination of wavelength of a LASER using a diffraction grating.
6. Determination of particle size using a diode laser
7. Estimation of Planck’s constant using the photoelectric effect.

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8. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
9. Determination of the energy gap of a semiconductor using a p-n junction diode.
10. Determination of magnetic field along the axis of a current-carrying circular coil by Stewart & Gee's Method.
11. Determination of temperature co-efficient of a given material –Thermistor
12. Determination of Numerical Aperture of an optical fiber.
13. Determination of bending loss in plastic optical fiber.
14. Determination of the resistivity of semiconductor by Four Probe Method
15. Determination of e/m of an electron by Thomson Method

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.

1. **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.
2. **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.
3. **Planck's Constant Estimation (Python / NumPy):** input stopping-potential vs. frequency data from the photoelectric experiment; apply linear regression (V0 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.

Textbooks

As prescribed by the department – refer to the corresponding Engineering Physics theory course textbooks and the laboratory manual issued by the Department of Physics.

Reference Books

As prescribed by the department – refer to the corresponding Engineering Physics theory course reference books and the laboratory manual issued by the Department of Physics.

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Recommended Free & Open-Source AI/Computational Tools

- Python (NumPy, SciPy, OpenCV, Matplotlib) – FREE on Google Colab for wave optics and EM field analysis
- scikit-learn (free, open-source) – for semiconductor property prediction and EMI data analysis
- OpenEMS (free, open-source) – for 3D electromagnetic field simulation and power system analysis
- 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
- HyperPhysics (free) — concept reference for optics, quantum, and EM theory: hyperphysics.phy-astr.gsu.edu.

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HEALTH & WELLNESS, YOGA AND SPORTS

Hours Per Week				Hours Per Semester				Credits	Assessment Marks		
L	T	P	Pr	L	T	P	Pr	C	CIE	SEE	Total
0	0	1	0	0	0	45	0	0.5	-	100	100

1. 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 Pre/corequisites

There are no Pre/corequisites

2. Course Outcomes (COs)

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

CO1 Explain the fundamental concepts of health, wellness, fitness and the dimensions of holistic well-being.

CO2 Demonstrate correct yogic practices – asanas, pranayama and meditation – for physical and mental health.

CO3 Design a personal fitness plan integrating nutrition, exercise, stress management and lifestyle modification.

CO4 Understand rules, skills and safety norms for a chosen sport and participate actively with sportsmanship.

CO5 Evaluate personal health indicators and reflect on lifestyle choices using technology and evidence-based practices.

3. Course Syllabus

UNIT I: Health, Wellness and Preventive Healthcare

Core Content:

- 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 II: Yoga, Pranayama, Meditation and Mind-Body Practice

Core Content:

- 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

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UNIT III: Physical Fitness, Sports Skills and Sports Technology

Core Content:

- 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.

4. Books and Materials

Textbook (s)

1. E Dr. S. K. Mangal & Shubhra Mangal, Helath and Physical Education, PHI Learning Pvt LTd, 2021.
2. William J Broad, The Science of Yoga, Simaon and Schuster, 2012

Reference Book(s)

1. Silva, Mira & Shyam Mehta, Yoga: The Iyengar Way, Dorling Kindersley, 2019
2. Jim Clover, Sports Medicin Essentials, Cengage Learning, 2020
3. Charles A Bucher, Foundation of Physical Education and Sport, McGrawHill Education 2018

Online Learning 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

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A50503 – CYBER SECURITY AWARENESS FOR ENGINEERS

Hours Per Week				Hours Per Semester				Credits	Assessment Marks		
L	T	P	Pr	L	T	P	Pr	C	CIE	SEE	Total
0	0	3	0	0	0	42	0	1.5	30	70	100

1. 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 Pre/corequisites

There are no Pre/corequisites

2. Course Outcomes (COs)

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

CO1	Explain fundamental cybersecurity concepts and their importance in digital environments.
CO2	Identify common cyber threats, cyberattacks, and social engineering techniques.
CO3	Apply safe practices for secure use of devices, networks, email, cloud services, and online platforms.
CO4	Demonstrate awareness of cyber ethics, privacy protection, and cyber laws.
CO5	Develop cyber hygiene habits and respond appropriately to common cybersecurity incidents.

3. Course Syllabus

UNIT–I: INTRODUCTION TO CYBERSPACE AND CYBERSECURITY

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.

UNIT–II: CYBER THREATS, CYBERCRIME AND SOCIAL ENGINEERING

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.

UNIT–III: PERSONAL CYBER SAFETY AND CYBER SECURITY TECHNOLOGIES

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.

UNIT–IV: PRIVACY, CYBER ETHICS AND CYBER LAWS

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.

UNIT–V: CYBER HYGIENE AND SECURE DIGITAL PRACTICES

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.

4. Books and Materials

Textbook (s)

1. Ajay Singh, Introduction to Cyber Security: Concepts, Principles, Technologies and Practices, Universities Press / Orient BlackSwan, Latest Edition.
2. Nina Godbole and SunitBelapure, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley India

Reference Book(s)

1. Charles J. Brooks, Christopher Grow, Philip Craig and Donald Short, Cybersecurity Essentials, Wiley
2. William Stallings and Lawrie Brown, Computer Security: Principles and Practice, Pearson.
3. Michael E. Whitman and Herbert J. Mattord, Principles of Information Security, Cengage Learning.
4. Joseph MiggaKizza, Guide to Computer Network Security, Springer.
5. Eric Cole, Cybersecurity for Beginners, Wiley

Online Learning 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