ANNAMACHARYA
INSTITUTE OF TECHNOLOGY AND SCIENCES
(AN AUTONOMOUS INSTITUTION)

25th ANNIVERSARY

R23 ACADEMIC REGULATIONS AND B.TECH. MECHANICAL ENGINEERING COURSE STRUCTURE & SYLLABI

For the students admitted to B. Tech. Regular Four-Year Degree Programme from AY 2023-24 and
B. Tech. Lateral Entry Scheme from AY 2024-25



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ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES

(An Autonomous Institution)

RAJAMPET-516126 (A.P) INDIA

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Academic Regulations (R23) for
B. Tech (Regular-Full Time)

(Effective for the students admitted into I year from the Academic Year 2023-24 onwards)

&

Academic Regulations (R23) for
B. Tech (Lateral Entry Scheme)

(Effective for the students admitted into II year through Lateral Entry Scheme from the Academic Year 2024-25 onwards)

VISION AND MISSION OF THE INSTITUTION

Vision

We impart futuristic technical education and instill high patterns of discipline through our dedicated staff who set global standards, making our students technologically superior and ethically strong, who in turn shall improve the quality of life of the human race.

Mission

Our mission is to educate students from the local and rural areas and from other states so that they become enlightened individuals, improving the living standards of their families, industry and society. We provide individual attention, world-class quality of technical education and take care of character building.

ACADEMIC RULES AND REGULATIONS OF FOUR-YEAR B. TECH REGULAR DEGREE PROGRAMME

APPLICABLE FOR THE STUDENT BATCHES ADMITTED FROM THE ACADEMIC YEAR 2023-24

APPLICABLE FOR THE STUDENTS (Lateral Entry) ADMITTED FROM THE ACADEMIC YEAR 2024-25

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Academic Regulations (R23) for B. Tech (Regular-Full time)

(Effective for the students admitted into I year from the Academic Year **2023-24** onwards)

1. Preamble

Annamacharya Institute of Technology and Sciences (Autonomous), Rajampet, relentlessly aims to achieve academic excellence by implementing new initiatives in teaching-learning and evaluation processes. Based on the directions of the Institute Grants Commission (UGC), New Delhi, All India Council for Technical Education (AICTE), New Delhi and Jawaharlal Nehru Technological Institute Anantapur (JNTUA) Anantapuramu, the institute adopted AICTE and APSCHE model curriculum, with minor modifications to match the needs, expectations, and skillsets of students of the region, in both the under-graduate and post-graduate programmes offered from the academic year 2023-24.

2. Award of the Degree

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

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

ii. Registers for 160 credits and secures all 160 credits.

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

i. Student secures additional 15 credits fulfilling all the requisites of a B.Tech. Programme i.e., 160 credits.

ii. Registering for Honors is optional.

iii. Honors are to be completed simultaneously with B.Tech. programme.

Students, who fail to fulfill all the academic requirements for the award of the degree within eight academic years from the year of their admission, shall forfeit their seat in B.Tech. course and their admission stands cancelled. This clause shall be read along with clause 2 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/Institute 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/Institute or any other order of merit approved by the A.P. Government/Institute, subject to reservations as prescribed by the Government/Institute from time to time.

4. Program related terms

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

Credit Definition:

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

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

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

5. Semester/Credits:

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

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

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

6. Programmes of offered by the Institute

The following B. Tech. programmes are offered as specializations by the Institute from 2023-2024.

S. No	Name of the Program	Programme Code
1	Civil Engineering	01
2	Electrical and Electronics Engineering	02
3	Mechanical Engineering	03
4	Electronics and Communication Engineering	04
5	Computer Sciences and Engineering	05
6	Artificial Intelligence and Data Science	30
7	Computer Science and Engineering (Artificial Intelligence)	31
8	Computer Science and Engineering (Data Science)	32
9	Artificial Intelligence and Machine Learning	33

7. Structure of the Undergraduate Programme

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

S. No	Category	Breakup of Credits	Percentage of Total Credits	ACITE Recommendation (%)
1	Humanities and Social Science including Management	13	8%	8-9%
2	Basic Sciences (BS)	20	13%	12-16%
3	Engineering Sciences (ES)	23.5	14%	10-18%
4	Professional Core (PC)	54.5	34%	30-36%
5	Electives – Professional (PE) & Open Electives (OE); Domain Specific Skill Enhancement courses (SEC)	33	21%	19-23%
6	Internship & Project work (PR)	16	10%	8-11%
7	Mandatory Courses (MC)	Non-Credit	Non-Credit	-

8. Course Classification:

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

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

9. Programme Pattern

i. Total duration of the of B. Tech (Regular) Programme is four academic years.

ii. Each academic year of study is divided into two semesters.

iii. Minimum number of instruction days in each semester is 90 days.

iv. There shall be mandatory student induction program for fresher's, with a three- week duration before the commencement of first semester. Physical activity, Creative Arts, Universal Human Values, Literary, Proficiency Modules, Lectures by Eminent People, Visits to local Areas, Familiarization to Dept./Branch & Innovations etc., are included as per the guidelines issued by AICTE.

v. Health/wellness/yoga/sports and NSS /NSS /Scouts & Guides / Community service activities are made mandatory as credit courses for all the under graduate students.

vi. Courses like Environmental Sciences, Indian Constitution, and Technical Paper Writing & IPR are offered as non-credit mandatory courses for all the undergraduate students.

vii. Design Thinking for Innovation & Tinkering Labs is made mandatory as credit courses for all the undergraduate students.

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

ix. 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.

x. A total of 04 Open Electives are offered in the curriculum. A student can complete the requirement for B.Tech. Degree with a Minor within the 160 credits by opting for the courses offered through various verticals/tracks under Open Electives.

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

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

xiii. 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.

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

xv. Undergraduate degree with Honors is introduced by the Institute for the students having good academic record.

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

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

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

10. Evaluation Process

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

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

Theory Courses

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

i. For theory subject, the distribution shall be 30 marks for Internal Evaluation and 70 marks for the End-Examination.

ii. For practical subject, the distribution shall be 30 marks for Internal Evaluation and 70 marks for the End- Examination.

iii. If any course contains two different branch subjects, the syllabus shall be written in two parts with 3 units each (Part-A and Part-B)and external examination question paper shall be set with two parts each for 35 marks.

iv. If any subject is having both theory and practical components, they will be evaluated separately as theory subject and practical subject. However, they will be given same subject code with an extension of 'T' for theory subject and 'P' for practical subject.

a) Continuous Internal Evaluation

i. For theory subjects, during the semester, there shall be two midterm examinations. Each midterm examination shall be evaluated for 30 marks of which 10 marks for objective paper (20 minutes duration), 15 marks for subjective paper (90 minutes duration) and 5 marks for assignment.

ii. Objective paper shall contain 5 short answer questions with 2 marks each or maximum of 20 bits for 10 marks. Subjective paper shall contain 3 either or type questions (totally six questions from 1 to 6) of which student has to answer one from each either-or type of question. Each question carries 10 marks. The marks obtained in the subjective paper are condensed to 15 marks.

NOTE:

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

Evaluation Criteria of Internal Examination for Courses handled on shared basis:

Question paper shall contain two sections. Section I is for Objective / Short Answer Questions. Section II is for Descriptive type questions. Internal examination is designed to assess students' knowledge of both PART A and PART B of the course syllabus, it is conducted to assess knowledge of students in one and a half units in PART A and one and a half units in PART B of the course.

Section I: Section I consists of 10 objective questions in total, 5 from PART A of the syllabus and 5 from PART B from the syllabus. Each objective question carries 1 mark, and a student is required to answer all of them. **Section II**: Section II consists of descriptive type questions aimed at evaluating deeper understanding of the course. Section II consists of PART A and PART B and each has TWO

descriptive type questions with an internal choice. One descriptive question in PART A / PART B carries 5 marks, and other descriptive question in PART A / PART B carries 10 marks. 30 Marks in Section II will be scaled down to 15 marks making the internal examination for 25 Marks.

Question Paper Pattern:

Section I (10 Marks)

PART A (Objective Type Questions)

1, 2, 3, 4, 5

PART B (Objective Type Questions)

6, 7, 8, 9, 10

Section II (30 Marks, scaled down to 15 Marks)

PART A (Descriptive Type Questions)

1 or 2 (5 Marks)

3 or 4 (10 Marks)

PART B (Descriptive Type Questions)

5 or 6 (5 Marks)

7 or 8 (10 Marks)

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

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

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

For example:

Marks obtained in first mid: 25
Marks obtained in second mid: 20
Final mid semester Marks: (25x0.8) + (20x0.2) = 24
If the student is absent for any one midterm examination, the final mid semester marks shall be arrived at by considering 80% weight age to the marks secured by the student in the appeared examination and zero to the other. For Example:
Marks obtained in first mid: Absent
Marks obtained in second mid: 25
Final mid semester Marks: (25x0.8) + (0x0.2) =20

b) End Examination Evaluation:

End examination of theory subjects shall have the following pattern:

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

ii. Question I shall contain 10 compulsory short answer questions for a total of 20marks such that each question carries 2 marks.

iii. There shall be 2 short answer questions from each unit.
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.

iv. The questions from 2 to 6 shall be set by covering one unit of the syllabus for each question.

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

vi. Question paper shall be in two parts viz., Part A and Part B with equal weight age of 35 marks each.

vii. In each part, question 1 shall contain 5 compulsory short answer questions for a total of 5 marks such that each question carries 1 mark.

viii. In each part, questions from 2 to 4, there shall be either/or type questions of 10 marks each. Student shall answer any one of them.

ix. The questions from 2 to 4 shall be set by covering one unit of the syllabus for each question.

Practical Courses

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

a. For practical courses, there shall be a continuous evaluation during the semester for 30 sessional marks and end examination shall be for 70 marks.

b. Day-to-day work in the laboratory shall be evaluated for 15 marks by the concerned laboratory teacher based on the record/viva and 15 marks for the internal test.

c. The end examination shall be evaluated for 70 marks, conducted by the concerned laboratory teacher and a senior expert in the subject from the same department.
   - Procedure: 20 marks
   - Experimental work & Results: 30 marks
   - Viva voce: 20 marks.

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

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

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

Day-to-day work shall be evaluated for 15 marks by the concerned subject teacher based on the reports/submissions prepared in the class. And there shall be two midterm examinations in a semester for duration of 2 hours each for 15 marks with weight age of 80% to better mid marks and

20% for the other. The subjective paper shall contain 3 either or type questions of equal weight age of 5 marks. There shall be no objective paper in mid semester examination. The sum of day- to-day evaluation and the mid semester marks will be the final sessional marks for the subject.

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

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

f. The laboratory records and mid semester test papers shall be preserved for a minimum of 3 years in the respective institutions as per the Institute norms and shall be produced to the Committees of the Institute as and when the same are asked for.

11. Skill oriented Courses

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

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

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

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

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

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

12. Massive Open Online Courses (MOOCs):

A Student has to pursue and complete one course compulsorily through MOOCs approved by the Institute. A student can pursue courses other than core through MOOCs and it is mandatory to complete one course successfully through MOOCs for awarding the degree. A student is not permitted to register and pursue core courses through MOOCs.

A student shall register for the course (Minimum of either 8 weeks or 12 weeks) offered through MOOCs with the approval of Head of the Department. The Head of the Department shall appoint one mentor to monitor the student's progression. The student needs to earn a certificate by passing the exam. The student shall be awarded the credits assigned in the curriculum only by submission of the certificate. Examination fee, if any, will be borne by the student.

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.

13. Credit Transfer Policy

Adoption of MOOCs is mandatory, to enable Blended model of teaching-learning as also envisaged in the NEP 2020. As per Institute Grants Commission (Credit Framework for Online Learning Courses through SWAYAM) Regulation, 2016, the Institute shall allow up to a maximum of 20% of the total courses being offered in a particular programme i.e., maximum of 32 credits through MOOCs platform.

i. The Institute shall offer credit mobility for MOOCs and give the equivalent credit weight age to the students for the credits earned through online learning courses.
ii. Student registration for the MOOCs shall be only through the respective department of the institution, it is mandatory for the student to share necessary information with the department.
iii. Credit transfer policy will be applicable to the Professional & Open Elective courses only.
iv. The concerned department shall identify the courses permitted for credit transfer.
v. The Institute/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 Institute shall ensure no overlap of MOOC exams with that of the Institute examination schedule. In case of delay in results, the Institute will re-issue the marks sheet for such students.
viii. Student pursuing courses under MOOCs shall acquire the required credits only after successful completion of the course and submitting a certificate issued by the competent authority along with the percentage of marks and grades.
ix. The institution shall submit the following to the examination section of the Institute:
    a) List of students who have passed MOOC courses in the current semester along with the certificate of completion.
    b) Undertaking form filled by the students for credit transfer.
x. The universities shall resolve any issues that may arise in the implementation of this policy from time to time and shall review its credit transfer policy in the light of periodic changes brought by UGC, SWAYAM, NPTEL and state government.

Note: Students shall be permitted to register for MOOCs offered through online platforms approved by the Institute from time to time.

14. Academic Bank of Credits (ABC)

The Institute 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 option to gain the credits through MOOCs from approved digital platforms.
iii. Facilitate award of certificate/diploma/degree in line with the accumulated credits in ABC
iv. Execute Multiple Entry and Exit system with credit count, credit transfer and credit acceptance from students' account.

15. 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 / Institute 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% weight age each. It shall be evaluated for 50 external marks. There shall be no internal marks for Summer Internship. A student shall secure minimum 40% of marks for successful completion. In case, if a student fails, he/she shall reappear as and when semester supplementary examinations are conducted by the Institute.

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 report on the work carried out during the internship.

The project report shall be evaluated with an external examiner. The total marks for project work 200 marks and distribution shall be 60 marks for internal and 140 marks for external evaluation. The supervisor assesses the student for 30 marks (Report: 15 marks, Seminar: 15 marks). At the end of the semester, all projects shall be 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 and external examiner appointed by the Institute 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.

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. The Minor program requires the completion of 12 credits in Minor stream chosen.
ii. Two courses for 06 credits related to a Minor are to be pursued compulsorily for the minor degree, but maybe waived for students who have done similar/equivalent courses. If waived for a student, then the student must take an extra elective course in its place. It is recommended that students should complete the compulsory courses (or equivalents) before registering for the electives.
iii. Electives (minimum of 2 courses) to complete a total of 12 credits.

Note: A total of 04 Open Electives are offered in the curriculum. A student can complete the requirement for Minor by opting for the courses offered through various verticals/tracks under Open Electives.

17. Guidelines for offering Honors

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

i. Honors is introduced in the curriculum of all B. Tech. programs offering a major degree and is applicable to all B. Tech (Regular and Lateral Entry) students admitted in Engineering & Technology.
ii. A student shall earn additional 15 credits 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., 160 credits).
iii. A student is permitted to register for Honors in IV semester after the results of III Semester are declared and students may be allowed to take maximum two subjects per semester pertaining to the Honors from V Semester onwards.
iv. The concerned Principal of the college shall arrange separate class work and timetable of the courses offered under Honors program.
v. Courses that are used to fulfill 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.
vi. 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.
vii. The attendance for the registered courses under Honors and regular courses offered for Major degree in a semester are to be considered separately.
viii. A student shall maintain an attendance of 75% in all registered courses under

ix. 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. 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.

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

Enrolment into Honors:

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

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

iii. If a student is detained due to lack of attendance either in Major or in Honors, registration 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:

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.

ii. The selected students shall submit their willingness to the principal through his/her parent department offering Honors. The parent department shall maintain the record of student pursuing the Honors.

iii. The students enrolled in the Honors courses will be monitored continuously.

iv. An advisor/mentor from parent department shall be assigned to a group of students to monitor the progress.

v. There is no fee for registration of subjects for Honors program offered in offline at the respective institutions.

18. Attendance Requirements:

i. A student shall be eligible to appear for the Institute external examinations if he/she acquires a minimum of 40% attendance in each subject and 75% of attendance in aggregate of all the subjects. b) Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester may be granted by the College Academic Committee.

ii. Shortage of Attendance below 65% in aggregate shall in NO CASE be condoned.

iii. A stipulated fee shall be payable towards condonation of shortage of attendance to the Institute.

iv. Students whose shortage of attendance is not condoned in any semester are not eligible to take their end examination of that class and their registration shall stand cancelled.

v. A student will not be promoted to the next semester unless he satisfies the attendance requirements of the present semester. They may seek readmission for that semester from the date of commencement of class work.

vi. If any candidate fulfills the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.

vii. If the learning is carried out in blended mode (both offline & online), then the total attendance of the student shall be calculated considering the offline and online attendance of the student.

viii. For induction programme attendance shall be maintained as per AICTE norms.

19. Promotion Rules:

The following academic requirements must be satisfied in addition to the attendance requirements mentioned in section 18.

i. A student shall be promoted from first year to second year if he/she fulfills the minimum attendance requirement as per Institute norms.

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

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

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

20. Grading:

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

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

Structure of Grading of Academic Performance

Range in which the marks in the subject fall	Grade	Grade points Assigned
90 & above	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 (Pass)	5
< 40	F (Fail)	0
Absent	Ab (Absent)	0

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

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

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

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

$$SGPA = \frac{\sum(C_i * G_i)}{\sum C_i}$$

Where $\boldsymbol{C_i}$ is the number of credits of the $\boldsymbol{i^{th}}$ subject and $\boldsymbol{G_i}$ is the grade point scored by the student in the $\boldsymbol{i^{th}}$ 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.,

$$CGPA = \frac{\sum(C_i * S_i)}{\sum C_i}$$

Where $\boldsymbol{S_i}$ is the SGPA of the $\boldsymbol{i^{th}}$ semester and $\boldsymbol{C_i}$ is the total number of credits up to that semester

Both SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts. While computing the SGPA the subjects in which the student is awarded Zero grade points will also be included.

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

Award of Class:

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

Class Awarded	**CGPA Secured**
First Class with Distinction	≥7.5
First Class	≥6.5 <7.5
Second Class	≥5.5 <6.5
Pass Class	≥5.0 <5.5

CGPA to Percentage conversion Formula – (CGPA – 0.5) x 10

21. With–holding of Results

If the candidate has any dues not paid to the Institute 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, 40 credits 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, 80 credits 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, 120 credits.

(b) Entry Policy:

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

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

23. Gap Year Concept

Gap year concept for Student Entrepreneur in Residence is introduced and outstanding students who wish to pursue entrepreneurship / become entrepreneur are allowed to take a break of one year at any time after II year to pursue full-time entrepreneurship programme/to establish start-ups. This period may be extended to two years at the most and these two years would not be counted for the time for the maximum time for graduation. The principal of the respective college shall forward such proposals submitted by the students to the Institute. An evaluation committee constituted by the Institute 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 fulfillment 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, subject to Section 2 and they will follow the academic regulations into which they are readmitted.

Candidates who are permitted to avail Gap Year shall be eligible for re-joining into the succeeding year of their B. Tech from the date of commencement of class work, subject to Section **2** and they will follow the academic regulations into which they are readmitted.

25. Minimum Instruction Days for a Semester:

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

26. Medium of Instruction:

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

27. Student Transfers:

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

28. General Instructions:

i. The academic regulations should be read as a whole for purpose of any interpretation.

ii. Malpractices rules-nature and punishments are appended.

iii. Where the words “he”, “him”, “his”, occur in the regulations, they also include “she”, “her”, “hers”, respectively.

iv. In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final

v. The Universities may change or amend the academic regulations or syllabi at any time and the changes or amendments shall be made applicable to all the students on rolls with effect from the dates notified by the Universities.

vi. In the case of any doubt or ambiguity in the interpretation of the guidelines given, the decision of the Vice-Chancellor / Head of the institution is final

ACADEMIC REGULATIONS (R23) FOR B.TECH. (LATERAL ENTRY SCHEME)

*(Effective for the students admitted into II year through Lateral Entry Scheme from the Academic Year **2024-25** onwards)*

1. Award of the Degree

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

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

ii. Registers for 120 credits and secures all 120 credits.

(b) Award of B.Tech. Degree with Honors if he/she fulfills the following:

i. Student secures additional 15 credits fulfilling all the requisites of a B.Tech. Programme i.e., 120 credits. Registering for Honors is optional.

ii. Honors is to be completed simultaneously with B.Tech. Programme.

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

3. Minimum Academic Requirements

The following academic requirements have to be satisfied in addition to the requirements mentioned in item no.

i. A student shall be deemed to have satisfied the minimum academic requirements and earned the credits allotted to each theory, practical, design, drawing subject or project if he secures 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 evaluation and end examination taken together.

ii. A student shall be promoted from III year to IV year if he/she fulfills the academic requirements of securing 40% of the credits (any decimal fraction should be rounded off to lower digit) in the subjects that have been studied up to V semester.

iii. And case if student is already detained for want of credits for particular academic year, the student may make up the credits through supplementary exams of the above exams before the commencement of IV year I semester class work of next year.

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 fulfillment of academic regulations, the student shall be in the academic regulations into which he/she is readmitted.

5. All other regulations as applicable for B. Tech. Four-year degree course (Regular) will hold good for B. Tech. (Lateral Entry Scheme).

Appendix-I: Internship Guidelines

The Head of the Department will arrange internship for students in industries/organization after fifth semester or as per AICTE/ affiliating University guidelines. Institutions may also device online system for arranging &managing internships. The general procedure for arranging internship is given below:

Step 1: Request Letter/ Email from the office of HOD of the department should go to industry to allot various slots of 4-6 weeks during summer vacation as internship periods for the students. Students request letter/profile/ interest areas may be submitted to industries for their willingness for providing the training.

Step 2: Industry will confirm the training slots and the number of seats allocated for internships via Confirmation Letter/ Email. In case the students arrange the training themselves the confirmation letter will be submitted by the students in the office of Training & Placement through concerned department. Based on the number of slots agreed to by the Industry.

Step 3: Students on joining Training at the concerned Industry / Organization, submit the Joining Report/ Letters / Email.

Step 4: Students undergo industrial training at the concerned Industry / Organization. In-between Faculty Member(s) evaluate(s) the performance of students once/twice by visiting the Industry/Organization and Evaluation Report of the students is submitted in department office/TPO with the consent of Industry persons/ Trainers.

Step 5: Students will submit training report after completion of internship.

Step 6: Training Certificate to be obtained from industry.

Step 7: List of students who have completed their internship successfully will be issued by concerned Department.

For more details refer:

https://www.aicte-india.org/sites/default/files/AICTE%20Internship%20Policy.pdf

Appendix II: Norms and Procedures for Challenge Evaluation/Revaluation/Recounting

Revaluation / Recounting:

- The students who wishes to apply for Revaluation/Recounting of his/her answer-books(s) must submit his/her application on the prescribed from together with the requisite fee to the Controller of Examinations before expiry of 15 days excluding the date of the declaration of his/her examination result. Application not received in the prescribed form or by the due date or without the requisite fee shall be rejected.
- After Recounting / Revaluation, records are updated with changes if any and the student will be issued a revised memorandum of marks. If there are no changes, the student shall be intimated the same through a notice.
- No Revaluation / Recounting for Laboratory Examination.
- The students are informed to be more careful in furnishing the information while applying for Recounting / Revaluation. The applications with insufficient information will be summarily rejected and the student has to forfeit the amount paid in this connection.
- **Challenge valuation:**
- Applications are invited from the students, who wish to apply for Challenge Valuation in the subjects of the B.Tech Regular and Supplementary examinations
- The student will apply for Challenge valuation in a specified application and should be routed through the HOD concerned.
- The students who have applied for the revaluation for a paper(s) of an examination are only eligible for the Challenge Valuation of that paper(s) of that examination.
- A Fee of Rs. 10000/- (Ten Thousand Rupees Only) for each paper is to be paid within the last date for challenge valuation.
- A Xerox copy of the answer script will be provided to the student on receipt of the payment of fee and date and time of the valuation will be informed to the student, so that valuation will be done in the presence of the teacher attended in support of the student nominated by the HOD concerned.
- The HOD concerned will nominate a teacher of the concerned subject to observe the valuation in support of the student. This will be done on the request of the student.
- If the marks obtained in the challenge valuation are more than or equal to 15% of the maximum marks with respect to the original marks obtained in the first valuation, then the marks obtained in the Challenge valuation will be awarded to the student and the institute will pay back Rs 9,000 (Nine thousands rupees only) to the student. If the student status changes from fail to pass, an amount of Rs. 5000 will be refunded to the student. Otherwise there will not be any change in the result of the student and original marks will be retained and the student will forfeit the fee paid.
- No Challenge valuation for Laboratory Examination

APPENDIX III: Rules for Disciplinary Action for Malpractices / Improper Conduct in Examinations

Malpractices identified by squad or special invigilators or invigilators

Punishments shall be given to the students as per the above guidelines. The case is to be referred to the malpractice committee.

Malpractice committee

1. The Principal, Chairman
2. Dean, Academics, Member
3. Invigilator, Member
4. Subject expert, Member
5. Concerned Head of the Department, Member
6. Controller of Examinations, Member Secretary

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 fill all the norms required for the award of Degree.

	Nature of Malpractices/Improper conduct	**Punishment**
	If the candidate:	
1.(a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
1 (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 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	The candidate who has impersonated shall be

	connection with the examination.	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 practical's 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	In case of student 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

	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.	that semester/year. If the candidate physically assaults the invigilator/officer-in-charge of the Examinations, then the candidate is also debarred and forfeits his/her seat. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9.	If students of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in nay malpractice or improper conduct mentioned in class 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 does 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.	If any malpractice is detected which is not covered in the above clauses 1 to 12 shall be reported to the University for further action to award suitable punishment.	

Activities (Non-Credit) as per AICTE Guidelines

List of Activities

1. Physical and Health

1.1 Physical Activities: (a) Games and Sports, (b) Gardening (c) Tree Plantation (d) Yoga:

1.2 NCC/NSS: Standard procedure

2. Culture

2.1 Learning an art form: music, dance, theatre, painting, and other art forms

2.2 Heritage: Visit to museum, archaeology sites, cultural walks, tours, local traditions

2.3 Intangible Cultural Heritage: Festivals, Food ways, Local Games

3. Literature & Media

3.1 Literature, Cinema and Media: workshop, reading multiple news sources, analyses ads

3.2 Group reading: Group sits and each person reads aloud (if possible, with proper modulation) taking turns. This if done properly for an hour one may complete 30-40 pages in an hour

4. Social Service

4.1 Social Awareness: Artisans-relates to engg., visit to hospitals, orphanages, police station, courts, trauma centres, consumer forums

4.2 Social Service: teach in neighborhood, adopt an underprivileged school, village stay / visit (NSS), cleanliness drive, and skill transfer

5. Self-Development

5.1 Spiritual, Mindfulness & Meditation

5.2 Religion and Inter-faith: Reading of books on religious texts of different faiths by famous authors, organizing lecture on interfaith issues covering philosophies and chronology and contemporary situations world over at a given time

5.3 Human Values

5.4 Behavioural and Interpersonal skills: Motivational lectures, Group Discussions/activities, Case Study, Games/Stimulation Exercises, Role-Playing, Mindfulness training.

5.5 Lectures: Areas could be from science, engineering, social sciences, arts or even politics.

6. Nature

6.1 Nature Club: bird watching, recognizing plants at institute/at home, recognizing local animals, appreciating biodiversity

6.2 Environment Protection (non-credit course)

7. Innovation

7.1 Project based – Sc. Tech., Social, Design & Innovation: (a) Exposure to social problems (which are amenable to technological solutions) (b) Design & Innovation (to address above problems)

First 3-weeks – Induction Program will have Physical activities (*), Learning an art form (*), Literature & Cinema, Social Awareness (*) Lectures, Visits to local areas, Universal Human Values (*)

(*) It is the core part of Induction Program (Besides Familiarization to the College, Department and Branch career opportunities)

After first 3 weeks (1st semester)

Based on student interest – the above may be continued

Universal Human Values Groups – Meet once a week with 1st year students with the same faculty mentor & senior student guide.

Semester 2 to 4

Every student should register for some activity mentioned above in every semester. Spend 3-5 hours per week on the activity.

a. Environment Science (mandatory non-credit course prescribed at 1/2 semester)
b. Life Sciences for Engineers (mandatory non-credit course prescribed at 3/4 semester)

c. Constitution of India (mandatory non-credit course prescribed at 5/6 semester)
d. Essence of Indian Traditional Knowledge (mandatory non-credit course prescribed at 5/6 semester)

For mandatory non-credit courses, these will be graded as Pass or Fail (P/F). Thus, the grades obtained will not affect the grade point average. However, they will appear on the grade sheet.

Semester 5 to 8

Every student should register for some activity mentioned above in every semester. Spend 3-5 hours per week on the activity. For activities, suitable registration system in case of the semesters will be developed.

STUDENT INDUCTION PROGRAMME (Zero Semesters)

Induction programme for newly admitted students is conducted in line with AICTE/UGC Induction programme policy, every year before the commencement of the first semester classes. The objective of the Induction programme is to demystify what is expected of students in Intermediate level and to provide adequate foundation in the core applied science subjects and English limited to moderate level so that students do not face any difficulty when the classes commence.

The syllabus for the course is framed in such a way that equal importance is given to both Engineering discipline and personality development which includes soft skills, sports and cultural Activities. The duration of the induction programme is **THREE** weeks. The students are trained in Foundation courses, basics of programming and English apart from other co-curricular and extra-curricular activities.

The objective of the Induction Programme is to work closely with the newly joined students in order to facilitate the following:

- Make the students feel comfortable in the new environment
- Allow them to explore their academic interests and activities
- Reduce competition and make them work for excellence
- Promote bonding within them
- Build relations between teachers and students
- Give a broader view of life
- Build character

S. No	Course Name	Category	L-T-P-C
1	Physical Activities – Sports, Yoga and Meditation	MC	0-0-6-0
2	Career Counseling	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	BS	2-1-2-0
6	Assessment on basic attitude and mathematical skills	MC	2-0-3-0
7	Remedial Training in Foundations Courses	MC	2-1-2-0
8	Human Values and Professional Ethics	MC	3-0-0-0
9	Communication Skills – Focus on Listening, Speaking, Reading and Writing Skills	BS	2-1-2-0
10	Concepts of Programming	ES	2-0-2-0

DEPARTMENT OF MECHANICAL ENGINEERING

I YEAR COURSE STRUCTURE

I Semester							
S.No.	**Category**	**Code**	**Title**	**L**	**T**	**P**	**Credits**
1	BS&H	23AHS12T	Communicative English	2	0	0	2
2	BS&H	23AHS13T	Engineering Chemistry	3	0	0	3
3	BS&H	23AHS11T	Linear Algebra & Calculus	3	0	0	3
4	ES	23A0111T	Basic Civil & Mechanical Engineering	3	0	0	3
5	ES	23A0511T	Introduction to Programming	3	0	0	3
6	BS&H	23AHS12L	Communicative English Lab	0	0	2	1
7	BS&H	23AHS13L	Engineering Chemistry Lab	0	0	2	1
8	ES	23A0311L	Engineering Workshop	0	0	3	1.5
9	ES	23A0511L	Computer Programming Lab	0	0	3	1.5
10	BS&H	23AHS16L	Health and wellness, Yoga and Sports	-	-	1	0.5
			Total	14	0	11	19.5

Category	**Credits**
Basic Science & Humanities Courses	10.5
Engineering Science Courses	9
Total Credits	19.5

II Semester							
S.No.	**Category**	**Code**	**Title**	**L**	**T**	**P**	**Credits**
1	BS&H	23AHS25T	Engineering Physics	3	0	0	3
2	BS&H	23AHS21T	Differential Equations & Vector Calculus	3	0	0	3
3	ES	23A0221T	Basic Electrical and Electronics Engineering	3	0	0	3
4	ES	23A0322T	Engineering Graphics	1	0	4	3
5	ES	23A0522L	IT Workshop	0	0	2	1
6	PC	23A0323T	Engineering Mechanics	3	0	0	3
7	BS&H	23AHS25L	Engineering Physics Lab	0	0	2	1
8	ES	23A0221L	Electrical and Electronics Engineering Workshop	0	0	3	1.5
9	PC	23A0323L	Engineering Mechanics Lab	0	0	3	1.5
10	BS&H	23AHS27L	NSS/NCC/Scouts & Guides/Community Service	-	-	1	0.5
			Total	13	0	15	20.5

Category	**Credits**
Basic Science & Humanities Courses	7.5
Engineering Science Courses	13
Total Credits	20.5

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET

(An Autonomous Institution)

Department of Mechanical Engineering

II YEAR COURSE STRUCTURE

I Semester							
S.No.	**Category**	**Code**	**Title**	**L**	**T**	**P**	**Credits**
1	BS	23AHS31T	Numerical Methods and Transform Techniques	3	0	0	3
2	HSSM	23AHS35T	Universal Human Values – Understanding Harmony & Ethical human conduct	2	1	0	3
3	ES	23A0331T	Thermodynamics	2	0	0	2
4	PC	23A0332T	Mechanics of Solids	3	0	0	3
5	PC	23A0333T	Material Science and Metallurgy	3	0	0	3
6	PC	23A0334L	Mechanics of Solids and Materials Science Lab	0	0	3	1.5
7	PC	23A0335L	Computer-Aided Machine Drawing	0	0	3	1.5
8	ES	23A0536L	Python programming Lab	0	0	2	1
9	SEC	23A0434L	Basic Embedded Systems and IoT	0	1	2	2
10	MC	23AHS39T	Environmental Science	2	0	0	0
			Total	15	2	10	20

Category	**Credits**
Basic Sciences	3
Humanities and Social Science including Management	3
Engineering Sciences	3
Professional Core	9
Skill Enhancement Courses	2
Total Credits	**20**

II Semester							
S.No.	**Category**	**Code**	**Title**	**L**	**T**	**P**	**Credits**
1	BS	23AHS41T	Complex Variables and Probability and Statistics	3	0	0	3
2	HSSM	23AHS4BT	Industrial Management	2	0	0	2
3	PC	23A0341T	Manufacturing processes	3	0	0	3
4	PC	23A0342T	Fluid Mechanics & Hydraulic Machines	3	0	0	3
5	PC	23A0343T	Theory of Machines	3	0	0	3
6	PC	23A0341L	Manufacturing Processes Lab	0	0	3	1.5
7	PC	23A0342L	Fluid Mechanics & Hydraulic Machines Lab	0	0	3	1.5
8	SEC	23A0545L	Fundamentals of Artificial Intelligence and Machine Learning	0	1	2	2
9	ES	23A994AT	Design Thinking & Innovation	1	0	2	2
			Total	15	1	10	21
Mandatory Community Service Project Internship of 08 weeks duration during summer Vacation							

Category	**Credits**
Basic Sciences	3
Humanities and Social Science including Management	2
Engineering Sciences	2
Professional Core	12
Skill Enhancement course	2
Total Credits	**21**

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES::RAJAMPET

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Department of Mechanical Engineering

R23 Regulations B.Tech. Mechanical Engineering III YEAR Course Structure

III Year I Semester							
S.No.	**Category**	**Code**	**Title**	**L**	**T**	**P**	**Credits**
1	PC	23A0351T	Machining Processes	3	0	0	3
2	PC	23A0352T	Thermal Engineering	3	0	0	3
3	PC	23A0353T	Metrology and Measurements	3	0	0	3
4	PC	23A0554T	Introduction To Quantum Technologies and Applications	3	0	0	3
5	PE	23A035AT 23A035BT 23A035CT 23A035DT 23A035ET	**Professional Elective-I** 1. Tool Design 2. Automobile Engineering 3. Mechanical behaviour of Materials 4. Work study and Ergonomics 5. Nano Technology	3	0	0	3
6	OE		**Open Elective-I**	3	0	0	3
7	PC	23A0352L	Thermal Engineering Lab	0	0	3	1.5
8	PC	23A0354L	Dynamics lab	0	0	3	1.5
9	SEC	23A0355L	Machine Tools & Metrology lab	0	1	2	2
10	ES	23A0356L	Tinkering Lab for Mechanical Engineers	0	0	2	1
11	INTERN	23A0357I	Evaluation of Community Service Internship	-	-	-	2
			Total	18	1	10	26

Category	**Credits**
Professional Core	15
Professional Elective	3
Open Elective	3
Skill Enhancement Courses	2
Engineering Sciences	1
Internship	2
Total Credits	**26**

Open Elective – I

S. No.	**Course Code**	**Course Name**	**Offered by the Dept.**
1	23A015DT	Green Buildings	Civil
2	23A015ET	Construction Technology and Management	
3	23A025ET	Electrical Safety Practices and Standards	EEE
4	23A045DT	Electronic Circuits	ECE
5	23A055ET	Java Programming	CSE & Allied/IT
6	23A055FT	Fundamentals of Artificial Intelligence	
7	23A055GT	Quantum Technologies and Applications	
8	23AHS51T	Mathematics for Machine Learning and AI	Mathematics
9	23AHS52T	Materials Characterization Techniques	Physics
10	23AHS53T	Chemistry of Energy Systems	Chemistry
11	23AHS54T	English for Competitive Examinations	Humanities
12	23AHS56T	Entrepreneurship and New Venture Creation	

Open Elective – I (Offered to the other departments)

III Year I Semester							
S.No.	**Category**	**Code**	**Title**	**L**	**T**	**P**	**Credits**
1	OE	23A035FT	Sustainable Energy Technologies	3	0	0	3

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Department of Mechanical Engineering
R23 Regulations B.Tech. Mechanical Engineering III YEAR Course Structure

III Year II Semester							
S.No.	**Category**	**Code**	**Title**	**L**	**T**	**P**	**Credits**
1	PC	23A0361T	Heat Transfer	3	0	0	3
2	PC	23A0362T	CAD/CAM	3	0	0	3
3	PC	23A0363T	Design of Machine Members	3	0	0	3
4	PE	23A036AT 23A036BT 23A036CT 23A036DT 23A036ET	**Professional Elective-II** 1. Engineering Fracture Mechanics 2. Introduction of Turbo Machinery 3. Control Systems 4. Operations Research 5. Smart Materials	3	0	0	3
5	PE	23A036FT 23A036GT 23A036HT 23A036IT 23A036JT	**Professional Elective-III** 1. Power Plant Engineering 2. Industrial Safety 3. Design of Automobile Transmission Systems 4. Mechanics & Manufacturing of Composite Materials 5. Introduction to hybrid and electric vehicles	3	0	0	3
6	OE		**Open Elective - II**	3	0	0	3
7	PC	23A0361L	Heat Transfer Lab	0	0	3	1.5
8	PC	23A0362L	CAD/CAM Lab	0	0	3	1.5
9	SEC	23A0364L	3D Printing Lab	0	1	2	2
10	MC	23AHS67T	Technical paper writing and IPR	2	0	0	0
11	PC	23A0365W	Workshop	0	0	0	0
			Total	20	1	08	23
Mandatory Community Service Project Internship of 08 weeks duration during summer Vacation							

Category	**Credits**
Professional Core	7.5
Professional Elective	6
Open Elective	3
Engineering Sciences	4.5
Skill Enhancement course	2
Total Credits	**23**

Open Elective – II

S. No.	**Course Code**	**Course Name**	**Offered by the Dept.**
1	23A016GT	Disaster Management	Civil
2	23A016HT	Sustainability In Engineering Practices	
3	23A026IT	Renewable Energy Sources	EEE
4	23A046GT	Digital Electronics	ECE
5	23A056IT	Operating Systems	CSE & Allied/IT
6	23A056JT	Introduction of Machine Learning	
7	23AHS61T	Optimization Techniques for Engineers	Mathematics
8	23AHS66T	Mathematical Foundation of Quantum Technologies	
9	23AHS62T	Physics of Electronic Materials and Devices	Physics
10	23AHS63T	Chemistry of Polymers and Applications	Chemistry
11	23AHS64T	Academic Writing and Public Speaking	Humanities

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R23 Regulations Open Electives Offered by Department of Mechanical Engineering

Open Elective – II (Offered to the other departments)

III Year II Semester							
S.No.	**Category**	**Code**	**Title**	**L**	**T**	**P**	**Credits**
1	OE	23A036KT	Automation and Robotics	3	0	0	3

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
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Title of the Course:	Communicative English	
Category:	BS&H	
Couse Code:	23AHS12T	23AHS22T
Branch/es:	CE, ME, CSE, AIML, CSE (DS)	ECE, EEE, AIDS, CSE (AI)
Semester:	I Semester	II Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
2	-	-	2

Course Objectives: The main objective of introducing this course, communicative English, is to facilitate effective listening, Reading, Speaking and Writing skills among the students. It enhances the same in their comprehending abilities, oral presentations, reporting useful information and providing knowledge of grammatical structures and vocabulary. This course helps the students to make them effective in speaking and writing skills and to make them industry-ready.

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

1. understand the context, topic, and pieces of specific information from social or transactional dialogues spoken by native speakers of English
2. analyse literary forms, journalistic articles and scientific readings for comprehension and retention
3. demonstrate effective writing and speaking skills
4. apply grammatical knowledge in speech and writing and formulate sentences with accuracy
5. produce coherent and unified paragraphs with adequate support and detail

Unit 1 9

Lesson: HUMAN VALUES: The Gift of the Magi (Short Story)
Listening: Identifying the topic, the context and specific pieces of information by listening to short audio texts and answering a series of questions.
Speaking: Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others.
Reading: Skimming to get the main idea of a text; scanning to look for specific pieces of information.
Writing: Mechanics of Writing-Capitalization, Spellings, Punctuation-Parts of Sentences.
Grammar: Parts of Speech, Basic Sentence Structures-forming questions
Vocabulary: Synonyms, Antonyms, Affixes (Prefixes/Suffixes), Root words.

Unit 2 9

Lesson: NATURE: The Brook by Alfred Tennyson (Poem)
Listening: Answering a series of questions about main ideas and supporting ideas after listening to audio texts.
Speaking: Discussion in pairs/small groups on specific topics followed by short structure talks.
Reading: Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together.
Writing: Structure of a paragraph - Paragraph writing (specific topics)
Grammar: Cohesive devices - linkers, use of articles and zero article; prepositions.
Vocabulary: Homonyms, Homophones, Homographs.

Unit 3 9

Lesson: BIOGRAPHY: Elon Musk
Listening: Listening for global comprehension and summarizing what is listened to.
Speaking: Discussing specific topics in pairs or small groups and reporting what is discussed

Reading: Reading a text in detail by making basic inferences -recognizing and interpreting specific context clues; strategies to use text clues for comprehension.
Writing: Summarizing, Note-making, paraphrasing
Grammar: Verbs - tenses; subject-verb agreement; Compound words, Collocations
Vocabulary: Compound words, Collocations

Unit 4 9
Lesson: INSPIRATION: The Toys of Peace by Saki
Listening: Making predictions while listening to conversations/ transactional dialogues without video; listening with video.
Speaking: Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions.
Reading: Studying the use of graphic elements in texts to convey information, reveal trends /patterns /relationships, communicate processes or display complicated data.
Writing: Letter Writing: Official Letters, Resumes
Grammar: Reporting verbs, Direct & Indirect speech, Active & Passive Voice
Vocabulary: Words often confused, Jargon

Unit 5 9
Lesson: MOTIVATION: The Power of Intrapersonal Communication (An Essay)
Listening: Identifying key terms, understanding concepts and answering a series of relevant questions that test comprehension.
Speaking: Formal oral presentations on topics from academic contexts
Reading: Reading comprehension.
Writing: Writing structured essays on specific topics.
Grammar: Editing short texts –identifying and correcting common errors in grammar and usage (articles, prepositions, tenses, subject verb agreement)
Vocabulary: Technical Jargon

Prescribed Textbooks:
1. Pathfinder: Communicative English for Undergraduate Students, 1st Edition, Orient Black Swan, 2023
2. Empowering with Language by Cengage Publications, 2023

Reference Books:

1. Dubey, Sham Ji & Co. English for Engineers, Vikas Publishers, 2020
2. Bailey, Stephen. Academic writing: A Handbook for International Students. Routledge, 2014.
3. Murphy, Raymond. English Grammar in Use, Fourth Edition, Cambridge University Press, 2019.
4. Lewis, Norman. Word Power Made Easy- The Complete Handbook for Building a Superior Vocabulary. Anchor, 2014.

Web Resources:
GRAMMAR:
1. www.bbc.co.uk/learningenglish
2. https://dictionary.cambridge.org/grammar/british-grammar/
3. www.eslpod.com/index.html
4. https://www.learngrammar.net/
5. https://english4today.com/english-grammar-online-with-quizzes/
6. https://www.talkenglish.com/grammar/grammar.aspx

VOCABULARY
1. https://www.youtube.com/c/DailyVideoVocabulary/videos
2. https://www.youtube.com/channel/UC4cmBAit8i_NJZE8qK8sfpA

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
23AHS12T/22T.1	1	-	-	-	-	-	-	1	-	3	-	1
23AHS12T/22T.2	1	-	-	-	-	-	-	1	-	3	-	1
23AHS12T/22T.3	1	-	-	-	-	-	-	1	-	3	-	1
23AHS12T/22T.4	1	-	-	-	-	-	-	1	-	3	-	1
23AHS12T/22T.5	1	-	-	-	-	-	-	1	-	3	-	1

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
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Title of the Course: Engineering Chemistry
Category: BS&H
Couse Code: 23AHS13T
Branch/es: CE & ME
Semester: I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	-	-	3

Course Objectives:
1. To familiarize engineering chemistry and its applications
2. To impart the concept of soft and hard waters, softening methods of hard water
3. To train the students on the principles and applications of electrochemistry, polymers, surface chemistry, and cement

Course Outcomes:
At the end of the course, the student will be able to
1. analyze the hardness of water and its treatment methods
2. demonstrate the working principle of the batteries, corrosion prevention methods and factors affecting corrosion.
3. explain the preparation, properties, and applications of thermoplastics & thermosetting polymers, refining of petroleum and cracking of oils.
4. explain the classification, properties and applications of composites, refractories, lubricants, and setting & hardening of cement.
5. summarize the concepts of colloids, micelle and nanomaterials.

Unit 1 Water Technology 9

Soft and hardwater, Estimation of hardness of water by EDTA Method, Estimation of dissolved Oxygen - Boiler troubles –Priming, foaming, scale and sludge, Caustic embrittlement, Industrial water treatment – Specifications for drinking water, Bureau of Indian Standards (BIS) and World health organization (WHO) standards, Ion-exchange processes - desalination of brackish water, reverse osmosis (RO) and electrodialysis.

Unit 2 Electrochemistry and Applications 11

Electrodes –electrochemical cell, Nernst equation, cell potential calculations.
Primary cells – Zinc-air battery, Secondary cells – Nickel-Cadmium (NiCad) and lithium-ion batteries-working principle of the batteries including cell reactions; Fuel cells-Basic Concepts, the principle and working of hydrogen-oxygen Fuel cell.
Corrosion: Introduction to corrosion, electrochemical theory of corrosion, differential aeration cell corrosion, galvanic corrosion, metal oxide formation by dry electrochemical corrosion, Pilling Bedworth ratios and uses, Factors affecting the corrosion, cathodic and anodic protection, electroplating and electro less plating (Nickel and Copper).

Unit 3 Polymers and Fuel Chemistry 10

Introduction to polymers, functionality of monomers, Mechanism of chain growth, step-growth polymerization.
Thermoplastics and Thermo-setting plastics-: Preparation, properties and applications of poly styrene. PVC Nylon 6,6 and Bakelite.
Elastomers – Preparation, properties and applications of Buna S, Buna N, Thiokol rubbers.
Fuels – Types of fuels, calorific value of fuels, numerical problems based on calorific value; Analysis of coal

(Proximate and Ultimate analysis), Liquid Fuels, refining of petroleum, Octane and Cetane number- alternative fuels- propane, methanol, ethanol and bio fuel-bio diesel.

Unit 4 Modern Engineering Materials 10

Composites- Definition, Constituents, Classification- Particle, Fibre and Structural reinforced composites, properties and Engineering applications

Refractories-Classification, Properties, Factors affecting the refractory materials and Applications.

Lubricants- Classification, Functions of lubricants, Mechanism, Properties of lubricating oils – Viscosity, Viscosity Index, Flash point, Fire point, Cloud point, saponification and Applications.

Building materials- Portland Cement, constituents, Setting and Hardening of cement.

Unit 5 Surface Chemistry and Nanomaterials 10

Introduction to surface chemistry, colloids, nanometals and nanometal oxides, micelle formation, synthesis of colloids (Braggs Method), chemical and biological methods of preparation of nanometals and metal oxides, stabilization of colloids and nanomaterials by stabilizing agents, adsorption isotherm (Freundlich and Longmuir), BET equation (no derivation) applications of colloids and nanomaterials – catalysis, medicine, sensors, etc.

Prescribed Textbooks:

1. Jain and Jain, Engineering Chemistry, 16/e, Dhanpat Rai, 2013.
2. Peter Atkins, Julio de Paula and James Keeler, Atkins' Physical Chemistry, 10/e, Oxford University Press, 2010

Reference Books:

1. H.F.W. Taylor, Cement Chemistry, 2/e, Thomas Telford Publications, 1997.
2. D.J. Shaw, Introduction to Colloids and Surface Chemistry, Butterworth- Heineman, 1992.
3. Textbook of Polymer Science, Fred W. Billmayer Jr, 3rd Edition

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
23AHS13T.1	3	3	2	2	-	-	2	-	-	-	-	1
23AHS13T.2	2	2	1	1	-	-	2	-	-	-	-	1
23AHS13T.3	2	2	1	1	-	-	2	-	-	-	-	1
23AHS13T.4	2	2	1	1	-	-	2	-	-	-	-	1
23AHS13T.5	2	2	1	1	-	-	2	-	-	-	-	1

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
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Title of the Course: Linear Algebra and Calculus
Category: BS&H
Couse Code: 23AHS11T
Branch/es: Common to all branches of engineering
Semester: I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	-	-	3

Course Objectives:

1. To enlighten the learners in the concept of differential equations and multivariable calculus.
2. To furnish the learners with basic concepts and techniques at plus two level to lead them into advanced level by handling various real-world applications.

Course Outcomes:

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

1. solve system of linear equations.
2. use the techniques of matrix algebra for engineering applications.
3. apply properties of mean value theorems in engineering techniques.
4. apply the functions of several variables in optimization techniques.
5. apply multiple integrals to find area of solids.

Unit 1 Matrices 9

Rank of a matrix by echelon form, normal form. Cauchy –Binet formulae (without proof). Inverse of Non-singular matrices by Gauss-Jordan method, System of linear equations: Solving system of Homogeneous and Non-Homogeneous equations by Gauss elimination method, Gauss Seidel Iteration Method.

Unit 2 Linear Transformation and Orthogonal Transformation 8

Eigenvalues, Eigenvectors and their properties, Diagonalization of a matrix, Cayley-Hamilton Theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton Theorem, Quadratic forms and Nature of the Quadratic forms, Reduction of Quadratic form to canonical forms by Orthogonal Transformation.

Unit 3 Calculus 8

Mean Value Theorems: Rolle's Theorem, Lagrange's mean value theorem with their geometrical interpretation, Cauchy's mean value theorem, Taylor's and Maclaurin theorems with remainders (without proof), Problems and applications on the above theorems.

Unit 4 Partial differentiation and Applications (Multi variable calculus) 10

Partial derivatives, total derivatives, chain rule, change of variables, Taylor's and Maclaurin's series expansion of functions of two variables. Jacobians, maxima and minima of functions of two variables, method of Lagrange multipliers.

Unit 5 Multiple Integrals (Multi variable Calculus) 9

Double integrals, triple integrals, change of order of integration, change of variables to polar, cylindrical and spherical coordinates. Finding areas (by double integrals) and volumes (by double integrals and triple integrals).

Prescribed Textbooks:

1. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2018.

Reference Books:

1. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 5th edition, Alpha Science International Ltd., 2021 (9th reprint).
2. George B. Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, 14th edition, Pearson Publishers, 2018.
3. Glyn James, Advanced Modern Engineering Mathematics, 5/e, Pearson Publishers, 2018.
4. Michael Greenberg, Advanced Engineering Mathematics, 9th edition, Pearson
5. H. K. Das, Er. Rajnish Verma, Higher Engineering Mathematics, S. Chand, 2021

Web resources:

1. https://proofwiki.org/wiki/Cauchy-Binet_Formula

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
23AHS11T.1	3	2	1	2	-	-	-	-	-	-	-	1
23AHS11T.2	3	2	1	2	-	-	-	-	-	-	-	1
23AHS11T.3	3	2	1	2	-	-	-	-	-	-	-	1
23AHS11T.4	3	2	1	2	-	-	-	-	-	-	-	1
23AHS11T.5	3	2	1	2	-	-	-	-	-	-	-	1

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
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Title of the Course:	Basic Civil and Mechanical Engineering	
Category:	ES	
Couse Code:	23A0111T	23A0121T
Year:	I B. Tech.	I B. Tech.
Semester:	I Semester	II Semester
Branch/es:	CSE, CE, ME, AIML, CSE (DS)	ECE, EEE, AI & DS, CSE(AI)

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	-	-	3

PART A: BASIC CIVIL ENGINEERING

Course Objectives: Get familiarized with the scope and importance of Civil Engineering sub-divisions.

1. Introduce the preliminary concepts of surveying.
2. Acquire preliminary knowledge on Transportation and its importance in nation'seconomy.
3. Get familiarized with the importance of quality, conveyance and storage of water.
4. Introduction to basic civil engineering materials and construction techniques.

Course Outcomes:

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

1. understand various sub-divisions of Civil Engineering and to appreciate their role inensuring better society.
2. know the concepts of surveying and to understand the measurement of distances, angles and levels through surveying.
3. realize the importance of Transportation in nation's economy and the engineeringmeasures related to Transportation.

Unit 1 Basics of Civil Engineering 8

Role of Civil Engineers in Society- Various Disciplines of Civil Engineering- Surveying-Structural Engineering- Transportation Engineering- Hydraulics and Water Resources Engineering - Environmental Engineering- Geo-technical Engineering -Scope of each discipline.

Building Construction and Planning- Construction Materials-Cement - Aggregate - Bricks- Cement concrete- Steel. Introduction to Prefabricated construction Techniques.

Geo-technical Engineering-Engineering properties of soil like Voids ratio, Porosity, Degree of saturation, Moisture content, Specific gravity, Bulk density, Dry density , Liquid Limit , Plastic Limit, shrinkage Limit (only theory).

Unit 2 8

Surveying: Objectives of Surveying- Horizontal Measurements- Angular Measurements- Introduction to Bearings. Levelling instruments used for levelling -Simple problems on levelling and bearings-Contour mapping.

Estimation: Introduction to Estimation- General items– different Standard Units in Civil components of Buildings -working out quantities for detailed and abstract estimates for Buildings (only theory).

Unit 3 8

Transportation Engineering: Importance of Transportation in Nation's economic development- Types of Highway Pavements- Flexible Pavements and Rigid Pavements - Simple Differences. Basics of Harbour, Tunnel, Airport, and Railway Engineering.

Water Resources and Environmental Engineering: Introduction, Sources of water- Quality of water- Specifications- Introduction to Hydrology–Rainwater Harvesting-Water Storage and Conveyance Structures (Simple introduction to Dams and Reservoirs).

Prescribed Textbooks:

1. Basic Civil Engineering, M.S.Palanisamy, , Tata Mcgraw Hill publications (India) Pvt.Ltd. Fourth Edition.
2. Introduction to Civil Engineering, S.S. Bhavikatti, New Age International Publishers.2022. First Edition.
3. Basic Civil Engineering, Satheesh Gopi, Pearson Publications, 2009, First Edition.
4. Building Construction by B.C.Punmia, Ashok Kumar Jain and Arun Kumar Jain - Laxmi Publications (P) ltd., New Delhi
5. Estimating and Costing, 27threvised edition by B.N. Dutta, UBS publishers, 2000.

Reference Books:

1. Surveying, Vol- I and Vol-II, S.K. Duggal, Tata McGraw Hill Publishers 2019. FifthEdition.
2. Hydrology and Water Resources Engineering, Santosh Kumar Garg, KhannaPublishers, Delhi. 2016
3. Irrigation Engineering and Hydraulic Structures - Santosh Kumar Garg, KhannaPublishers, Delhi 2023. 38th Edition.
4. Highway Engineering, S.K.Khanna, C.E.G. Justo and Veeraraghavan, Nemchand and Brothers Publications 2019. 10th Edition.
5. Indian Standard DRINKING WATER — SPECIFICATION IS 10500-2012.
6. Soil Mechanics and Foundation Engg. By K.R. Arora, Standard Publishers and Distributors, Delhi.

PART B: BASIC MECHANICAL ENGINEERING

Course Objectives: The students after completing the course are expected to

1. Get familiarized with the scope and importance of Mechanical Engineering in different sectors and industries.
2. Explain different engineering materials and different manufacturing processes.
3. Provide an overview of different thermal and mechanical transmission systems and introduce basics of robotics and its applications.

Course Outcomes:

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

4. summarize the importance of mechanical engineer role in different sectors and also in the selection of engineering materials
5. describe different manufacturing process and also the basics of thermal engineering
6. explain the working of different mechanical power transmission systems, power plants and basics of robotics

Unit 4 8

Introduction to Mechanical Engineering: Role of Mechanical Engineering in Industries and Society-Technologies in different sectors such as Energy, Manufacturing, Automotive, Aerospace, and Marine sectors.

Engineering Materials - Metals-Ferrous and Non-ferrous, Ceramics, Composites, Smart materials

Unit 5 8

Manufacturing Processes: Principles of Casting, Forming, joining processes, Machining, Introduction to CNC machines, 3D printing, and Smart manufacturing.

Thermal Engineering – working principle of Boilers, Otto cycle, Diesel cycle, Refrigeration and air-conditioning cycles, IC engines, 2-Stroke and 4-Stroke engines, SI/CI Engines, Components of Electric and Hybrid Vehicles.

Unit 6 8

Power plants – working principle of Steam, Diesel, Hydro, Nuclear power plants.

Mechanical Power Transmission - Belt Drives, Chain, Rope drives, Gear Drives and their applications.

Introduction to Robotics - Joints & links, configurations, and applications of robotics.

(Note: The subject covers only the basic principles of Civil and Mechanical Engineering systems. The evaluation shall be intended to test only the fundamentals of the subject)

Prescribed Textbooks:

1. An introduction to Mechanical Engg by Jonathan Wicker and Kemper Lewis, Cengage learning India Pvt. Ltd
2. Internal Combustion Engines by V.Ganesan, By Tata McGraw Hill publications (India) Pvt. Ltd

Reference Books:

1. Appuu Kuttan KK, Robotics, I.K. International Publishing House Pvt. Ltd. Volume-I
2. 3D printing & Additive Manufacturing Technology- L. Jyothish Kumar, Pulak M Pandey, Springer publications
3. G. Shanmugam and M. S. Palanisamy, Basic Civil and the Mechanical Engineering, Tata McGraw Hill publications (India) Pvt. Ltd
4. Thermal Engineering by Mahesh M Rathore Tata McGraw Hill publications (India) Pvt. Ltd.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
23A0111T/21T.1	2	2	1	1	-	-	-	-	-	-	-	-
23A0111T/21T.2	2	2	1	1	-	-	-	-	-	-	-	-
23A0111T/21T.3	2	2	1	1	-	-	-	-	-	-	-	-
23A0111T/21T.4	3	3	1	1	-	-	-	-	-	-	-	-
23A0111T/21T.5	3	3	1	1	-	-	-	-	-	-	-	-
23A0111T/21T.6	3	3	1	1	-	-	-	-	-	-	-	-

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)

Title of the Course:	Introduction to Programming
Category:	ES
Couse Code:	23A0511T
Branch/es:	Common to All Branches of Engineering
Year:	I Year
Semester:	I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To introduce students to the fundamentals of computer programming.
2. To provide hands-on experience with coding and debugging.
3. To foster logical thinking and problem-solving skills using programming.
4. To familiarize students with programming concepts such as data types, control structures,functions, and arrays.
5. To encourage collaborative learning and teamwork in coding projects.

Course Outcomes:

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

1. summarize the basics of computers, the concept of algorithm and algorithmic thinking**.**
2. analyze a problem and develop an algorithm to solve it**.**
3. implement various algorithms using the C programming language**.**
4. analyze more advanced features of C language**.**
5. develop problem-solving skills and the ability to debug and optimize the code**.**

Unit 1 Introduction to Programming and Problem Solving 9

History of Computers, Basic organization of a computer: ALU, input-output units, memory, program counter, Introduction to Programming Languages, Basics of a Computer Program- Algorithms, flowcharts (Using Dia Tool), pseudo code.

Problem solving techniques: Algorithmic approach, characteristics of algorithm, Problem solving strategies:

Top-down approach, Bottom-up approach, Time and space complexities of algorithms.

Introduction to C: Introduction to Compilation and Execution, Primitive Data Types, Variables,and Constants, Basic Input and Output, Operators, Type Conversion and Casting.

Unit 2 Control Structures 9

Control Structures: Simple sequential programs, Conditional Statements (if, if-else, switch), Loops (for, while, do-While), Break and Continue.

Unit 3 Arrays and Strings 9

Arrays indexing, memory model, programs with array of integers, two dimensional arrays, Introduction to Strings and string handling functions.

Unit 4 Pointers and User Defined Data types 9

Pointers, dereferencing and address operators, pointer and address arithmetic, array manipulation using pointers, dynamic memory allocation functions.

User-defined data types-Structures and Unions.

Unit 5 Functions and File Handling 9

Introduction to Functions, Function Declaration and Definition, Function call Return Types and Arguments,modifying parameters inside functions using pointers, arrays as parameters. Storage classes, Basics of File Handling

Prescribed Textbooks:

1. The C Programming Language, Brian W. Kernighan and Dennis M. Ritchie, Prentice- Hall, 1988
2. Schaum's Outline of Programming with C, Byron S Gottfried, McGraw-Hill Education, 1996

Reference Books:

1. Computing fundamentals and C Programming, Balagurusamy, E., McGraw-Hill Education, 2008.
2. Programming in C, Rema Theraja, Oxford, 2016, 2nd edition.
3. C Programming, A Problem Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE, 3rd edition

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
23A0511T.1	2	2	1	1	2	-	-	-	3	1	1	-
23A0511T.2	3	3	2	2	2	-	-	-	3	-	-	-
23A0511T.3	3	2	1	2	3	-	-	-	3	-	-	3
23A0511T.4	2	3	2	2	2	-	-	-	2	-	-	3
23A0511T.5	3	3	2	3	3	-	-	-	2	-	-	3

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)

Title of the Course:	Communicative English Lab	
Category:	BS&H	
Couse Code:	23AHS12L	23AHS22L
Branch/es:	CE, ME, CSE, AIML, CSE (DS)	ECE, EEE, AIDS, CSE (AI)
Semester:	I Semester	II Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
-	-	2	1

Course Objectives: The main objective of introducing this course, Communicative English Laboratory, is to expose the students to a variety of self-instructional, learner friendly modes of language learning. The students will get trained in the basic communication skills and also make them ready to face job interviews.

Course Outcomes:
At the end of the course, the student will be able to
1. improve their public speaking skills and make oral presentations effectively
2. apply communication skills through various language learning activities.
3. analyze the English speech sounds, stress, rhythm, intonation and syllable division for better listening and speaking comprehension.
4. evaluate and exhibit professionalism in participating in debates and group discussions.
5. create effective resonate and prepare themselves to face interviews in future.

List of Topics
1. Vowels & Consonants
2. Neutralization/Accent Rules
3. Just a Minute
4. Role Play / Situational Dialogues
5. Oral Presentation/ Poster Presentation
6. Information Transfer
7. Describing people/objects/situations

Advanced topics
8. E-mail Writing
9. Resume Writing, Cover letter, SOP
10. Group Discussions - Methods & Practice
11. Debates - Methods & Practice
12. Interviews Skills

Suggested Software:
1. Walden Infotech
2. Sky Pronunciation Suite
3. Clarity Pronunciation Power – Part I
4. Learning to Speak English - 4 CDs
5. Loose Your Accent in 28 days, CD Rom, Judy Ravin

Reference Books:

1. Meenakshi Raman, Sangeeta-Sharma. Technical Communication. Oxford Press.2018.
2. Grant Taylor: English Conversation Practice, Tata McGraw-Hill Education India, 2016
3. Hewing's, Martin. Cambridge Academic English (B2). CUP, 2012.
4. T. Balasubramanyam, A Textbook of English Phonetics for Indian Students, (3rd Ed) Trinity Press.

Web Resources:

Spoken English:

1. www.esl-lab.com
2. www.englishmedialab.com
3. www.englishinteractive.net
4. https://www.britishcouncil.in/english/online
5. http://www.letstalkpodcast.com/
6. https://www.youtube.com/c/mmmEnglish_Emma/featured
7. https://www.youtube.com/c/ArnelsEverydayEnglish/featured
8. https://www.youtube.com/c/engvidAdam/featured
9. https://www.youtube.com/c/EnglishClass101/featured
10. https://www.youtube.com/c/SpeakEnglishWithTiffani/playlists
11. https://www.youtube.com/channel/UCV1h_cBE0Drdx19qkTM0WNw

Voice & Accent:

1. https://www.youtube.com/user/letstalkaccent/videos
2. https://www.youtube.com/c/EngLanguageClub/featured
3. https://www.youtube.com/channel/UC_OskgZBoS4dAnVUgJVexc
4. https://www.youtube.com/channel/UCNfm92h83W2i2ijc5Xwp_IA

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
23AHS12L/22L.1	-	-	-	-	-	-	-	1	2	3	-	3
23AHS12L/22L.2	-	-	-	-	-	-	-	1	2	3	-	3
23AHS12L/22L.3	-	-	-	-	-	-	-	1	2	3	-	3
23AHS12L/22L.4	-	-	-	-	-	-	-	1	2	3	-	3
23AHS12L/22L.5	-	-	-	-	-	-	-	1	2	3	-	3

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)

Title of the Course: Engineering Chemistry Lab
Category: BS&H
Couse Code: 23AHS13L
Branches: CE & ME
Semester: I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	2	1

Course Objectives: To verify the fundamental concepts with experiments

Course Outcomes: At the end of the course, the student will be able to
1. determine the Strength of an acid in secondary battery.
2. synthesize advanced polymer materials.
3. determine the physical properties like surface tension, adsorption, calorific values and viscosity.
4. estimate the Iron and Calcium in cement
5. analyze the hardness and Dissolved oxygen levels of various water samples.

List of experiments
1. Determination of Hardness of a groundwater sample.
2. Estimation of Dissolved Oxygen by Winkler's method.
3. Determination of Strength of an acid in Pb-Acid battery.
4. Preparation of a polymer (Bakelite).
5. Determination of percentage of Iron in Cement sample by colorimetry
6. Estimation of Calcium in port land Cement.
7. Preparation of nanomaterials by precipitation method.
8. Adsorption of acetic acid by charcoal.
9. Determination of percentage Moisture content in a coal sample.
10. Determination of Viscosity of lubricating oil by Redwood Viscometer 1.
11. Determination of Viscosity of lubricating oil by Redwood Viscometer 2.
12. Determination of Calorific value of gases by Junker's gas Calorimeter.

Prescribed Textbooks:
1. Vogel's Quantitative Chemical Analysis, J. Mendham, R. C. Denney, J. D. Barnes and B. Sivasankar Pearson Publications, 6th Edition.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
23AHS13L.1	3	3	-	3	1	-	2	-	1	-	-	3
23AHS13L.2	3	3	-	3	1	-	2	-	1	-	-	3
23AHS13L.3	3	3	-	3	1	-	2	-	1	-	-	3
23AHS13L.4	3	3	-	3	1	-	2	-	1	-	-	3
23AHS13L.5	3	2	-	2	1	-	2	-	1	-	-	3

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)

Title of the Course:	Engineering Workshop	
Category:	ES	
Couse Code:	23A0311L	23A0321L
Year:	I B.Tech.	
Semester:	I Semester	II Semester
Branch/es:	CSE, CE, ME, AIML & CSE-DS	EEE, ECE, AIDS & CSE-AI

Lecture Hours	Tutorial Hours	Practice Hours	Credits
-	-	3	1.5

Course Objectives: This course will enable the student to

1. make familiar with different types of wooden joints.
2. make conversant with tools used in sheet metal work.
3. identify tools, work material and measuring instruments useful for fitting.
4. develop electrical wiring skills in students.
5. have practical exposure in foundry, welding and plumbing.

Course Outcomes:

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

1. apply wood working skills to prepare different joints.
2. development of sheet metal jobs with GI sheet.
3. design and model various proto types with mild steel for different assemblies.
4. apply basic electrical engineering knowledge for house wiring practice.
5. practice on manufacturing of components in foundry, welding and pipe line fitting execution in plumbing.

Cycle:01

Trade 1 Wood Working: 6

Familiarity with different types of woods and tools used in wood working and make following joints.

a) Half – Lap joint b) Mortise and Tenon joint

Trade 2 Sheet Metal Working: 6

Familiarity with different types of tools used in sheet metalworking, Developments of following sheet metal job from GI sheets.

a) Tapered tray b) Conical funnel c) Brazing (Demonstration)

Trade 3 Fitting: 9

Familiarity with different types of tools used in fitting and do the followingfitting exercises.

a) V-fit b) Dovetail fit

c) Two-wheeler tyre puncture and change of tyre (Demonstration)

Cycle:02

Trade 4 Electrical Wiring: 9

Familiarity with different types of basic electrical circuits and makethe following connections.

a) Parallel and series b) Two-way switch

c) Tube light d) Soldering of wires

Trade 5 Foundry Trade: 3

Demonstration and practice on Moulding tools and processes,Preparation of Green Sand Mould for given Pattern.

Trade 6 Welding Shop: 6

Demonstration and practice on Arc Welding and Gas welding.Preparation of Lap joint and Butt joint.

Trade 7 Plumbing: 6

Demonstration and practice of Plumbing tools, Preparation of Pipe jointswith coupling for same diameter and with reducer for different diameters.

Prescribed Textbooks:

1. A Course in Workshop Technology Vol I. & II, B.S. Raghuwanshi, Dhanpath Rai & Co., 2015 & 2017.
2. Kannaiah P. and Narayana K.L., Workshop Manual, 3rd Edn, Scitech publishers.

Reference Books:

1. Elements of Workshop Technology, Vol. I by S. K. Hajra Choudhury & Others, Media Promoters and Publishers, Mumbai. 2007, 14th edition
2. Workshop Practice by H. S. Bawa, Tata-McGraw Hill, 2004.
3. Wiring Estimating, Costing and Contracting; Soni P.M. & Upadhyay P.A.; Atul Prakashan, 2021-22.
4. Jeyapoovan T. and Pranitha S., Engineering Practices Lab Manual, 3rd Edn. Vikas Pub.2008.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
23A0311L/21L.1	3	3	1	-	-	1	-	-	2	2	-	2
23A0311L/21L.2	3	3	1	-	-	1	-	-	2	2	-	2
23A0311L/21L.3	3	3	1	-	-	1	-	-	2	2	-	2
23A0311L/21L.4	3	3	1	-	-	1	-	-	2	2	-	2
23A0311L/21L.5	3	3	1	-	-	1	-	-	2	2	-	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES: RAJAMPET
(An Autonomous Institution)

Title of the Course: Computer Programming Lab
Category: ES
Couse Code: 23A0511L
Branch/es: Common to all branches of engineering
Year: I B. Tech
Semester: I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
-	-	3	1.5

Course Objectives:

1. Getting familiar with how to formally describe a solution to a problem in a series of finite steps and learn how to define variables with the desired data-type, initialize them with appropriate values
2. Explore the full scope of expressions, type-compatibility of variables & constants and operators used in the expression and how operator precedence works.
3. Understand the full scope of different variants of decision-making constructs and iterative constructs.
4. Analyze the full scope of Arrays construct namely 1-D, 2-D and bubble sort.
5. Explore pointers to manage dynamic array of integers, including memory allocation and file handling with various file I/O functions.

Course Outcomes:

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

1. read, understand, and trace the execution of programs written in C language.
2. select the right control structure for solving the problem.
3. compare C programs which utilize memory efficiently using programming constructs like pointers.
4. prepare, Debug and Execute programs to demonstrate the applications of arrays, functions, basic concepts of pointers in C.
5. create, read from and write text into a file using various file operations.

Unit1 Introduction to programming and problem solving

WEEK 1: Suggested Experiments/Activities:

Tutorial 1: Problem-solving using Computers.

Familiarization with programming environment i) Basic Linux environment and its editors like Vi, Vim &Emacs etc. ii) Exposure to Turbo C, gcc iii) Writing simple programs using printf(), scanf()

WEEK 2: Suggested Experiments /Activities:

Tutorial 2: Problem-solving using Algorithms and Flow charts.

Converting algorithms/flow charts into C Source code. Developing the algorithms/flowcharts for the following sample programs i) Sum and average of 3 numbers ii) Conversion of Fahrenheit to Celsius and vice versa iii) Simple interest calculation.

WEEK 3: Suggested Experiments/Activities:

Tutorial 3: Variable types and type conversions:

Simple computational problems using arithmetic expressions. i) Finding the square root of a given number ii) Finding compound interest iii) Area of a triangle using heron's formulae iv) Distance travelled by an object.

Unit 2 Control structures

WEEK 4: Suggested Experiments/Activities

Tutorial4: Operators and the precedence and as associativity:

Simple computational problems using the operator' precedence and associativity
i) Evaluate the following expressions.

a. A+B*C+(D*E) + F*G
b. A/B*C-B+A*D/3
c. A+++B---A
d. J= (i++) + (++i)
ii) Find the maximum of three numbers using conditional operator iii) Take marks of 5 subjects in integers, and find the total, average in float

WEEK 5: Suggested Experiments/Activities:

Tutorial 5: Branching and logical expressions: Problems involving if-then-else structures. i) Write a C program to find the max and min of four numbers using if-else. ii) Write a C program to generate electricity bill. iii) Find the roots of the quadratic equation. iv) Write a C program to simulate a calculator using switch case. v) Write a C program to find the given year is a leap year or not.

WEEK 6: Suggested Experiments/Activities:

Tutorial 6: Loops, while and for loops

Iterative problems e.g., the sum of series i) Find the factorial of given number using any loop. ii) Find the given number is a prime or not. iii) Compute sine and cos series iv) Checking a number palindrome v) Construct a pyramid of numbers.

Unit 3 Arrays and Strings

WEEK 7: Suggested Experiments/Activities:

Tutorial 7: 1 D Arrays: searching.

1D Array manipulation, linear search i) Find the min and max of a 1-D integer array. ii) Perform linear search on1D array. iii) The reverse of a 1D integer array iv) Find 2's complement of the given binary number.
v) Eliminate duplicate elements in an array.

WEEK 8: Suggested Experiments/Activities:

Tutorial 8: 2 D arrays, sorting and Strings

Matrix problems, String operations, Bubble sort i) Addition of two matrices ii) Multiplication two matrices iii) Sort array elements using bubble sort iv) Concatenate two strings without built-in functions v) Reverse a string using built-in and without built-in string functions

Unit 4 Pointers & User defined Data types

WEEK 9: Suggested Experiments/Activities:

Tutorial 9: Pointers, structures and dynamic memory allocation

Pointers and structures, memory dereferences.

i) Write a C program to find the sum of a 1D array using malloc()
ii) Write a C program to find the total, average of n students using structures
iii) Enter n students data using calloc() and display failed students list
iv) Read student name and marks from the command line and display the student details along with the total.
v) Write a C program to implement realloc()

WEEK 10: Suggested Experiments/Activities:

Tutorial 10: Bitfields, Self-Referential Structures, Linked lists

Bitfields, linked lists Read and print a date using dd/mm/yyyy format using bit-fields and differentiate the same without using bit- fields i) Create and display a singly linked list using self-referential structure.
ii) Demonstrate the differences between structures and unions using a C program. iii) Write a C program to shift/rotate using bitfields. iv) Write a C program to copy one structure variable to another structure of the same type.

Unit 5 Functions & File Handling

WEEK 11: Suggested Experiments/Activities:

Tutorial 11: Functions, call by value, scope and extent

Simple functions using call by value, solving differential equations using Eulers theorem. i) Write a C function to calculate NCR value. ii) Write a C function to find the length of a string. iii) Write a C function

to transpose of a matrix. iv) Write a C function to demonstrate numerical integration of differential equations using Euler's method

WEEK 12: Suggested Experiments/Activities:

Tutorial 12: Recursion, the structure of recursive calls

Recursive functions i) Write a recursive function to generate Fibonacci series. ii) Write a recursive function to find the lcm of two numbers. iii) Write a recursive function to find the factorial of a number. iv) Write a C Program to implement Ackermann function using recursion. v) Write a recursive function to find the sum of series.

WEEK 13: Suggested Experiments/Activities:

Tutorial 13: Call by reference, dangling pointers

Simple functions using Call by reference, Dangling pointers. i) Write a C program to swap two numbers using call by reference. ii) Demonstrate Dangling pointer problem using a C program. iii) Write a C program to copy one string into another using pointer. iv) Write a C program to find no of lowercase, uppercase, digits and other characters using pointers.

WEEK14: Suggested Experiments/Activities:

Tutorial 14: File handling

File operations i) Write a C program to write and read text into a file. ii) Write a C program to write and read text into a binary file using fread() and fwrite() iii) Copy the contents of one file to another file. iv) Write a C program to merge two files into the third file using command-line arguments. v) Find no. of lines, words and characters in a file vi) Write a C program to print last n characters of a given file.

Prescribed Textbooks:

1. Programming in C: A practical approach, Ajay Mittal, Pearson.
2. Schaum' s Outline of Programming with C, Byron Gottfried, McGraw Hill

Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, PrenticeHall of India
2. C Programming, A Problem-Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
23A0511L.1	2	2	1	1	2	-	-	-	3	1	1	-
23A0511L.2	3	3	2	2	2	-	-	-	3	-	-	-
23A0511L.3	3	2	1	2	3	-	-	-	3	-	-	3
23A0511L.4	2	3	2	2	2	-	-	-	2	-	-	3
23A0511L.5	3	3	2	3	3	-	-	-	2	-	-	3

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
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Title of the Course:	Health And Wellness, Yoga and Sports	
Category:	BS&H	
Couse Code:	23AHS16L	23AHS26L
Branch/es:	CSE, CE, ME, AIML, CSE-DS	ECE, EEE, AIDS, CSE-AI
Semester:	I Semester	II Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
-	-	1	0.5

Course Objectives:

1. To maintain their mental and physical wellness upright and develop ability in them to cope up with the stress arising in the life.
2. To create space in the curriculum to nurture the potential of the students in sports/games/yoga etc.
3. To introduce a practice oriented introductory course on the subject.

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

1. perform daily routine without undue fatigue
2. be mentally alert and socially cohesive
3. consider success and failure equally
4. develop positive personality
5. improve leadership qualities

Unit 1

Concept of health and fitness, Nutrition and Balanced diet, basic concept of immunity Relationship between diet and fitness, Globalization and its impact on health, Body Mass Index (BMI) of all age groups.
Activities:

i. Organizing health awareness programmes in community
ii. Preparation of health profile
iii. Preparation of chart for balance diet for all age groups

Unit 2

Concept of yoga, need for and importance of yoga, origin and history of yoga in Indian context, classification of yoga, Physiological effects of Asanas- Pranayama and meditation, stress management and yoga, Mental health and yoga practice.
Activities: Yoga practices – Asana, Kriya, Mudra, Bandha, Dhyana, Surya Namaskar

Unit 3

Concept of Sports and fitness, importance, fitness components, history of sports, Ancient and Modern Olympics, Asian games and Commonwealth games.
Activities:

i. Participation in one major game and one individual sport viz., Athletics, Volleyball, Basketball, Handball, Football, Badminton, Kabaddi, Kho-kho, Table tennis, Cricket etc.
ii. Practicing general and specific warm up, aerobics
iii. Practicing cardiorespiratory fitness, treadmill, run test, 9 min walk, skipping and running.

General Guidelines:

1. Institutes must assign slots in the Timetable for the activities of Health/Sports/Yoga.
2. Institutes must provide field/facility and offer the minimum of five choices of as many as Games/Sports.
3. Institutes are required to provide sports instructor / yoga teacher to mentor the students.

Evaluation Guidelines:

- Evaluated for a total of 100 marks.
- A student can select 6 activities of his/her choice with a minimum of 01 activity per unit. Each activity shall be evaluated by the concerned teacher for 15 marks, totaling to 90 marks.
- A student shall be evaluated by the concerned teacher for 10 marks by conducting viva voce on the subject.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
23AHS16L/26L.1	-	-	-	-	-	-	-	3	3	3	-	3
23AHS16L/26L.2	-	-	-	-	-	-	-	3	3	3	-	3
23AHS16L/26L.3	-	-	-	-	-	-	-	3	3	3	-	3
23AHS16L/26L.4	-	-	-	-	-	-	-	3	3	3	-	3
23AHS16L/26L.5	-	-	-	-	-	-	-	3	3	3	-	3

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)

Title of the Course:	Engineering Physics	
Category:	BS&H	
Couse Code:	23AHS15T	23AHS25T
Branch/es:	EEE, ECE, AIDS, CSE (AI)	CE, ME, CSE, AIML, CSE (DS)
Semester:	I Semester	II Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	-	-	3

Course Objectives: To bridge the gap between the Physics in school at 10+2 level and UG level engineering courses by identifying the importance of the optical phenomenon like interference, diffraction etc, enlightening the periodic arrangement of atoms in crystalline solids and concepts of quantum mechanics, introduce novel concepts of dielectric and magnetic materials, physics of semiconductors.

Course Outcomes:
At the end of the course, the student will be able to
1. apply interference, diffraction and polarization of light in engineering.
2. explain the basics of crystals structures and x-ray diffraction.
3. describe various types of polarization of dielectrics and magnetic materials.
4. explain the basic concepts of Quantum Mechanics and the electron theory of solids.
5. describe the properties and behavior of semiconductors

Unit 1 Wave Optics 10

Interference: Introduction - Principle of superposition –Interference of light - Interference in thin films (Reflection Geometry) & applications - Colours in thin films- Newton's Rings, Determination of wavelength and refractive index.
Diffraction: Introduction - Fresnel and Fraunhofer diffractions - Fraunhofer diffraction due to single slit, double slit & N-slits (Qualitative) – Diffraction Grating - Dispersive power and resolving power of Grating (Qualitative). Polarization: Introduction -Types of polarization - Polarization by reflection, refraction and Double refraction - Nicol's Prism -Half wave and Quarter wave plates.

Unit 2 Crystallography and X-ray diffraction 10

Crystallography: Space lattice, Basis, Unit Cell and lattice parameters – Bravais Lattices – crystal systems (3D) – coordination number - packing fraction of SC, BCC & FCC - Miller indices – separation between successive (hkl) planes.
X-ray diffraction: Bragg's law - X-ray Diffractometer – crystal structure determination by Laue's and powder methods

Unit 3 Dielectric and Magnetic Materials 10

Dielectric Materials: Introduction - Dielectric polarization - Dielectric polarizability, Susceptibility, Dielectric constant and Displacement Vector – Relation between the electric vectors - Types of polarizations- Electronic (Quantitative), Ionic (Quantitative) and Orientation polarizations (Qualitative) - Lorentz internal field - Clausius- Mossotti equation - complex dielectric constant – Frequency dependence of polarization – dielectric loss
Magnetic Materials: Introduction - Magnetic dipole moment - Magnetization-Magnetic susceptibility and permeability – Atomic origin of magnetism - Classification of magnetic materials: Dia, para, Ferro, anti-ferro & Ferri magnetic materials - Domain concept for Ferromagnetism & Domain walls (Qualitative) - Hysteresis - soft and hard magnetic materials.

Unit 4 Quantum Mechanics and Free electron Theory 10

Quantum Mechanics: Dual nature of matter – Heisenberg's Uncertainty Principle – Significance and properties of wave function – Schrodinger's time independent and dependent wave equations– Particle in a one-dimensional infinite potential well.

Free Electron Theory: Classical free electron theory (Qualitative with discussion of merits and demerits) – Quantum free electron theory – electrical conductivity based on quantum free electron theory - Fermi-Dirac distribution - Density of states - Fermi energy

Unit 5 Semiconductors 8

Semiconductors: Formation of energy bands – classification of crystalline solids

Intrinsic semiconductors: Density of charge carriers – Electrical conductivity – Fermi level

Extrinsic semiconductors: density of charge carriers – dependence of Fermi energy on carrier concentration and temperature - Drift and diffusion currents – Einstein's equation – Hall effect and its applications.

Prescribed Textbooks:

1. A Text book of Engineering Physics, M. N. Avadhanulu, P. G. Kshirsagar & TVS Arun Murthy, S. Chand Publications, 11th Edition 2019.
2. Engineering Physics - D. K. Bhattacharya and Poonam Tandon, Oxford press (2015)

Reference Books:

1. Engineering Physics - B.K. Pandey and S. Chaturvedi, Cengage Learning 2021.
2. Engineering Physics - Shatendra Sharma, Jyotsna Sharma, Pearson Education, 2018.
3. Engineering Physics" - Sanjay D. Jain, D. Sahasrabudhe and Girish, University Press. 2010
4. Engineering Physics - M.R. Srinivasan, New Age international publishers (2009).

Web Resources: https://www.loc.gov/rr/scitech/selected-internet/physics.html

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
23AHS15T/25T.1	3	2	1	2	-	-	-	-	-	-	-	1
23AHS15T/25T.2	2	2	1	1	-	-	-	-	-	-	-	1
23AHS15T/25T.3	2	2	1	1	-	-	-	-	-	-	-	1
23AHS15T/25T.4	2	2	1	1	-	-	-	-	-	-	-	1
23AHS15T/25T.5	2	2	1	1	-	-	-	-	-	-	-	1

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)

Title of the Course: Differential Equations and Vector Calculus
Category: BS&H
Couse Code: 23AHS21T
Branch/es: Common to all branches of engineering
Semester: II Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	-	-	3

Course Objectives:
1. To enlighten the learners in the concept of differential equations and multivariable calculus.
2. To furnish the learners with basic concepts and techniques at plus two level to lead them into advanced level by handling various real-world applications.

Course Outcomes:
At the end of the course, the student will be able to
1. solve the differential equations related to various engineering fields
2. apply the knowledge of the higher order differential equations in electrical circuit problems
3. solve the standard partial differential equations.
4. illustrate the physical meaning of different operators such as gradient, curl and divergence.
5. estimate the work done against a field, circulation and flux using vector calculus.

Unit 1 Differential equations of first order and first degree 10
Linear differential equations – Bernoulli's equations- Exact equations and equations reducible to exact form. Applications: Newton's Law of cooling – Law of natural growth and decay -Electrical circuits.

Unit 2 Linear differential equations of higher order (Constant Coefficients) 8
Definitions, homogeneous and non-homogeneous, complimentary function, general solution, particular integral, Wronskian, Method of variation of parameters. Simultaneous linear equations, Applications to L-C-R Circuit problems and Simple Harmonic motion.

Unit 3 Partial Differential Equations 8
Introduction and formation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions, solutions of first order linear equations using Lagrange's method. Homogeneous Linear Partial differential equations with constant coefficients.

Unit 4 Vector differentiation 8
Scalar and vector point functions, vector operator Del, Del applies to scalar point functions-Gradient, Directional derivative, del applied to vector point functions-Divergence and Curl, vector identities

Unit 5 Vector integration 10
Line integral-circulation-work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof) and related problems

Prescribed Textbooks:
1. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 2017, 44th Edition
2. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons, 2018, 10th Edition.

Reference Books:

1. Thomas Calculus, George B. Thomas, Maurice D. Weir and Joel Hass, Pearson Publishers, 2018, 14th Edition
2. Advanced Engineering Mathematics, Dennis G. Zill and Warren S. Wright, Jones and Bartlett, 2018
3. Advanced Modern Engineering Mathematics, Glyn James, Pearson publishers, 2018, 5th Edition.
4. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha Science International Ltd., 2021 5th Edition (9th reprint).
5. Higher Engineering Mathematics, B. V. Ramana, , McGraw Hill Education, 2017

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
23AHS21T.1	3	2	1	2	-	-	-	-	-	-	-	1
23AHS21T.2	3	2	1	2	-	-	-	-	-	-	-	1
23AHS21T.3	3	2	1	2	-	-	-	-	-	-		1
23AHS21T.4	3	2	1	2	-	-	-	-	-	-	-	1
23AHS21T.5	3	3	2	3	-	-	-	-	-	-	-	1

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)

Title of the Course:	Basic Electrical and Electronics Engineering	
Category:	ES	
Couse Code:	23A0211T	23A0221T
Year:	I B.Tech.	I B.Tech.
Semester:	I Semester	II Semester
Branch/es:	ECE, EEE, AIDS, CSE-AI	CSE, CE, ME, AIML, CSE-DS

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	-	-	3

PART-A: BASIC ELECTRICAL ENGINEERING

Course Objectives: To expose to the field of electrical & electronics engineering, laws and principles of electrical/ electronic engineering and to acquire fundamental knowledge in the relevant field.

Course Outcomes:
At the end of the course, the student will be able to
1. analyze DC & AC circuits
2. understand the concept of machines and know the various measuring instruments
3. know the different energy resources, electricity billing concept and importance of safety measures

Unit 1 DC & AC Circuits 8

DC Circuits: Electrical circuit elements (R, L and C), Ohm's Law and its limitations, KCL & KVL, series, parallel, series-parallel circuits, Super Position theorem, Simple numerical problems.

AC Circuits: A.C. Fundamentals: Equation of AC Voltage and current, waveform, time period, frequency, amplitude, phase, phase difference, average value, RMS value, form factor, peak factor, Voltage and current relationship with phasor diagrams in R, L, and C circuits, Concept of Impedance, Active power, reactive power and apparent power, Concept of power factor (Simple Numerical problems).

Unit 2 Machines and Measuring Instruments 8

Machines: Construction, principle and operation of (i) DC Motor, (ii) DC Generator, (iii) Single Phase Transformer, (iv) Three Phase Induction Motor and (v) Alternator, Applications of electrical machines.

Measuring Instruments: Construction and working principle of Permanent Magnet Moving Coil (PMMC), Moving Iron (MI) Instruments and Wheat Stone bridge.

Unit 3 Energy Resources, Electricity Bill & Safety Measures 8

Energy Resources: Conventional and non-conventional energy resources; Layout and operation of various Power Generation systems: Hydel, Nuclear, Solar & Wind power generation.

Electricity bill: Power rating of household appliances including air conditioners, PCs, Laptops, Printers, etc. Definition of "unit" used for consumption of electrical energy, two-part electricity tariff, calculation of electricity bill for domestic consumers.

Equipment Safety Measures: Working principle of Fuse and Miniature circuit breaker (MCB), merits and demerits. Personal safety measures: Electric Shock, Earthing and its types, Safety Precautions to avoid shock.

Prescribed Textbooks:

1. Basic Electrical Engineering, D. C. Kulshreshtha, Tata McGraw Hill, 2019, First Edition
2. Power System Engineering, P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co, 2013.
3. Fundamentals of Electrical Engineering, Rajendra Prasad, PHI publishers, 2014, Third Edition

Reference Books:

1. Basic Electrical Engineering, D. P. Kothari and I. J. Nagrath, Mc Graw Hill, 2019, Fourth Edition
2. Principles of Power Systems, V.K. Mehtha, S.Chand Technical Publishers, 2020
3. Basic Electrical Engineering, T. K. Nagsarkar and M. S. Sukhija, Oxford University Press, 2017
4. Basic Electrical and Electronics Engineering, S. K. Bhatacharya, Person Publications, 2018, Second Edition

Web Resources:

1. https://nptel.ac.in/courses/108105053
2. https://nptel.ac.in/courses/108108076

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
23A0211T/21T.1	3	3	3	3	2	-	-	-	-	-	2	2
23A0211T/21T.2	3	3	3	3	3	-	-	-	-	-	2	3
23A0211T/21T.3	3	3	3	3	3	3	3	3	3	3	3	3

PART B: BASIC ELECTRONICS ENGINEERING

Course Objectives: This course provides the student with the fundamental skills to understand the principles of digital electronics, basics of semiconductor devices like diodes & transistors, characteristics and its applications

Course Outcomes:

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

4. apply the concept of science and mathematics to comprehend the working of diodes, transistors, and their characteristics.
5. explain the applications of diodes and transistors
6. familiarize with the number systems, codes, Boolean algebra and logic gates and comprehend the basic principles of combinational, sequential circuits role in digital systems

Unit 1 Semiconductor Devices 8

Introduction - Evolution of electronics – Vacuum tubes to Nano electronics - Characteristics of PN Junction Diode — Zener Effect — Zener Diode and its Characteristics. Bipolar Junction Transistor — CB, CE, CC Configurations and Characteristics — Elementary Treatment of Small Signal CE Amplifier.

Unit 2 Basic Electronic Circuits and Instrumentation 8

Rectifiers and power supplies: Block diagram description of a dc power supply, working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple Zener voltage regulator. Amplifiers: Block diagram of Public Address system, Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response. Electronic Instrumentation: Block diagram of an electronic instrumentation system.

Unit 3 Digital Electronics 8

Overview of Number Systems, Logic gates including Universal Gates, BCD codes, Excess-3 code, Gray code, Hamming code. Boolean Algebra, Basic Theorems and properties of Boolean Algebra, Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR. Simple combinational circuits–Half and Full Adder, Introduction to sequential circuits, Flip flops, Registers and counters (Elementary Treatment only)

Prescribed Textbooks:

1. R. L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, Pearson Education, 2021
2. R. P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill, 2009

Reference Books:

1. R. S. Sedha, A Textbook of Electronic Devices and Circuits, S. Chand & Co, 2010.
2. Santiram Kal, Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall, India, 2002.
3. R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version, Pearson Education, 2009.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
20A0211T/21T.4	3	3	1	1	3	-	1	-	-	1	-	2
20A0211T/21T.5	3	3	1	1	3	-	-	-	-	1	-	1
20A0211T/21T.6	2	2	1	1	2	-	2	1	1	-	-	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)

Title of the Course:	Engineering Graphics	
Category:	ES	
Couse Code:	23A0312T	23A0322T
Year:	I B.Tech.	
Semester:	I Semester	II Semester
Branch/es:	EEE, ECE, AIDS & CSE-AI	CSE, CE, ME, AIML & CSE-DS

Lecture Hours	Tutorial Hours	Practice Hours	Credits
1	-	4	3

Course Objectives:

1. To enable the students with various concepts like dimensioning, conventions and standards related to Engineering Drawing.
2. To impart knowledge on the projection of points, lines and plane surfaces.
3. To improve the visualization skills for better understanding of projection of solids.
4. To develop the imaginative skills of the students required to understand Section of solids and Developments of surfaces.
5. To make the students understand the viewing perception of a solid object in Isometric and Perspective projections.

Course Outcomes:

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

1. apply the appropriate annotations and geometric techniques to draw the conic sections, Cycloidal Curves and Involutes
2. apply the principles of orthographic projection for engineering problems involving inclined lines to create drawings that represent real-world objects
3. apply the principles of orthographic projection for solving engineering problems of planes and solids
4. apply knowledge to draw sectional views, true shapes and sectional views of right regular solids and can draw surface developments related to various parts of right regular solids.
5. apply the conversion techniques to solve problems related to orthographic projections and isometric projection views

Unit 1 5

Introduction: Lines, Lettering and Dimensioning, Geometrical Constructions and Constructing regular polygons by general methods.

Engineering Curves:

Conics: construction of ellipse, parabola and hyperbola by general method, Normal and tangent to curves

Cycloidal curves: Cycloids, Epi Cycloid and Hypo Cycloid, Normal and tangent to curves.

Involutes: Square, Pentagon, Hexagon **-** Normal and tangent to Curves (treatment of simple problems)

Scales: Plain scales, diagonal scales and vernier scales.

Unit 2 3

Orthographic Projections: Reference plane, importance of reference lines or Plane, Projections of a point situated in any one of the four quadrants.

Projections of Straight Lines: Projections of straight lines parallel to both reference planes, perpendicular to one reference plane and parallel to other reference plane, inclined to one reference plane and parallel to the other reference plane. Projections of Straight Line Inclined to both the reference planes

Unit 3 5

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

Projections of Solids: Types of solids: Polyhedra and Solids of revolution. Projections of solids (Prism, Pyramid, Cylinder and Cone) 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

Unit 4 5

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

Unit 5 5

Conversion of Views:

Isometric Projections and its principles: Conversion of orthographic views to isometric views.
Conversion of isometric views to orthographic views.

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

Prescribed Textbooks:

1. N. D. Bhatt, Engineering Drawing, Charotar Publishing House

Reference Books:

1. Engineering Drawing, K.L. Narayana and P. Kannaiah, Tata McGraw Hill
2. Engineering Drawing, M.B.Shah and B.C. Rana, Pearson Education Inc
3. Engineering Drawing with an Introduction to AutoCAD, Dhananjay Jolhe, Tata McGraw Hill

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
23A0312T/22T.1	3	2	1	2	-	-	-	1	-	1	-	1
23A0312T/22T.2	3	2	1	2	-	-	-	1	-	1	-	1
23A0312T/22T.3	3	2	1	2	-	-	-	1	-	1	-	1
23A0312T/22T.4	3	2	1	2	-	-	-	1	-	1	-	1
23A0312T/22T.5	3	2	1	2	2	-	-	1	-	1	-	1

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)

Title of the Course: IT Workshop
Category: ES
Couse Code: 23A0522L
Branch/es: Common to all branches of engineering
Year: I B. Tech
Semester: II Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	2	1

Course Objectives:

1. To make the students know about the internal parts of a computer, assembling and dissembling a computer from the parts, preparing a computer for use by installing the operating system
2. To learn about Networking of computers and use Internet facility for browsing and searching
3. To provide technical training to the students on Productivity tools like Word processors, Spreadsheets, Presentations and LateX
4. To gain knowledge on how to eliminate the problem of traditional chatbot methods using ChatGPT

Course Outcomes:

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

1. identify various hardware components of a system and apply their knowledge about computer peripherals to identify or rectify problems onboard.
2. integrate the PCs into local area network and re-install operating system and various application programs.
3. understand the process of inserting graphics, pictures and table of contents, drop cap using Latex and word.
4. demonstrate the basic mechanics and navigation of an Excel Spreadsheet.
5. analyze formatting techniques and presentation styles and understanding of data creation, writing skills using ChatGPT.

List of Experiments

PC Hardware & Software Installation

Task 1: Identify the peripherals of a computer, components in a CPU and its functions. Draw the block diagram of the CPU along with the configuration of each peripheral and submit to your instructor.

Task 2: Every student should disassemble and assemble the PC back to working condition. Lab instructors should verify the work and follow it up with a Viva. Also students need to go throughthe video which shows the process of assembling a PC. A video would be given as part of the course content.

Task 3: Every student should individually install MS windows on the personal computer. Lab instructor should verify the installation and follow it up with a Viva.

Task 4: Every student should install Linux on the computer. This computer should have windows installed. The system should be configured as dual boot (VMWare) with both Windows and Linux. Lab instructors should verify the installation and follow it up with a Viva.

Task 5: Every student should install BOSS on the computer. The system should be configuredas dual boot (VMWare) with both Windows and BOSS. Lab instructors should verify the installation and follow it up with a Viva

Internet & World Wide Web

Task 1: Orientation & Connectivity Boot Camp: Students should get connected to their Local Area Network and access the Internet. In the process they configure the TCP/IP setting. Finallystudents should demonstrate, to the instructor, how to access the websites and email. If there is internet connectivity

preparations need to be made by the instructors to simulate the WWWon the LAN.
Task 2: Web Browsers, Surfing the Web: Students customize their web browsers with the LAN proxy settings, bookmarks, search toolbars and pop up blockers. Also, plug-ins like Macromedia Flash and JRE for applets should be configured.

Task 3: Search Engines & Netiquette: Students should know what search engines are and howto use the search engines. A few topics would be given to the students for which they need to search on Google. This should be demonstrated to the instructors by the student.
Task 4: Cyber Hygiene: Students would be exposed to the various threats on the internet and would be asked to configure their computer to be safe on the internet. They need to customize their browsers to block pop ups, block active x downloads to avoid viruses and/or worms.

LaTeX and WORD
Task 1: Word Orientation: The mentor needs to give an overview of La TeX and Microsoft (MS) office or equivalent (FOSS) tool word: Importance of La TeX and MS office or equivalent (FOSS) tool Word as word Processors, Details of the four tasks and features that would be covered in each, Using La TeX and word – Accessing, overview of toolbars, saving files, Usinghelp and resources, rulers, format painter in word.
Task 2: Using La TeX and Word to create a project certificate. Features to be covered: Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing, Borders and Colors, Inserting Header and Footer, Using Date and Time option in both La TeXand Word.
Task 3: Creating project abstract Features to be covered: Formatting Styles, Inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes.
Task 4: Creating a Newsletter: Features to be covered: Table of Content, Newspaper columns,Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes, Paragraphs and Mail Merge in word.

EXCEL
Excel Orientation: The mentor needs to tell the importance of MS office or equivalent (FOSS)tool Excel as a Spreadsheet tool, give the details of the four tasks and features that would be covered in each. Using Excel – Accessing, overview of toolbars, saving excel files, Using helpand resources.
Task 1: Creating a Scheduler - Features to be covered: Gridlines, Format Cells, Summation, auto fill, Formatting Text
Task 2: Calculating GPA -. Features to be covered: Cell Referencing, Formulae in excel – average, std. deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function.
LOOKUP/VLOOKUP
Task 3: Split cells, freeze panes, group and outline, Sorting, Boolean and logical operators, Conditional formatting.

POWER POINT
Task 1: Students will be working on basic power point utilities and tools which help them create basic power point presentations. PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows in PowerPoint.
Task 2: Interactive presentations - Hyperlinks, Inserting –Images, Clip Art, Audio, Video, Objects, Tables and Charts.
Task 3: Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide slotter, notes etc), and Inserting – Background, textures, Design Templates, Hidden slides.

AI TOOLS – ChatGPT
Task 1: Prompt Engineering: Experiment with different types of prompts to see how the modelresponds. Try asking questions, starting conversations, or even providing incomplete sentencesto see how the model completes them.
Ex: Prompt: "You are a knowledgeable AI. Please answer the following question: What is the capital of France?"

Task 2: Creative Writing: Use the model as a writing assistant. Provide the beginning of a story or a description of a scene and let the model generate the rest of the content. This can be a funway to brainstorm creative ideas.
Ex: Prompt: "In a world where gravity suddenly stopped working, people started floating upwards. Write a story about how society adapted to this new reality."
Task 3: Language Translation: Experiment with translation tasks by providing a sentence in one language and asking the model to translate it into another language. Compare the output tosee how accurate and fluent the translations are.
Ex: Prompt: "Translate the following English sentence to French: 'Hello, how are you doing today?'"

Reference Books:

1. Comdex Information Technology course tool kit, Vikas Gupta, WILEY Dream tech, 2003
2. The Complete Computer upgrade and repair book, Cheryl A Schmidt, WILEY Dream tech, 2013, 3rd edition
3. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education, 2012, 2nd edition
4. PC Hardware - A Handbook, Kate J. Chase, PHI (Microsoft)
5. LaTeX Companion, Leslie Lamport, PHI/Pearson.
6. IT Essentials PC Hardware and Software Companion Guide, David Anfins on and Ken Quamme. – CISCO Press, Pearson Education, 3rd edition
7. IT Essentials PC Hardware and Software Labs and Study Guide, Patrick Regan– CISCO Press, Pearson Education, 3rd edition

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
22A0522L.1	3	3	-	-	-	-	-	-	-	-	-	-
23A0522L.2	3	-	3	-	-	2	-	-	3	3	-	-
23A0522L.3	3	-	2	-	-	3	-	-	3	3	-	-
23A0522L.4	3	3	-	3	2	-	-	-	-	-	-	-
23A0522L.5	3	3	-	2	2	3	-	-	-	-	-	-

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)

Title of the Course: Engineering Mechanics
Category: PC
Couse Code: 23A0323T
Year: I B.Tech.
Semester: II Semester
Branch/es: CE & ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	-	-	3

Course Objectives:
1. To explain the effect of force and moment in the different engineering applications.
2. To familiarize frictional forces in mechanical applications.
3. To teach centre of gravity and moment of inertia of solids and surfaces.
4. To apply the Work-Energy method to particle motion.
5. To understand the analysis of rigid bodies under dynamic conditions.

Course Outcomes:
At the end of the course, the student will be able to:
1. calculate the resultant forces and couple in mechanical systems.
2. analyze the frictional forces under equilibrium conditions and forces in members of a truss.
3. evaluate the centroid, centre of gravity and moment of inertia for various geometric shapes.
4. evaluate the different types of motions of a body without considering forces.
5. calculate the displacement, velocity and acceleration in dynamic systems.

Unit 1 Introduction to Engineering Mechanics 9

Introduction to Engineering Mechanics: Composition and resolution of forces, parallelogram law, principle of transmissibility, types of force systems - concurrent and concurrent coplanar forces, resultant of coplanar force systems, couple, moment of a force, Varignon's theorem. Concept of free body diagrams, concept of equilibrium of coplanar force and non-coplanar force systems (Use Graphical Method also). Equations of Equilibrium for Spatial System of forces, Numerical examples on spatial system of forces using vector approach.

Unit 2 Analysis of Structures and Friction 9

Introduction to plane trusses, analysis of plane trusses by method of joints and method of sections.
Friction: Introduction, limiting friction and impending motion, Coulomb's laws of dry friction, coefficient of friction, Cone of Static friction.

Unit 3 Centroid and Moments of Inertia 9

Properties of Surfaces and Volumes: Centroid and center of gravity, derivation of centroids from first moment of area, centroids of composite sections, center of gravity of common volumes - cylinder, cone, sphere, theorem of Pappus-guldinus.
Moment of Inertia: Area moment of inertia of plane and composite shapes, parallel axis theorem, perpendicular axis theorem, polar moment of inertia, mass moment of inertia of common volumes -thin plates, thin rod, cylinder, cone, sphere, rectangular prism, radius of gyration.

Unit 4 Kinematics 9

Equations of motion for rigid bodies, constant and variable acceleration, rectilinear and curvilinear motion, motion under gravity -projectile motion, rotation of a rigid body about a fixed axis, introduction to plane motion.

Unit 5 Kinetics 9

Kinetics: Principles of dynamics - Newton's Laws of motion, D'Alembert's principle in rectilinear translation, principle of Work-Energy method and Impulse Momentum method. Principle of virtual work with simple examples.

Prescribed Textbooks:

1. Engineering Mechanics, Statics and Dynamics, Rogers and M A. Nelson., McGraw Hill Education. 2017. First Edition.
2. A Textbook of Engineering Mechanics, S.S Bhavikatti. New age international Publications 2018. 4th Edition.

Reference Books:

1. J. L. Meriam , L. G. Kraige , J. N. Bolton, Engineering Mechanics-statics, Engineering Mechanics-Dynamics, Wiley India Private Limited, Fifth edition (June 2006)
2. RK Bansal, Engineering Mechanics, Laxmi Publications, Sixth edition (2015) Reference Books:
3. K L Kumar, Veenu Kumar, Engineering Mechanics, 4/e, Tata McGraw Hill, 2010.
4. Basudeb Bhattacharya., Engineering Mechanics, 2/e, Oxford University Press (India), 2015.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
23A0323T.1	3	3	2	3	2	-	-	1	-	1	-	2
23A0323T.2	3	3	3	3	-	-	-	-	-	1	-	2
23A0323T.3	3	3	3	3	2	-	-	1	-	-	-	2
23A0323T.4	3	3	3	3	2	-	-	1	-	1	-	2
23A0323T.5	3	3	2	3	2	-	-	-	-	1	-	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)

Title of the Course:	Engineering Physics Lab	
Category:	BS&H	
Couse Code:	23AHS15L	23AHS25L
Branch/es:	EEE, ECE, AIDS, CSE (AI)	CE, ME, CSE, AIML, CSE (DS)
Semester:	I Semester	II Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
-	-	2	1

Course Objectives: To study the concepts of optical phenomenon like interference, diffraction etc., recognize the importance of energy gap in the study of conductivity and Hall effect in semiconductors and study the parameters and applications of dielectric and magnetic materials by conducting experiments.

Course Outcomes: At the end of the course, the student will be able to
1. estimate various optical parameters from optical instruments.
2. evaluate various magnetic and dielectric parameters.
3. estimate the properties of semiconductors.
4. estimate the physical quantities of various materials.

List of Experiments:
1. Determination of radius of curvature of a given Plano-convex lens by Newton's rings.
2. Determination of wavelengths of different spectral lines in mercury spectrum using diffraction grating in normal incidence configuration.
3. Verification of Brewster's law
4. Determination of dielectric constant using charging and discharging method.
5. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
6. Determination of wavelength of Laser light using diffraction grating.
7. Estimation of Planck's constant using photoelectric effect.
8. Determination of the resistivity of semiconductors by four probe methods.
9. Determination of energy gap of a semiconductor using p-n junction diode.
10. Magnetic field along the axis of a current carrying circular coil by Stewart Gee's Method.
11. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall effect.
12. Determination of temperature coefficients of a thermistor.
13. Determination of acceleration due to gravity and radius of Gyration by using a compound pendulum.
14. Determination of magnetic susceptibility by Kundt's tube method.
15. Determination of rigidity modulus of the material of the given wire using Torsional pendulum.
16. Sonometer: Verification of laws of stretched string.
17. Determination of young's modulus for the given material of wooden scale by non-uniform bending (or double cantilever) method.
18. Determination of Frequency of electrically maintained tuning fork by Melde's experiment.

Note: Any TEN of the listed experiments are to be conducted. Out of which any TWO experiments may be conducted in virtual mode.

Prescribed Textbooks:
1. A Textbook of Practical Physics - S. Balasubramanian, M.N. Srinivasan, S. Chand Publishers, 2017.

Web Resources:

1. www.vlab.co.in
2. https://phet.colorado.edu/en/simulations/filter?subjects=physics&type=html,prototype

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
23AHS15L/25L.1	3	3	1	1	2	-	-	-	-	-	-	3
23AHS15L/25L.2	3	3	1	1	2	-	-	-	-	-	-	3
23AHS15L/25L.3	2	3	1	1	2	-	-	-	-	-	-	3
23AHS15L/25L.4	3	3	1	1	2	-	-	-	-	-	-	3

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)

Title of the Course:	Electrical and Electronics Engineering Workshop	
Category:	ES	
Couse Code:	23A0211L	23A0221L
Year:	I B.Tech.	I B.Tech.
Semester:	I Semester	II Semester
Branch/es:	ECE, EEE, AIDS, CSE-AI	CSE, CE, ME, AIML, CSE-DS

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	3	1.5

Course objectives:
To impart knowledge on the fundamental laws & theorems of electrical circuits, functions of electrical machines and energy calculations.

Course Outcomes:
At the end of the course, the student will be able to
1. understand the Electrical circuit design concept; measurement of resistance, power, power factor; concept of wiring and operation of Electrical Machines and Transformer
2. analyse various characteristics of electrical circuits, electrical machines and measuring instruments
3. design suitable circuits and methodologies for the measurement of various electrical parameters; Household and commercial wiring

Activities:
1. Familiarization of commonly used Electrical & Electronic Workshop Tools: Bread board, Solder, cables, relays, switches, connectors, fuses, Cutter, plier, screwdriver set, wire stripper, flux, knife/blade, soldering iron, de-soldering pump etc.
2. Provide some exercises so that hardware tools and instruments are learned to be used by the students.
3. Familiarization of Measuring Instruments like Voltmeters, Ammeters, multimeter, LCR-Q meter, Power Supplies, CRO, DSO, Function Generator, Frequency counter.
4. Provide some exercises so that measuring instruments are learned to be used by the students.
   Components:
   a. Familiarization/Identification of components (Resistors, Capacitors, Inductors, Diodes, transistors, IC's etc.) – Functionality, type, size, colour coding package, symbol, cost etc.
5. Testing of components like Resistor, Capacitor, Diode, Transistor, ICs etc. - Compare values of components like resistors, inductors, capacitors etc with the measured values by using instruments

PART A: ELECTRICAL ENGINEERING LAB

List of experiments
1.Verification of KCL and KVL
2.Verification of Superposition theorem
3.Measurement of Resistance using Wheat stone bridge
4.Magnetization Characteristics of DC shunt Generator
5.Measurement of Power and Power factor using Single-phase wattmeter
6.Measurement of Earth Resistance using Megger
7.Calculation of Electrical Energy for Domestic Premises
8. Brake Test on DC Shunt Motor
9. OC and SC Test on Single Phase Transformer

Prescribed Textbooks:

1. Basic Electrical engineering , C L Wadhwa, New Age International (P) Ltd., Publishers,2018,4th edition
2. Principles of Basic Electrical Engineering, T.N. Nagsarkar & M.S. Sukhija, Oxford University press, August 2018, 2nd Edition.

Reference Books:

1. Basic Electrical Engineering, D. C. Kulshreshtha, Tata McGraw Hill, 2019, First Edition
2. Power System Engineering, P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co, 2013
3. Fundamentals of Electrical Engineering, Rajendra Prasad, PHI publishers, 2014, Third Edition

Note: Minimum Six Experiments to be performed

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
23A0211L/21L.1	3	3	3	3	3	-	2	-	3	3	3	3
23A0211L/21L.2	3	3	3	3	3	-	2	-	3	3	3	3
23A0211L/21L.3	3	3	3	3	3	-	2	-	3	3	3	3

PART B: ELECTRONICS ENGINEERING LAB

Course Objectives: To impart knowledge on the principles of digital electronics and fundamentals of Electronic devices & its applications.

Course Outcomes:

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

4. identify & testing of various electronic components and plot the characteristics of various electronic devices
5. comprehend the usage of electronic measuring instruments.
6. explain the operation of a digital circuit.

List of Experiments

1. Plot V-I characteristics of PN Junction diode A) Forward bias B) Reverse bias
2. Plot V – I characteristics of Zener Diode and its application as voltage Regulator.
3. Implementation of half wave and full wave rectifiers
4. Plot Input & Output characteristics of BJT in CE and CB configurations
5. Frequency response of CE amplifier
6. Simulation of RC coupled amplifier with the design supplied
7. Verification of Truth Table of AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gates using ICs.
8. Verification of Truth Tables of S-R, J-K& D flip flops using respective ICs.

Reference Books:

1. R. L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, Pearson Education, 2021
2. R. P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill, 2009
3. R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version, Pearson Education, 2009.

Note: Minimum Six Experiments to be performed. All the experiments shall be implemented Using both Hardware and Software.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	**PSO1**	**PSO2**	**PSO3**
23A0211L/21L.4	2	2	1	1	2	-	-	-	-	-	-	1	-	-	-
23A0211L/21L.5	2	2	1	1	2	-	-	-	-	1	-	1	-	-	-
23A0211L/21L.6	2	2	1	1	2	1	-	1	-	1	-	1	-	--	

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)

Title of the Course: Engineering Mechanics Lab
Category: PC
Couse Code: 23A0323L
Year: I B.Tech.
Semester: II Semester
Branch/es: Mechanical Engineering

Lecture Hours	Tutorial Hours	Practice Hours	Credits
-	-	3	1.5

Course Objectives:

1. Verify the Law of Parallelogram and Triangle of Forces.
2. Determine the coefficients of friction of Static and Rolling friction and Centre of gravity of different plane Lamina.
3. Analyse the system of Pulleys and Moment of Inertia of Compound Pendulum and Flywheel.

Course Outcomes:

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

1. analyze the system of forces acting on a system.
2. evaluate the frictional parameters in different conditions.
3. calculate the centroid, centre of gravity of different plane shape lamina.
4. analyze the equilibrium of a rigid body under various conditions.
5. evaluate the Moment of Inertia of the compound pendulum and Flywheel.

List of Experiments:

1. Verification of Law of Parallelogram of Forces.
2. Verification of Law of Triangle of Forces.
3. Verification of the Law of polygon for coplanar-concurrent forces acting on a particle in equilibrium and to find the value of unknown forces considering particle to be in equilibrium using universal force table.
4. Determination of coefficient of Static and Rolling Frictions.
5. Determination of Centre of Gravity of different shaped Plane Lamina.
6. Verification of the conditions of equilibrium of a rigid body under the action of coplanar non concurrent, parallel force system with the help of a simply supported beam.
7. Study of the systems of pulleys and draw the free body diagram of the system.
8. Determine the acceleration due to gravity using a compound pendulum.
9. Determine the Moment of Inertia of the compound pendulum about an axis perpendicular to the plane of oscillation and passing through its centre of mass.
10. Determine the Moment of Inertia of a Flywheel.
11. Verification of Law of Moment using Rotation Disc Apparatus and Bell Crank Lever.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
23A0323L.1	3	3	3	3	-	-	-	2	-	-	-	2
23A0323L.2	3	3	3	3	-	-	-	2	-	-	-	2
23A0323L.3	3	3	2	3	-	-	-	2	-	-	-	2
23A0323L.4	3	3	3	3	-	-	-	2	-	-	-	2
23A0323L.5	3	3	2	3	-	-	-	2	-	-	-	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)

Title of the Course:	NSS/NCC/Scouts & Guides/Community Service	
Category:	BS&H	
Couse Code:	23AHS17L	23AHS27L
Branch/es:	ECE, EEE, AIDS, CSE-AI	CSE, CE, ME, AIML, CSE-DS
Semester:	I Semester	II Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
-	-	1	0.5

Course Objectives: The objective of introducing this course is to impart discipline, character, fraternity, teamwork, social consciousness among the students and engaging them in selfless service.

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

1. understand the importance of discipline, character and service motto.
2. solve some societal issues by applying acquired knowledge, facts, and techniques.
3. explore human relationships by analyzing social problems.
4. determine to extend their help for the fellow beings and downtrodden people.
5. develop leadership skills and civic responsibilities.

Unit 1 Orientation

General Orientation on NSS/NCC/ Scouts & Guides/Community Service activities, career guidance.
Activities:

i. Conducting –ice breaking sessions-expectations from the course-knowing personal talents and skills.
ii. Conducting orientations programs for the students –future plans-activities-releasing road map etc.
iii. Displaying success stories-motivational biopics- award winning movies on societal issues etc.
iv. Conducting talent show in singing patriotic songs-paintings- any other contribution.

Unit 2 Nature & Care

i. Best out of waste competition.
ii. Poster and signs making competition to spread environmental awareness.
iii. Recycling and environmental pollution article writing competition.
iv. Organising Zero-waste day.
v. Digital Environmental awareness activity via various social media platforms.
vi. Virtual demonstration of different eco-friendly approaches for sustainable living.
vii. Write a summary on any book related to environmental issues.

Unit 3 Community Service

Activities:

i. Conducting One Day Special Camp in a village contacting village-area leaders- Survey in the village, identification of problems- helping them to solve via media- authorities experts- etc.
ii. Conducting awareness programs on Health-related issues such as General Health, Mental health, Spiritual Health, HIV/AIDS
iii. Conducting consumer Awareness. Explaining various legal provisions etc.
iv. Women Empowerment Programmes- Sexual Abuse, Adolescent Health and Population Education.
v. Any other programmes in collaboration with local charities, NGOs etc.

General Guidelines:

i. Institutes must assign slots in the Timetable for the activities.
ii. Institutes are required to provide instructor to mentor the students.

Evaluation Guidelines:

i. Evaluated for a total of 100 marks.
ii. A student can select 6 activities of his/her choice with a minimum of 01 activity per unit. Each activity shall be evaluated by the concerned teacher for 15 marks, totaling to 90 marks.
iii. A student shall be evaluated by the concerned teacher for 10 marks by conducting viva voce on the subject.

Reference Books:

1. A Text Book of National Service Scheme, Nirmalya Kumar Sinha & Surajit Majumder, Vol;.I, Vidya Kutir Publication, 2021 (ISBN 978-81-952368-8-6)
2. Red Book - National Cadet Corps – Standing Instructions Vol I & II, Directorate General of NCC, Ministry of Defence, New Delhi
3. Introduction to Environmental Engineering, Davis M. L. and Cornwell D. A., McGraw Hill, New York 4/e 2008
4. Introduction to Environmental Engineering and Science, Masters G. M., Joseph K. and Nagendran R., Pearson Education, New Delhi. 2/e 2007
5. Social Problems in India, Ram Ahuja, Rawat Publications, New Delhi.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
23AHS17L/27L.1	-	-	-	-	-	2	2	3	3	2	-	3
23AHS17L/27L.2	-	-	-	-	-	2	2	3	3	2	-	3
23AHS17L/27L.3	-	-	-	-	-	2	-	3	3	2	-	3
23AHS17L/27L.4	-	-	-	-	-	2	-	3	3	2	-	3
23AHS17L/27L.5	-	-	-	-	-	2	-	3	3	2	-	3

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Numerical Methods and Transform Techniques
Category: BS
Couse Code: 23AHS31T
Branch/es: Mechanical engineering
Semester: II B.Tech I-Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
1. To introduce numerical methods for solving algebraic and transcendental equations.
2. To notify the numerical methods in interpolation.
3. To introduce the numerical solutions of ordinary differential equations.
4. To elucidate the Laplace transforms and their inverses.
5. To introduce Fourier Series and Fourier Transforms to solve real life problems.

Course Outcomes:
At the end of the course, the student will be able to
1. solve algebraic and transcendental equations using numerical methods
2. apply interpolation technique in engineering.
3. solve the ordinary differential equations using numerical methods.
4. solve the ordinary differential equations using Laplace transformations.
5. apply Fourier Series and Fourier Transforms in engineering.

Unit 1 Solution of Algebraic & Transcendental Equations 08
Introduction-Bisection Method-Iterative method, Regula-falsi method and Newton Raphson method.

Unit 2 Interpolation 08
Finite differences-Newton's forward and backward interpolation formulae – Lagrange's formula.
Curve fitting: Fitting of straight line, second-degree and Exponential curve by method of least squares.

Unit 3 Solution of Initial value problems to Ordinary differential equations 08
Numerical solution of Ordinary Differential equations: Solution by Taylor's series-Picard's Method of successive Approximations-Euler's and modified Euler's methods-Runge-Kutta methods (second and fourth order).

Unit 4 Laplace Transforms 10
Definition-Laplace transform of standard functions-existence of Laplace Transform – Inverse transform – First shifting Theorem, transforms of derivatives and integrals – Unit step function – Second shifting theorem– Convolution theorem – Laplace transform of Periodic function.

Unit 5 Fourier series and Fourier transforms 10
Existence of Fourier series -Fourier series of Even and odd functions – Fourier series in an arbitrary interval – Half-range Fourier sine and cosine expansions
Fourier transforms: Fourier integral theorem (without proof) – Fourier sine and cosine integrals-complex form of Fourier integral. Fourier transform – Fourier sine and cosine transforms – Properties – Inverse transforms – convolution theorem.

Prescribed Textbooks:
1. S S Sastry, Introductory Methods of Numerical Analysis, PHI Learning Private Limited
2. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2017, 44th Edition

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley &Sons, 2018, 10th Edition
2. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 5/e, AlphaScience International Ltd., 2021 (9th reprint).
3. H. K Das, Er. Rajnish Verma, Higher Engineering Mathematics, S. Chand Publications,2014, Third Edition (Reprint 2021)
4. Alan Jeffrey, Advanced Engineering Mathematics, Elsevier

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23AHS31T.1	3	2	1	2	-	-	-	-	-	-	-	1	-	-
23AHS31T.2	3	2	1	2	-	-	-	-	-	-	-	1	-	-
23AHS31T.3	3	2	1	2	-	-	-	-	-	-	-	1	-	-
23AHS31T.4	3	2	1	2	-	-	-	-	-	-	-	1	-	-
23AHS31T.5	3	2	1	2	-	-	-	-	-	-	-	1	-	-

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Universal Human Values – Understanding Harmony and Ethical Human Conduct
Category: HSSM
Couse Code: 23AHS35T
Branch/es: ME, CE, ECE, CSE(DS) and AI &DS
Semester: II B.Tech I-Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
2	1	0	3

Course Objectives:

1. To help the students appreciate the essential complementary between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity.
2. To facilitate the development of a holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the human reality and the rest of existence ultimately towards value-based living in a natural way.
3. To highlight plausible implications of such a holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with nature.

Course Outcomes:

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

1. comprehend the terms like Natural Acceptance, Happiness and Prosperity
2. analyze one's self, and one's surroundings (family, society, nature)
3. apply human values in enriching human relationships and human society.
4. analyze the need for universal human values and harmonious existence.
5. evaluate themselves as socially and ecologically responsible engineers.

Unit 1 Introduction to Value Education 9

Lecture1: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)
Lecture2: Understanding Value Education
Tutorial 1: Practice Session1: Sharing about Oneself
Lecture 3: Self-Exploration as the Process for Value Education
Lecture4: Continuous Happiness and Prosperity – The Basic Human Aspirations
Tutorial 2: Practice Session2: Exploring Human Consciousness
Lecture 5: Happiness and Prosperity – Current Scenario
Lecture 6: Method to Fulfill the Basic Human Aspirations
Tutorial 3: Practice Session3: Exploring Natural Acceptance

Unit 2 Harmony in the Human Being 9

Lecture 7: Understanding Human being as the Co-existence of the self and the body.
Lecture 8: Distinguishing between the needs of the self and the body
Tutorial 4: Practice Session4: Exploring the difference of needs of self and body.
Lecture 9: The body as an instrument of the self
Lecture 10: Understanding harmony in the self
Tutorial 5: Practice Session5: Exploring sources of imagination in the self
Lecture 11: Harmony of the self with the body
Lecture 12: Programme to ensure self-regulation and health
Tutorial 6: Practice Session 6: Exploring harmony of self with the body

Unit 3 Harmony in the Family and Society 9

Lecture 13: Harmony in the Family – the Basic Unit of Human Interaction
Lecture 14: 'Trust' – the Foundational Value in Relationship

Tutorial 7: Practice Session7: Exploring the Feeling of Trust
Lecture 15: 'Respect' – as the Right Evaluation
Tutorial 8: Practice Session 8: Exploring the Feeling of Respect
Lecture 16: Other Feelings, Justice in Human-to-Human Relationship
Lecture 17: Understanding Harmony in the Society
Lecture 18: Vision for the Universal Human Order
Tutorial 9: Practice Session9: Exploring systems to fulfil human goal

Unit 4 Harmony in the Nature/Existence 6

Lecture 19: Understanding Harmony in the Nature
Lecture 20: Interconnectedness, Self-Regulation and Mutual Fulfilment among the Four Orders of Nature
Tutorial 10: Practice Session 10: Exploring the Four Orders of Nature
Lecture 21: Realizing Existence as Co-existence at All Levels
Lecture 22: The Holistic Perception of Harmony in Existence
Tutorial 11: Practice Session11: Exploring Co-existence in Existence

Unit 5 Implications of the Holistic Understanding – a Look at Professional Ethics 9

Lecture 23: Natural Acceptance of Human Values
Lecture 24: Definitiveness of (Ethical) Human Conduct
Tutorial 12: Practice Session 12: Exploring Ethical Human Conduct
Lecture 25: A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order
Lecture 26: Competence in Professional Ethics
Tutorial 13: Practice Session13: Exploring Humanistic Models in Education
Lecture 27: Holistic Technologies, Production Systems and Management
Models-Typical Case Studies
Lecture 28: Strategies for Transition towards Value-based Life and Profession
Tutorial 14: Practice Session14: Exploring Steps of Transition towards Universal Human Order

Practice Sessions for UNIT I – Introduction to Value Education
PS1 Sharing about Oneself
PS2 Exploring Human Consciousness
PS3 Exploring Natural Acceptance

Practice Sessions for UNIT II – Harmony in the Human Being
PS4 Exploring the Difference of Needs of Self and Body
PS5 Exploring Sources of Imagination in the Self
PS6 Exploring Harmony of Self with the Body

Practice Sessions for UNIT III – Harmony in the Family and Society
PS7 Exploring the Feeling of Trust
PS8 Exploring the Feeling of Respect
PS9 Exploring Systems to fulfil Human Goal

Practice Sessions for UNIT IV – Harmony in the Nature (Existence)
PS10 Exploring the Four Orders of Nature
PS11 Exploring Co-existence in Existence

Practice Sessions for UNIT V – Implications of the Holistic Understanding – a Look at Professional Ethics
PS12 Exploring Ethical Human Conduct
PS13 Exploring Humanistic Models in Education
PS14 Exploring Steps of Transition towards Universal Human Order

Prescribed Textbooks:
Textbook and Teachers Manual

1. The Textbook

R R Gaur, R Asthana, G P Bagaria, A Foundation Course in Human Values and Professional Ethics, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

2. The Teacher's Manual

R R Gaur, R Asthana, G P Bagaria, Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books:

1. Jeevan Vidya: Ek Parichaya, A. Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – Pandit Sunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

Web Resources:

1. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%201Introduction%20to%20Value%20Education.pdf
2. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%202-Harmony%20in%20the%20Human%20Being.pdf
3. https://fdp-si.aicte-india.org/UHV%201%20Teaching%20Material/D3S2%20Respect%20July%2023.pdf
4. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%205-Harmony%20in%20the%20Nature%20and%20Existence.pdf
5. https://fdp-si.aicte-india.org/UHV%20II%20Teaching%20Material/UHV%20II%20Lecture%202325%20Ethics%20v1.pdf
6. https://www.studocu.com/in/document/kiet-group-of-institutions/universal-humanvalues/chapter-5-holistic-understanding-of-harmony-on-professional-ethics/62490385
   https://onlinecourses.swayam2.ac.in/aic22_ge23/preview
7. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%203-Harmony%20in%20the%20Family.pdf

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23AHS35T.1	-	-	-	-	-	-	-	3	-	1	-	2	-	-
23AHS35T.2	-	-	-	-	-	-	-	3	-	1	-	2	-	-
23AHS35T.3	-	-	-	-	-	-	-	3	-	1	-	2	-	-
23AHS35T.4	-	-	-	-	-	-	2	3	-	1	-	2	-	-
23AHS35T.5	-	-	-	-	-	2	3	3	-	1	-	2	-	-

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Thermodynamics
Category: ES
Couse Code: 23A0331T
Branch/es: Mechanical Engineering
Semester: II B.Tech I-Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
2	0	0	2

Course Objectives:
1. Familiarize concepts of heat, work, energy and governing rules for conversion of one form to other.
2. Explain relationships between properties of matter and basic laws of thermodynamics.
3. Teach the concept of entropy for identifying the disorder and feasibility of a thermodynamic process.
4. Introduce the concept of available energy for maximum work conversion.
5. Provide fundamental concepts of Refrigeration and Psychrometry.

Course Outcomes:
At the end of the course, the student will be able to
1. Calculate the energy transfer for a thermodynamic process.
2. Apply the law of thermodynamics to different energy system.
3. Apply the second law of thermodynamics to various thermodynamics systems.
4. Calculate the thermodynamics properties of pure substances.
5. Apply the knowledge of thermodynamics laws to verify the performance of air standard cycles.

Unit 1 **12**

Introduction: Basic Concepts: System, boundary, Surrounding, control volume, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Cycle – Reversibility – Quasi static Process, Irreversible Process, Causes of Irreversibility. Energy in State and in Transition, Types, Work and Heat.

Unit 2 **8**

Point and Path function. Zeroth Law of Thermodynamics – PMM-I, Joule's Experiment – First law of Thermodynamics and applications. Limitations of the First Law – Enthalpy, Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance.

Unit 3 **8**

Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements and their Equivalence / Corollaries, PMM-II, Carnot's principle, Carnot cycle and its specialties, Thermodynamic scale of Temperature, Clausius Inequality, Entropy, Principle of Entropy Increase – Energy Equation, Availability and Irreversibility – Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations – Elementary Treatment of the Third Law of Thermodynamics.

Unit 4 **10**

Pure Substances, P-V-T- surfaces, T-S and h-s diagrams, Mollier Charts, Phase Transformations – Triple point at critical state properties during change of phase, Dryness Fraction – Clausius – Clapeyron Equation Property tables. Mollier charts – Various Thermodynamic processes and energy Transfer – Steam Calorimetry.

Unit 5 **6**

Air Standard Cycles: Otto, Diesel, Dual cycles and Stirling Cycles, P-V and T -S diagrams - Description and Efficiencies- Mean effective pressures. Comparison of Otto, Diesel and Dual cycles.

Prescribed Textbooks:

1. P. K. Nag, Engineering Thermodynamics, 5/e, Tata McGraw Hill, 2013.
2. Claus Borgnakke Richard E. Sonntag, Fundamentals of Thermodynamics, 7/e, Wiley, 2009.

Reference Books:

1. J.B. Jones, and R.E. Dugan, Engineering Thermodynamics, 1/e, Prentice Hall, 1995.
2. Y. A. Cengel & M. A. Boles, Thermodynamics – An Engineering Approach, 7/e, McGraw Hill, 2010.
3. P. Chattopadhyay, Engineering Thermodynamics, 1/e, Oxford University Press, 2011.
4. CP Arora, Refrigeration and Air-conditioning, 4/e, McGraw Hill, 2021

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A0331T.1	3	2	1	1	-	-	-	-	-	1	-	1	1	1
23A0331T.2	3	2	1	1	-	-	-	-	-	1	-	1	1	2
23A0331T.3	3	2	1	1	-	-	-	-	-	1	-	1	2	2
23A0331T.4	3	2	1	1	-	-	-	-	-	1	-	1	1	2
23A0331T.5	3	3	1	1	-	-	1	-	-	1	-	1	2	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Mechanics of Solids
Category: PC
Couse Code: 23A0332T
Branch/es: Mechanical Engineering
Semester: II B.Tech I-Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
1. Understand the behavior of basic structural members subjected to uni axial and bi axial loads.
2. Apply the concept of stress and strain to analyse and design structural members and machine parts under axial, shear and bending loads, moment and torsional moment.
3. Students will learn all the methods to analyse beams, columns, frames for normal, shear, and torsion stresses and to solve deflection problems in preparation for the design of such structural components. Students are able to analyse beams and draw correct and complete shear and bending moment diagrams for beams.
4. Students attain a deeper understanding of the loads, stresses, and strains acting on a structure and their relations in the elastic behavior
5. Design and analysis of Industrial components like pressure vessels

Course Outcomes:
At the end of the course, the student will be able to
1. Solve for simple stresses and strains when members are subjected to load
2. Analyze shear force and bending moment in the beam subjected to different loading conditions.
3. Evaluate shear stresses and bending stresses in a beam subjected to different loading conditions.
4. Analyze the deflections in beam subjected to different loading conditions,
5. Analyzer he thin cylinder, thick cylinder and columns and struts

Unit 1 Simple Stresses & Strains 12

Elasticity and plasticity – Types of stresses & strains–Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio & volumetric strain – Bars of varying section – composite bars – Temperature stresses- Complex Stresses - Stresses on an inclined plane under different uniaxial and biaxial stress conditions - Principal planes and principal stresses - Mohr's circle - Relation between elastic constants, Strain energy – Resilience – Gradual, sudden, impact and shock loadings.

Unit 2 Shear Force and Bending Moment 8

Definition of beam – Types of beams –Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, u.d.l, uniformly varying loads and combination of these loads – Point of contra flexure – Relation between S.F., B.M and rate of loading at a section of abeam.

Unit 3 8

FLEXURAL STRESSES: Theory of simple bending, Derivation of bending equation, Determination of bending stresses – section modulus of rectangular, circular, I and T sections– Design of simple beam sections.
SHEAR STRESSES: Derivation of formula – Shear stress distribution across various beams sections like rectangular, circular, triangular, I and T sections.

Unit 4 10

DEFLECTION OF BEAMS: Bending into a circular arc – slope, deflection and radius of curvature – Differential equation for the elastic line of a beam – Double integration and Macaulay's methods – Determination of slope and deflection for cantilever and simply supported beams subjected to point loads, UDL and UVL. Mohr's theorem and Moment area method – application to simple cases.

TORSION: Introduction-Derivation- Torsion of Circular shafts- Pure Shear-Transmission of power by circular shafts, Shafts in series, Shafts in parallel.

Unit 5 **10**

THIN AND THICK CYLINDERS: Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and volumetric strains – changes in dia, and volume of thin cylinders– Thin spherical shells. Wire wound thin cylinders. Lame's equation – cylinders subjected to inside & outside pressures –compound cylinders.

COLUMNS: Buckling and Stability, Columns with Pinned ends, Columns with other support Conditions, Limitations of Euler's Formula, Rankine's Formula

Prescribed Textbooks:

1. GH Ryder, Strength of materials, Palgrave Macmillan publishers India Ltd, 1961.
2. B.C. Punmia, Strength of materials, 10/e, Lakshmi publications Pvt.Ltd, New Delhi, 2018.

Reference Books:

1. Gere & Timoshenko, Mechanics of materials, 2/e, CBS publications, 2004.
2. U.C. Jindal, Strength of Materials, 2/e, Pearson Education, 2017.
3. Timoshenko, Strength of Materials Part – I& II, 3/e, CBS Publishers, 2004.
4. Andrew Pytel and Ferdinand L. Singer, Strength of Materials, 4/e, Longman Pulications, 1990.
5. Popov, Mechanics of Solids, 2/e, New Pearson Education, 2015

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A0332T.1	3	3	2	3	-	-	-	1	-	1	-	-	2	2
23A0332T.2	3	3	3	3	-	-	-	-	-	-	-	1	2	2
23A0332T.3	3	3	3	3	-	-	-	-	-	1	-	-	2	2
23A0332T.4	3	3	3	3	-	-	-	1	-	1	-	-	2	2
23A0332T.5	3	3	3	3	-	-	-	1	-	-	-	-	2	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Material Science and Metallurgy
Category: PC
Couse Code: 23A0333T
Branch/es: Mechanical Engineering
Semester: II B.Tech I-Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
1. To understand the mechanism of crystallization, imperfections in crystals and factors affecting solid solubility.
2. To study the stability of phases in different alloy systems.
3. To acquire knowledge on properties and structure of ferrous and nonferrous alloys and to select suitable materials for various engineering applications
4. To learn various methods of heat treatment and surface hardening.
5. To gain knowledge on properties and applications of ceramic, composites and other advanced materials.

Course Outcomes:
At the end of the course, the student will be able to
1. Summarize the crystallization of metals and factors affecting the solid solubility.
2. Analyze the phase diagrams of binary systems and iron-carbide diagram to identify the material composition depending on the design requirements.
3. Summarize the structure, properties and applications of various cast irons, steels and non-ferrous alloys.
4. Apply the various heat treatment processes, surface hardening methods depending on material requirements.
5. Summarize the concepts of powder metallurgy and properties, applications of ceramic, composites and other advanced materials.

Unit 1 **Learning Hours**

Structure of Metals and Constitution of alloys: Crystallization of metals, Packing Factor - SC, BCC, FCC & HCP- line density, plane density. Grain and grain boundaries, effect of grain boundaries – determination of grain size.
Imperfections, Slip and Twinning.
Necessity of alloying, types of solid solutions, Hume Rothery's rules, intermediate alloy phases, and electron compounds.

Unit 2 **Learning Hours**

Equilibrium Diagrams: Experimental methods of construction of equilibrium diagrams, Isomorphous alloy systems, equilibrium cooling and heating of alloys, Lever rule, coring miscibility gaps, eutectic systems, congruent melting intermediate phases, peritectic reaction. Transformations in the solid state – allotropy, eutectoid, peritectoid reactions, phase rule, relationship between equilibrium diagrams and properties of alloys. Study of binary phase diagrams such as Cu-Ni and Fe-Fe3C.

Unit 3 **Learning Hours**

Ferrous metals and alloys: Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, Spheroidal graphite cast iron, Alloy cast iron. Classification of steels, structure and properties of plain carbon steels, Low alloy steels, Hadfield manganese steels, tool and die steels.
Non-ferrous Metals and Alloys: Structure and properties of Copper and its alloys, Aluminum and its alloys, Titanium and its alloys, Magnesium and its alloys, Super alloys.

Unit 4 **Learning Hours**

Heat treatment of Steels: Effect of alloying elements on Fe-Fe3C system, annealing, normalizing, hardening, TTT diagrams, tempering, hardenability, surface - hardening methods, age hardening treatment, Cryogenic treatment.

Unit 5 **Learning Hours**

Powder Metallurgy: Basic processes- Methods of producing metal powders- milling atomization-Granulation-Reduction-Electrolytic Deposition. Compacting methods – Sintering - Methods of manufacturing sintered parts. Secondary operations, Applications of powder metallurgical products.

Ceramics, Composites and Advanced materials: Crystalline ceramics, glasses, cermets, abrasive materials, Classification of composites, manufacturing methods, particle reinforced composites, fiber reinforced composites, PMC, MMC, CMC and CCCs. Introduction to Nanomaterials and smart materials.

Prescribed Textbooks:

1. S.H.Avner, Introduction to Physical Metallurgy, 2/e, Tata McGraw- Hill, 1997.
2. Donald R.Askeland, Essentials of Materials science and Engineering, 4/e, CL Engineering publications, 2018

Reference Books:

1. Dr. V.D.kodgire, Material Science and Metallurgy, 39/e, Everest Publishing House, 2017.
2. V.Raghavan, Material Science and Engineering, 5/e, Prentice Hall of India, 2004.
3. William D. Callister Jr, Materials Science and Engineering: An Introduction, 8/e, John Wiley and Sons, 2009.
4. George E.Dieter, Mechanical Metallurgy, 3/e, McGraw-Hill, 2013.
5. Yip-Wah Chung, Introduction to Material Science and Engineering, 2/e, CRC Press, 2022.
6. A V K Suryanarayana, Material Science and Metallurgy, B S Publications, 2014.
7. U. C. Jindal, Material Science and Metallurgy, 1/e, Pearson Publications, 2011.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A0333T.1	2	2	1	1	-	-	-	-	-	-	-	-	-	1
23A0333T.2	3	3	2	2	-	-	-	-	-	-	-	-	-	1
23A0333T.3	2	2	1	1	-	-	-	-	-	-	-	-	-	1
23A0333T.4	3	2	1	2	-	-	-	-	-	-	-	-	-	1
23A0333T.5	2	2	1	1	-	-	-	-	-	-	-	-	-	1

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Mechanics of Solids and Materials Science Lab
Category: PC
Couse Code: 23A0334L
Branch/es: Mechanical Engineering
Semester: II B.Tech I-Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	3	1.5

Course Objectives:
1. To evaluate the values of yield stress, ultimate stress and bending stress of the given specimen under tension test and bending test.
2. To conduct the torsion test to determine the modulus of rigidity of given specimen.
3. To Justify the Rockwell hardness test over with Brinell hardness and measure the hardness of the given specimen.
4. To examine the stiffness of the open coil and closed coil spring and grade them.
5. To analyze the microstructure and characteristics of ferrous and nonferrous alloy specimens.
6. To calculate the hardenability by jominy & quench apparatus.

Course Outcomes:
At the end of the course, the student will be able to
1. Understand the stress strain behavior of different materials.
2. Evaluate the hardness of different materials.
3. Explain the relation between elastic constants and hardness of materials.
4. Identify various microstructures of steels and cast irons.
5. Evaluate hardness of treated and untreated steels.

A) MECHANICS OF SOLIDS LAB
1. Tensile test
2. Bending test on
    A. Simply supported beam
    B. Cantilever beam
3. Torsion test
4. Hardness test
    A. Brinell's hardness test
    B. Rockwell hardness test
    C. Vickers hardness test
5. Test on springs
6. Impact test
    A. Charpy test
    B. Izod test
7. Punch shear test
8. Liquid penetration test

B) MATERIAL SCIENCE LAB
1. Preparation and study of the Microstructure of pure metals like Iron, Cu and Al.
2. Preparation and study of the Microstructure of Mild steel, medium carbon steels, and High carbon steels.
3. Study of the Microstructures of Cast Irons.
4. Study of the Microstructures of Non-Ferrous alloys.
5. Study of the Microstructures of Heat-treated steels.
6. Hardenability of steels by Jominy End Quench Test.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A0334L.1	3	-	-	3	-	-	-	-	-	-	-	-	1	2
23A0334L.2	3	-	-	3	-	-	-	-	-	-	-	-	1	2
23A0334L.3	3	-	-	3	-	-	-	-	-	-	-	-	1	2
23A0334L.4	3	3	-	3	-	-	3	-	3	-	3	3	2	2
23A0334L.5	3	3	-	3	-	-	3	-	3	-	3	3	2	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Computer-aided Machine Drawing
Category: PC
Couse Code: 23A0335L
Branch/es: Mechanical Engineering
Semester: II B.Tech I-Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	3	1.5

Course Objectives:
1. Introduce conventional representations of material and machine components.
2. Train to use software for 2D and 3D modeling.
3. Familiarize with thread profiles, riveted, welded and key joints.
4. Teach solid modeling of machine parts and their sections.
5. Explain creation of 2D and 3D assembly drawings and familiarize with limits, fits, and tolerances in mating components

Course Outcomes:
At the end of the course, the student will be able to
1. Demonstrate the conventional representations of materials and machine components.
2. Model riveted, welded and key joints using CAD system.
3. Create solid models and sectional views of machine components.
4. Generate solid models of machine parts and assemble them.
5. Translate 3D assemblies into 2D drawings.

The following are to be done by any 2D software package
1. **Conventional representation of materials and components:**
2. **Detachable joints:** Drawing of thread profiles, hexagonal and square-headed bolts and nuts, bolted joint with washer and locknut, stud joint, screw joint and foundation bolts.
3. **Riveted joints:** Drawing of rivet, lap joint, butt joint with single strap, single riveted, double riveted double strap joints.
4. **Welded joints:** Lap joint and T joint with fillet, butt joint with conventions.
5. **Keys:** Taper key, sunk taper key, round key, saddle key, feather key, woodruff key.
6. **Couplings:** rigid – Muff, flange; flexible – bushed pin-type flange coupling, universal coupling, Oldham's' coupling.

The following exercises are to be done by any 3D software package:
1. **Sectional views:** Creating solid models of complex machine parts and sectional views.
2. **Assembly drawings: (Any four of the following using solid model software)**
   Lathe tool post, tool head of shaping machine, tail-stock, machine vice, gate valve, carburetor, piston, connecting rod, eccentric, screw jack, plumber block, axle bearing, pipe vice, clamping device, Geneva cam, universal coupling.
3. **Production drawing:** Representation of limits, fits and tolerances for mating parts. Use any four parts of above assembly drawings and prepare manufacturing drawing with dimensional and geometric tolerances.

Prescribed Textbooks:

1. Machine Drawing by K.L.Narayana, P.Kannaiah and K.Venkat Reddy, New Age International Publishers, 3/e, 2014.
2. Machine drawing by N.Sideshwar, P. Kannaiah, V.V.S.Sastry, TMH Publishers. 2014.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A0335L.1	2	-	2	-	-	-	-	-	-	2	-	-	2	-
23A0335L.2	2	-	2	-	-	-	-	-	-	2	-	-	2	-
23A0335L.3	2	-	2	-	-	-	-	-	-	2	-	-	2	-
23A0335L.4	2	-	2	-	-	-	-	-	-	2	-	-	2	-
23A0335L.5	2	-	2	-	-	-	-	-	-	2	-	-	2	-

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course:	Python Programming Lab
Category:	ES
Couse Code:	23A0536L
Branch/es:	Mechanical Engineering
Semester:	II B.Tech I-Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	2	1

Course Objectives:

The main objectives of the course are to

1. Introduce core programming concepts of Python programming language.
2. Demonstrate about Python data structures like Lists, Tuples, Sets and dictionaries
3. Implement Functions, Modules and Regular Expressions in Python Programming and to create practical and contemporary applications using these.

Course Outcomes:

After completion of the course, students will be able to

1. Showcase adept command of Python syntax, deftly utilizing variables, data types, control structures, functions, modules, and exception handling to engineer robust and efficient code solutions. (L4)
2. apply Python programming concepts to solve a variety of computational problems (L3)
3. understand the principles of object-oriented programming (OOP) in Python, including classes, objects, inheritance, polymorphism, and encapsulation, and apply them to design and implement Python programs (L3)
4. become proficient in using commonly used Python libraries and frameworks such as JSON, XML, NumPy, pandas (L2)
5. exhibit competence in implementing and manipulating fundamental data structures such as lists, tuples, sets, dictionaries (L3)

UNTI-I:

History of Python Programming Language, Thrust Areas of Python, Installing Anaconda Python Distribution, Installing and Using Jupyter Notebook.

Parts of Python Programming Language: Identifiers, Keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, the type () Function and Is Operator, Dynamic and Strongly Typed Language.

Control Flow Statements: if statement, if-else statement, if...elif…else, Nested if statement, while Loop, for Loop, continue and break Statements, Catching Exceptions Using try and except Statement.

Sample Experiments:

1. Write a program to find the largest element among three Numbers.
2. Write a Program to display all prime numbers within an interval
3. Write a program to swap two numbers without using a temporary variable.
4. Demonstrate the following Operators in Python with suitable examples.
   i) Arithmetic Operators ii) Relational Operators iii) Assignment Operators iv) Logical Operators v) Bit wise Operators vi) Ternary Operator vii) Membership Operators viii) Identity Operators
5. Write a program to add and multiply complex numbers
6. Write a program to print multiplication table of a given number.

UNIT-II:

Functions: Built-In Functions, Commonly Used Modules, Function Definition and Calling the function, return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, *args and **kwargs, Command Line Arguments.

Strings: Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings.

Lists: Creating Lists, Basic List Operations, Indexing and Slicing in Lists, Built-In Functions Used on Lists, List Methods, del Statement.

Sample Experiments:

7. Write a program to define a function with multiple return values.
8. Write a program to define a function using default arguments.
9. Write a program to find the length of the string without using any library functions.
10. Write a program to check if the substring is present in a given string or not.
11. Write a program to perform the given operations on a list:
    i. Addition ii. Insertion iii. slicing
12. Write a program to perform any 5 built-in functions by taking any list.

UNIT-III:

Dictionaries: Creating Dictionary, Accessing and Modifying key:value Pairs in Dictionaries, Built-In Functions Used on Dictionaries, Dictionary Methods, del Statement.

Tuples and Sets: Creating Tuples, Basic Tuple Operations, tuple() Function, Indexing and Slicing in Tuples, Built-In Functions Used on Tuples, Relation between Tuples and Lists, Relation between Tuples and Dictionaries.

Sample Experiments:

13. Write a program to create tuples (name, age, address, college) for at least two members and concatenate the tuples and print the concatenated tuples.
14. Write a program to count the number of vowels in a string (No control flow allowed).
15. Write a program to check if a given key exists in a dictionary or not.
16. Write a program to add a new key-value pair to an existing dictionary.
17. Write a program to sum all the items in a given dictionary.

UNIT-IV:

Files: Types of Files, Creating and Reading Text Data, File Methods to Read and Write Data.

Object-Oriented Programming: Classes and Objects, Creating Classes in Python, Creating Objects in Python, Constructor Method, Classes with Multiple Objects, Class Attributes Vs Data Attributes, Encapsulation, Inheritance, Polymorphism.

Sample Experiments:

18. Write a program to sort words in a file and put them in another file. The output file should have only lower-case words, so any upper-case words from source must be lowered.
19. Python program to print each line of a file in reverse order.
20. Python program to compute the number of characters, words and lines in a file.
21. Write a program to create, display, append, insert and reverse the order of the items in the array.
22. Write a program to add, transpose and multiply two matrices.
23. Write a Python program to create a class that represents a shape. Include methods to calculate its area and perimeter. Implement subclasses for different shapes like circle, triangle, and square.

UNIT-V:

Introduction to Data Science: Functional Programming, JSON and XML in Python, NumPy with Python, Pandas.

Sample Experiments:

24. Python Program to demonstrate NumPy arrays creation using array () function.
25. Python program to demonstrate use of ndim, shape, size, dtype.
26. Python program to demonstrate basic slicing, integer and Boolean indexing.
27. Python program to find min, max, sum, cumulative sum of array
28. Select any two columns from the above data frame, and observe the change in one attribute with respect to other attribute with scatter and plot operations in matplotlib

Reference Books:

1. Gowri shankar S, Veena A., Introduction to Python Programming, CRC Press.
2. Python Programming, S Sridhar, J Indumathi, V M Hariharan, 2nd Edition, Pearson, 2024
3. Introduction to Programming Using Python, Y. Daniel Liang, Pearson.

Online Learning Resources/Virtual Labs:

1. https://www.coursera.org/learn/python-for-applied-data-science-ai
2. https://www.coursera.org/learn/python?specialization=python#syllabus

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A0536L.1	3	3	2	1	2	-	-	-	1	1	1	2	-	-
23A0536L.2	3	3	3	2	3	-	-	-	1	1	1	2	-	-
23A0536L.3	3	3	3	3	3	-	-	-	2	1	2	3	-	-
23A0536L.4	3	3	3	3	3	2	-	-	2	1	2	3	-	-
23A0536L.5	3	3	3	3	3	2	2	-	2	2	2	3	-	-

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Basic Embedded Systems and IoT
Category: SEC
Couse Code: 23A0434L
Branch/es: Mechanical Engineering
Semester: II B.Tech I-Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	1	2	2

Course Objectives:
1. To comprehend Microcontroller-Transducers Interface techniques
2. To establish Serial Communication link with Arduino
3. To analyse basics of SPI interface.
4. To interface Stepper Motor with Arduino
5. To analyse Accelerometer interface techniques
6. To introduce the Raspberry PI platform, that is widely used in IoT applications
7. To introduce the implementation of distance sensor on IoT devices.

Course Outcomes:
At the end of the course, the student will be able to
1. Comprehend Microcontroller-Transducers Interface techniques.
2. Establish Serial Communication link with Arduino
3. Analyse basics of SPI interface.
4. Understand the concept of M2M (machine to machine) with necessary protocols and get awareness in implementation of distance sensor.
5. Realize the revolution of internet in mobile devices, cloud and sensor networks

Embedded Systems Experiments: (Any 5 experiments from the following)
1. Measure Analog signal from Temperature Sensor.
2. Generate PWM output.
3. Drive single character generation on Hyper Terminal.
4. Drive a given string on Hyper Terminal.
5. Full duplex Link establishment using Hyper terminal.
6. Drive a given value on a 8 bit DAC consisting of SPI.
7. Drive Stepper motor using Analog GPIOs.
8. Drive Accelerometer and Display the readings on Hyper Terminal.

COMPONENTS/ BOARDS: 1. Arduino Duemilanove Board 2. Arduino Software IDE.

Prescribed Textbooks:

1. Embedded Systems Architecture- By Tammy Noergaard, Elsevier Publications, 2013.
2. Embedded Systems-By Shibu. K.V-Tata McGraw Hill Education Private Limited, 2013.
3. Embedded System Design, Frank Vahid, Tony Givargis, John Wiley Publications, 2013.
4. Embedded Systems-Lyla B.Das-Pearson Publications, 2013

Internet of Things Experiments: (Any 5 experiments from the following)
1. Getting started with Raspberry Pi, Install Raspian on your SD card.
2. Python-based IDE (integrated development environments) for the Raspberry Pi and how to trace and debug Python code on the device.
3. Using Raspberry pi a. Calculate the distance using distance sensor. b. Basic LED functionality.
4. Raspberry Pi interact with online services through the use of public APIs and SDKs.
5. Study and Install IDE of Arduino and different types of Arduino.
6. Study and Implement Zigbee Protocol using Arduino / Raspberry Pi.

7. Calculate the distance using distance sensor Using Arduino.
8. Basic LED functionality Using Arduino.
9. Calculate temperature using temperature sensor Using Arduino.
10. Calculate the distance using distance sensor Using Node MCU.
11. Basic LED functionality Using Node MCU.

Reference Books:

1. Arsheep Bahga & Vijay Madisetti, Internet of Things - A Hands-on Approach, 1/e, Orient Blackswan Private Limited - New Delhi, 2015.
2. Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015.
3. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014

Online Learning Sources

1. https://onlinecourses.nptel.ac.in/noc21_cs17/preview
2. https://onlinecourses.nptel.ac.in/noc20_ee98/preview
3. https://archive.nptel.ac.in/courses/108/105/108105057/
4. https://www.edx.org/learn/embedded-systems/the-university-of-texas-at-austin-embedded-systems-shape-the-world-microcontroller-input-output?index=product&objectID=course-785cf551-7f66-4350-b736-64a93427b4db&webview=false&campaign=Embedded+Systems+-+Shape+The+World%3A+Microcontroller+Input%2FOutput&source=edX&product_category=course&placement_url=https%3A%2F%2Fwww.edx.org%2Flearn%2Fembedded-systems
5. https://www.edx.org/learn/iot-internet-of-things/universitat-politecnica-de-valencia-introduction-to-the-internet-of-things?index=product&queryID=e1322674dcb3d246be981d0669265399&position=4&linked_from=autocomplete&c=autocomplete
6. https://www.edx.org/learn/iot-internet-of-things/curtin-university-iot-sensors-and-devices?index=product&queryID=94ff5bcb80b8e4f427a0985bb2a5e07f&position=3&results_level=first-level-results&term=IOT&objectID=course-967eee29-87e8-4f2d-9257-a1b38ec07e85&campaign=IoT+Sensors+and+Devices&source=edX&product_category=course&placement_url=https%3A%2F%2Fwww.edx.org%2Fsearch
7. Virtual Labs - http://vlabs.iitkgp.ac.in/rtes/
8. Virtual Labs - https://cse02-iiith.vlabs.ac.in/
9. Virtual Labs - https://iotvirtuallab.github.io/vlab/Experiments/index.html

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A0434L.1	2	3	2	2	-	-	-	-	-	-	-	-	-	-
23A0434L.2	1	2	3	1	-	-	-	-	-	-	-	-	-	-
23A0434L.3	2	3	2	2	-	-	-	-	-	-	-	-	-	-
23A0434L.4	3	2	1	1	-	-	-	-	-	-	-	-	-	-
23A0434L.5	2	2	2	2	-	-	-	-	-	-	-	-	-	-

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES: RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Environmental Science
Category: MC
Couse Code: 23AHS39T
Branch/es: ME, CE, ECE, CSE (DS), AIDS
Semester: II B.Tech I-Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
2	-	-	-

Course Objectives:
1. To make the students to get awareness on environment.
2. To understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day to day activities of human life.
3. To save earth from the inventions by the engineers.

Course Outcomes:
At the end of the course, the student will be able to
1. explain how natural resources should be utilised with a focus on sustainability.
2. describe the need to protect ecosystems and biodiversity for future generations.
3. comprehend major pollution problems related to ecosystems.
4. apply quantitative reasoning skills in the proper utilization of goods and services.
5. explain the interconnectedness of human dependence on the earth's ecosystems.

Unit 1 Natural Resources 7

Multidisciplinary nature of environmental studies: Definition, Scope and Importance – Need for public awareness. Natural Resources: Renewable and non-renewable resources – Natural resources and associated problems – Forest resources: Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and their effects on forest and tribal people – Water resources: Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer – pesticide problems, water logging, salinity, case studies – Energy resources.

Unit 2 Ecosystems, Biodiversity and its conservation 7

Ecosystems: Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystems: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).
Biodiversity and its conservation: Introduction - Definition: Genetic, species and ecosystem diversity – Bio-geographical classification of India – Value of biodiversity: Consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit 3 Environmental Pollution 6

Definition, causes, effects and control measures of: Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards.
Solid waste management: Causes**,** effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: Floods, earthquake, cyclone and landslides.

Unit 4 Social Issues and the Environment 5

From unsustainable to sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people: Its problems and concerns, case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies – Wasteland reclamation – Consumerism and waste products – Environment Protection Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and Control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act– Issues involved in enforcement of environmental legislation – Public awareness.

Unit 5 Human Population and the Environment 5

Population growth, variation among nations, Population explosion – Family welfare programmes – Environment and human health – Human rights – Value education – HIV/AIDS – Women and child welfare – Role of information technology in environment and human health – Case studies.

Field Work: Visit to a local area to document environmental assets – River/forest/grassland/hill/mountain – Visit to a local polluted site-Urban/Rural/Industrial/Agricultural, Study of common plants, insects and birds –Study of simple ecosystems - river, hill slopes etc..

Prescribed Text books:

1. Text book of Environmental Studies for Undergraduate Courses Erach Bharucha for University Grants Commission, Universities Press.
2. Palaniswamy, "Environmental Studies", Pearson Education.
3. S. Azeem Unnisa, "Environmental Studies" Academic Publishing Company.
4. K. Raghavan Nambiar, "Text book of Environmental Studies for Undergraduate Courses as per UGC model syllabus", Scitech Publications (India) Pvt. Ltd.

Reference Books:

1. Deeksha Dave and E. Sai Baba Reddy, "Textbook of Environmental Science", Cengage Publications.
2. M. Anji Reddy, "Text book of Environmental Sciences and Technology", BS Publication.
3. J.P. Sharma, "Comprehensive Environmental Studies", Laxmi publications.
4. J. Glynn Henry and Gary W. Heinke, "Environmental Sciences and Engineering", Prentice Hall of India Private Limited.
5. G.R. Chatwal, "A Text Book of Environmental Studies" Himalaya Publishing House.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23AHS39T.1	2	2	-	-	-	-	3	-	-	-	-	2	-	-
23AHS39T.2	2	2	-	-	-	-	3	-	-	-	-	2	-	-
23AHS39T.3	2	2	-	-	-	-	3	-	-	-	-	2	-	-
23AHS39T.4	3	2	-	-	-	-	3	-	-	-	-	3	-	-
23AHS39T.5	2	2	-	-	-	-	3	-	-	-	-	2	-	-

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Complex Variables, Probability and Statistics
Category: BS&H
Couse Code: 23AHS41T
Branch/es: Mechanical Engineering
Semester: II B.Tech II-Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To describe continuity/differentiability/analyticity of a function and find the derivative of a function.
2. To classify and explain complex power series, singularities, calculus of residues and its applications in the evaluation of integrals.
3. To introduce the basic concepts of probability theory.
4. To elucidate probability distribution for solving problems in engineering.
5. To introduce test of Hypothesis and confidence interval for a population parameter of large samples.

Course Outcomes:

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

1. apply the method to construct specific analytic functions from given data or conditions.
2. solve problems involving evaluation of definite integrals, trigonometric integrals by using the Residue theorem.
3. apply the concepts of probability theorems in stochastic process
4. apply the probability distribution in real life problems
5. evaluate the hypotheses of large samples

Unit 1 Complex Variable – Differentiation 8

Introduction to functions of complex variable-concept of Limit & continuity- Differentiation, Cauchy-Riemann equations (without proof), analytic functions harmonic functions, finding harmonic conjugate-construction of analytic function by Milne Thomson method.

Unit 2 Complex Variable – Integration 10

Line integral-Contour integration, Cauchy's integral theorem (Simple Case), Cauchy Integral formula, Power series expansions: Taylor's series, zeros of analytic functions, singularities, Laurent's series, Residues, Cauchy Residue theorem (without proofs), Evaluation of definite integral involving sine and cosine.

Unit 3 Probability theory & Random variables 8

Probability, probability axioms, addition law and multiplicative law of probability, conditional probability, Baye's theorem, random variables (discrete and continuous), probability density functions, properties, mathematical expectation.

Unit 4 Probability Distributions 8

Probability distribution - Binomial, Poisson approximation to the binomial distribution, Normal distribution and their properties.

Unit 5 Estimation and Testing of hypothesis, large sample tests 10

Estimation-parameters, statistics, sampling distribution, point estimation, Formulation of null hypothesis, alternative hypothesis, the critical and acceptance regions, level of significance, two types of errors and power of the test. Large Sample Tests: Test for single proportion, difference of proportions, test for single mean and difference of means. Confidence interval for parameters in one sample and two sample problems.

Prescribed Textbooks:

1. B. S. Grewal, Higher Engineering Mathematics, KhannaPublishers,2017, 44th Edition.
2. Miller and Freund, Probability and Statistics for Engineers,7/e, Pearson, 2008.

Reference Books:

1. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Alpha Science International Ltd.,2021 5th Edition (9th reprint).
2. B. V. Ramana, Higher Engineering Mathematics, Mc Graw Hill publishers
3. W. Feller, an Introduction to Probability Theory and its Applications, 1/e, Wiley,1968.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23AHS41T.1	3	2	1	2	-	-	-	-	-	-	-	1	-	-
23AHS41T.2	3	2	1	2	-	-	-	-	-	-	-	1	-	-
23AHS41T.3	3	2	1	2	-	-	-	-	-	-	-	1	-	-
23AHS41T.4	3	2	1	2	-	-	-	-	-	-	-	1	-	-
23AHS41T.5	3	3	2	3	-	-	-	-	-	-	-	1	-	-

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Industrial Management
Category: HSSM
Couse Code: 23AHS4BT
Branch/es: Mechanical Engineering
Semester: II B.Tech II-Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
2	-	-	2

Course Objectives: The objectives of the course are to
1. Introduce the scope and role of industrial engineering and the techniques for optimal design of layouts
2. Illustrate how work study is used to improve productivity and project management techniques
3. Explain TQM and quality control techniques
4. Introduce financial management aspects and
5. Discuss human resource management and value analysis

Course Outcomes:
At the end of the course, the student will be able to
1. Describe the principles and functions of management & Plant layouts.
2. Apply work study methods and project management concepts at Industrial level.
3. Analyze data using control charts to monitor and improve quality.
4. Understand various sources of finance and their implications.
5. Understand the human resource management methods.

Unit 1 **7**

INTRODUCTION: Definition of industrial engineering (I.E), development, applications, role of an industrial engineer, differences between production management and industrial engineering, quantitative tools of IE and productivity measurement. concepts of management, importance, functions of management, scientific management, Taylor's principles, theory X and theory Y, Fayol's principles of management.
PLANT LAYOUT: Factors governing plant location, types of production layouts, advantages and disadvantages of process layout and product layout, applications, quantitative techniques for optimal design of layouts, plant maintenance, preventive and breakdown maintenance

Unit 2 **7**

WORK STUDY: Importance, types of production, applications, work study, method study and time study, work sampling, PMTS, micro-motion study, rating techniques, MTM, work factor system, principles of Ergonomics, flow process charts, string diagrams and Therbligs.
PROJECT MANAGEMENT: Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), Identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing (simple problems).

Unit 3 **6**

STATISTICAL QUALITY CONTROL: Quality control, Queuing assurance and its importance, SQC, attribute sampling inspection with single and double sampling, Control charts X and R charts and their applications, simple numerical examples.
TOTAL QUALITY MANAGEMENT: Elements of TQM – Continuous Improvement zero defect concept, quality circles, implementation, applications, ISO quality systems. Six Sigma–definition, basic concepts

Unit 4 6

FINANCIAL MANAGEMENT: Scope and nature of financial management, Sources of finance, Ratio analysis, Management of working capital, estimation of working capital requirements, budget and budgetary control, Capital budgeting – Nature of Investment Decisions – Investment Evaluation criteria- NPV, IRR, PI, Payback Period, and ARR, numerical problems

Unit 5 **6**

HUMAN RESOURCE MANAGEMENT: Concept of human resource management, personnel management and industrial relations, functions of personnel management, Job-evaluation, its importance and types, merit rating, quantitative methods, wage incentive plans, and types.

VALUE ANALYSIS: Value engineering, implementation procedure, enterprise resource planning and supply chain management

Prescribed Textbooks:

1. O.P Khanna, Industrial Engineering and Management, Dhanpat Rai Publications (P) Ltd, 2018
2. Mart and Telsang, Industrial Engineering and Production Management, S.Chand & Company Ltd. New Delhi, 2006

Reference Books:

1. Bhattacharya DK, Industrial Management, S.Chand, publishers, 2010
2. J.G Monks, Operations Management, 3/e, McGraw Hill Publishers1987
3. T.R. Banga, S.C.Sharma, N. K. Agarwal, Industrial Engineering and Management Science, Khanna Publishers, 2008
4. Koontz O'Donnell, Principles of Management, 4/e, McGraw Hill Publishers, 1968
5. R.C.Gupta, Statistical Quality Control, Khanna Publishers, 1998
6. NVS Raju, Industrial Engineering and Management, 1/e, Cengage India Private Limited, 2013

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and	Life-long learning	**PSO1**	**PSO2**
23AHS4BT.1	2	2	2	2	-	-	-	-	-	-	-	-	1	1
23AHS4BT.2	3	2	2	2	-	-	-	-	-	-	-	-	1	1
23AHS4BT.3	2	2	2	2	-	-	-	-	-	-	-	-	1	1
23AHS4BT.4	3	2	2	2	-	-	-	-	-	-	-	-	1	1
23AHS4BT.5	2	2	2	2	-	-	-	-	-	-	-	-	1	1

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Manufacturing processes
Category: PC
Couse Code: 23A0341T
Branch/es: Mechanical Engineering
Semester: II B.Tech II-Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
The objectives of the course are to
1. Know the working principle of different metal casting processes and gating system.
2. Classify the welding processes, working of different types of welding processes and welding defects.
3. Know the nature of plastic deformation, cold and hot working process, working of a rolling mill and types, extrusion processes.
4. Understand the principles of forging, tools and dies, working of forging processes.
5. Know about the Additive manufacturing.

Course Outcomes:
At the end of the course, the student will be able to
1. Design the patterns and core boxes for metal casting processes
2. Understand the different welding processes
3. Demonstrate the different types of bulk forming processes
4. Understand sheet metal forming processes
5. Learn about the different types of additive manufacturing processes

Unit 1 **12**
Casting: Steps involved in making a casting – Advantage of casting and its applications. Patterns and Pattern making – Types of patterns – Materials used for patterns, pattern allowances and their construction, Molding, different types of cores , Principles of Gating, Risers, casting design considerations. Methods of melting and types of furnaces, Solidification of castings and casting defects- causes and remedies. Basic principles and applications of special casting processes - Centrifugal casting, Die casting, Investment casting and shell molding.

Unit 2 **8**
Welding: Classification of welding processes, types of welded joints and their characteristics, Gas welding, Different types of flames and uses, Oxy – Acetylene Gas cutting. Basic principles of Arc welding, power characteristics, Manual metal arc welding, submerged arc welding, TIG& MIG welding. Electro–slag welding. Resistance welding, Friction welding, Friction stir welding, Forge welding, Explosive welding; Thermit welding, Plasma Arc welding, Laser welding, electron beam welding, Soldering &Brazing.
Heat affected zones in welding; pre & post heating, welding defects –causes and remedies.

Unit 3 **8**
Bulk Forming: Plastic deformation in metals and alloys-recovery, recrystallization and grain growth.
Hot working and Cold working-Strain hardening and Annealing. Bulk forming processes: Forging-Types of Forging, forging defects and remedies; Rolling – fundamentals, types of rolling mills and products, Forces in rolling and power requirements. Extrusion and its characteristics. Types of extrusion, Impact extrusion, Hydrostatic extrusion; Wire drawing and Tube drawing.

Unit 4 10
Sheet metal forming-Blanking and piercing, Forces and power requirement in these operations, Deep drawing, stretch forming, Bending, Spring back and its remedies, Coining, Spinning, Types of presses and press tools.

High energy rate forming processes: Principles of explosive forming, electromagnetic forming, Electro hydraulic forming, rubber pad forming, advantages and limitations.

Unit 5 **10**

Additive manufacturing - Steps in Additive Manufacturing (AM), Classification of AM processes, Advantages of AM, and types of materials for AM, VAT photopolymerization AM Processes, Extrusion - Based AM Processes, Powder Bed Fusion AM Processes, Direct Energy Deposition AM Processes, Post Processing of AM Parts, Applications

Plastics: Classification – Properties – Plastics as engineering materials – Method of processing plastics – Injection Moulding – Blow Moulding – Extrusion compression and transfer Moulding.

Prescribed Textbooks:

1. Kalpakjain S and Steven R Schmid, Manufacturing Processes for Engineering Materials, 5/e, Pearson Publications, 2007.
2. P.N. Rao, Manufacturing Technology -Vol I, 5/e, McGraw Hill Education, 2018.

Reference Books:

1. A.Ghosh & A.K.Malik, Manufacturing Science, East West Press Pvt. Ltd, 2010.
2. Lindberg and Roy, Processes and materials of manufacture, 4/e, Prentice Hall India Learning Private Limited, 1990.
3. R.K. Jain, Production Technology, Khanna Publishers, 2022.
4. Sharma P.C., A Text book of Production Technology, 8/e, S Chand Publishing, 2014.
5. H.S. Shaun, Manufacturing Processes, 1/e, Pearson Publishers, 2012.
6. WAJ Chapman , Workshop Technology, 5/e, CBS Publishers & Distributors Pvt.Ltd, 2001.
7. Hindustan Machine Tools, Production Technology, Tata McGraw Hill Publishers, 2017.
8. Ian Gibson, David W Rosen, Brent Stucker., Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, 2/e, Springer, 2015.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A0341T.1	2	2	1	1	-	-	-	-	-	-	-	-	2	1
23A0341T.2	2	2	1	1	-	-	-	-	-	-	-	-	2	1
23A0341T.3	2	2	1	1	-	-	-	-	-	-	-	-	2	1
23A0341T.4	2	1	1	-	-	-	-	-	-	-	-	-	2	1
23A0341T.5	2	-	-	-	-	-	-	-	-	-	-	-	2	1

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Fluid Mechanics and Hydraulic Machines
Category: PC
Couse Code: 23A0342T
Branch/es: Mechanical Engineering
Semester: II B.Tech II-Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
The students completing this course are expected to
1. Understand the properties of fluids, manometry,hydrostatic forces acting on different surfaces
2. Understand the kinematic and dynamic behavior through various laws of fluids like continuity, Euler's, Bernoulli's equations, energy and momentum equations.
3. Understand the theory of boundary layer, working and performance characteristics of various hydraulic machines like pumps and turbines.

Course Outcomes:
At the end of the course, the student will be able to
1. Solve the problems related to fluid statics, Buoyancy and Floatation
2. Apply the fundamental equations for flow through various conduit and fluid kinematics
3. Solve the numerical using dimensional analysis and boundary layer theory concepts
4. Analyze the force exerted by jet on turbine blades as well as efficiency of turbines
5. Analyze the performance of hydraulic turbines, hydraulic systems and hydraulic pumps

Unit 1 **12**

Fluid statics: Dimensions and units: physical properties of fluids - specific gravity, viscosity and its significance, surface tension, capillarity, vapor pressure. Atmospheric, gauge and vacuum pressure, Measurement of pressure – Manometers - Piezometer, U-tube, inverted and differential manometers. Pascal's & hydrostatic laws.
Buoyancy and floatation: Meta center, stability of floating body. Submerged bodies. Calculation of metacenter height. Stability analysis and applications.

Unit 2 **8**

Fluid kinematics: Introduction, flow types. Equation of continuity for one dimensional flow, circulation and vorticity, Stream line, path line and streak lines and stream tube. Stream function and velocity potential function, differences and relation between them. Condition for irrotational flow, flownet, source and sink, doublet and vortex flow.
Fluid dynamics: surface and body forces –Euler's and Bernoulli's equations for flow along a stream line, momentum equation and its applications, force on pipe bend.
Closed conduit flow: Reynold's experiment- Darcy Weisbach equation- Minor losses in pipes- pipes in series and pipes in parallel- total energy line-hydraulic gradient line.

Unit 3 **8**

Boundary Layer Theory: Introduction, momentum integral equation, displacement, momentum and energy thickness, separation of boundary layer, control of flow separation, Stream lined body, Bluff body and its applications, basic concepts of velocity profiles.
Dimensional Analysis: Dimensions and Units, Dimensional Homogeneity, Non dimensionalization of equations, Method of repeating variables and Buckingham Pi Theorem.

Unit 4 **10**

Basics of turbo machinery: hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes.

Hydraulic Turbines: classification of turbines, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design – draft tube-theory- functions and efficiency.

Unit 5 **10**

Performance of hydraulic turbines: Geometric similarity, Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer. Hydraulic systems-hydraulic ram, hydraulic lift, hydraulic coupling. Fluidics – amplifiers, sensors andoscillators. Advantages, limitations and applications.

Centrifugal pumps: classification, working, work done – manometric head- losses and efficiencies- specific speed- pumps in series and parallel-performance characteristic curves, cavitation & NPSH. **Reciprocating pumps:** Working, Discharge, slip, indicator diagrams.

Prescribed Textbooks:

1. Y.A Cengel, J.M.Cimbala, Fluid Mechanics, Fundamentals and Applications,6/e, McGraw Hill Publications, 2019.
2. Dixon, Fluid Mechanics and Thermodynamics of Turbomachinery, 7/e, Elsevier Publishers, 2014.

Reference Books:

1. P N Modi and S M Seth, Hydraulics & Fluid Mechanics including Hydraulics Machines, Standard Book House, 2017.
2. RK Bansal, Fluid Mechanics and Hydraulic Machines, 10/e, Laxmi Publications (P)Ltd, 2019.
3. Rajput, Fluid Mechanics and Hydraulic Machines, S Chand & Company, 2016.
4. D.S. Kumar, Fluid Mechanics and Fluid Power Engineering, S K Kataria & Sons, 2013.
5. D. Rama Durgaiah, Fluid Mechanics and Machinery, 1/e, New Age International, 2002.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A0342T.1	3	2	1	2	-	-	-	-	-	-	-	-	2	1
23A0342T.2	3	2	1	2	-	-	-	--	-	-	-	-	2	1
23A0342T.3	3	2	1	2	-	-	-	-	-	-	-	-	1	1
23A0342T.4	3	3	2	2	-	-	-	-	-	-	-	-	1	2
23A0342T.5	3	3	2	2	-	-	-	-	-	-	-	-	1	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Theory of Machines
Category: PC
Couse Code: 23A0343T
Branch/es: Mechanical Engineering
Semester: II B.Tech II-Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives: The objectives of the course are to
1. Introduce various basic mechanisms and their applications.
2. Explain importance of degree of freedom.
3. Familiarize velocity and acceleration in mechanisms.
4. Describe the cams and follower motions.
5. Explain the importance of gyroscopic couples.
6. Introduce the equation of motion for single degree of freedom system.

Course Outcomes:
At the end of the course, the student will be able to
1. Understand different mechanisms and their inversions.
2. Calculate velocity and acceleration of different links in a mechanism.
3. Apply the effects of gyroscopic couple in ships, aero planes and road vehicles.
4. Evaluate unbalance mass in rotating machines.
5. Analyze free and forced vibrations of single degree freedom systems.

Unit 1 Simple Mechanisms **9**

Simple Mechanisms: Classification of mechanisms – Basic kinematic concepts and definitions – Degree of freedom, mobility – Grashof's law, kinematic inversions of four bar chain and slider crank chains- Limit positions – Mechanical advantage- Transmission angle- Description of some common mechanisms- Quick return mechanism, straight line mechanisms – Universal Joint – Rocker mechanisms.

Unit 2 Plane and motion analysis **9**

Plane and motion analysis: Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations – kinematic analysis of simple mechanisms – slider crank mechanism dynamics – Coincident points – Coriolis component of acceleration.

Unit 3 Gyroscope & Gear Profile **10**

Gyroscope: Principle of gyroscope, gyroscopic effect in an aeroplane, ship, car and two-wheeler, simple problems.

Gear Profile: Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting – helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics.

Unit 4 Balancing of Rotating masses & Cams **10**

Balancing of Rotating masses: Need for balancing, balancing of single mass and several masses in different planes, using analytical and graphical methods.

Cams: Classification of cams and followers- Terminology and definitions – Displacement diagrams –Uniform velocity, parabolic, simple harmonic and cycloidal motions – derivatives of follower motions- specified contour cams- circular and tangent cams –pressure angle and undercutting.

Unit 5 Vibrations & Turning Moment Diagrams and Flywheels 10

Vibrations: Introduction, degree of freedom, types of vibrations, free natural vibrations, Newton method and energy method for single degree of freedom. Damped vibrations- under damped, critically damped; and over damped systems, forced vibrations with and without damping in single degree of freedom; Vibration isolation and transmissibility.

Turning Moment Diagrams and Flywheels: Turning moment diagrams for steam engine, I.C engine and Multi Cylinder Engine. Crank effort – coefficient of fluctuation of energy, coefficient of fluctuation of speed – Fly Wheel and their design, fly wheels for punching press.

Prescribed Textbooks:

1. S.S.Rattan, Theory of Machines, 4/e, Tata Mc-Graw Hill, 2014.
2. P.L.Ballaney, Theory of Machines & Mechanisms, 25/e, Khanna Publishers, Delhi, 2003.

Reference Books:

1. F. Haidery, Dynamics of Machines, 5/e, NiraliPrakashan, Pune, 2003.
2. J.E.Shigley, Theory of Machines and Mechanisms, 4/e, Oxford, 2014.
3. G.K.Groover, Mechanical Vibrations, 8/e, Nemchand Bros, 2009.
4. Norton, R.L., Design of Machinery – An Introduction to Synthesis and Analysis of Mechanisms and Machines, 2/e, McGraw Hill, New York, 2000.
5. William T. Thomson, Theory of vibration with applications, 4/e, Englewood Cliffs, N.J.:Prentice Hall, 1993.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A0343T.1	3	2	1	-	-	-	-	-	1	-	1	-	1	1
23A0343T.2	3	2	2	-	-	-	-	-	2	-	1	-	1	1
23A0343T.3	3	2	2	-	-	-	-	-	2	-	1	-	1	1
23A0343T.4	3	2	1	-	-	-	-	-	1	-	1	-	1	1
23A0343T.5	3	2	2	-	-	-	-	-	2	-	1	-	1	1

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Manufacturing processes Lab
Category: PC
Couse Code: 23A0341L
Branch/es: Mechanical Engineering
Semester: II B.Tech II-Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	3	1.5

Course Objectives:
1. Acquire practical knowledge on Metal Casting, Welding, Press Working and Processing of Plastics

Course Outcomes:
At the end of the course, the student will be able to
1. Make moulds for sand casting.
2. Fabricate different types of components using various manufacturing techniques.
3. Adapt unconventional manufacturing methods.
4. Develop Different Weld joints.
5. Explain different types of 3d Printing techniques.

List of Experiments

1. Design and making of pattern
   I. Single piece pattern
   II. Split pattern
2. Sand properties testing
   i. Sieve analysis (dry sand)
   ii. Clay content test
   iii. Moisture content test
   iv. Strength test (Compression test & Shear test)
   v. Permeability test
3. Mould preparation
   i. Straight pipe
   ii. Bent pipe
   iii. Dumble
   iv. Gear blank
4. Gas cutting and welding
5. Manual metal arc welding
   i. Lap joint
   ii. Butt joint
6. Injection Molding
7. Blow Molding
8. Simple models using sheet metal operations
9. Study of deep drawing and extrusion operations
10. To make weldments using TIG/MIG welding
11. To weld using Spot welding machine
12. To join using Brazing and Soldering
13. To make simple parts on a 3D printing machine
14. Demonstration of metal casting.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A0341L.1	3	3	2	3	-	-	-	1	-	-	-	-	2	2
23A0341L.2	3	3	3	3	-	-	-	-	1	-	-	-	2	2
23A0341L.3	3	3	2	1	-	-	1	-	-	1	-	-	2	2
23A0341L.4	3	3	3	3	-	-	-	-	-	-	-	1	2	2
23A0341L.5	3	3	3	3	-	-	-	-	-	-	-	1	2	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Fluid Mechanics & Hydraulic Machines Lab
Category: PC
Couse Code: 23A0342L
Branch/es: Mechanical Engineering
Semester: II B.Tech II-Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	3	1.5

Course Objectives:

1. To provide knowledge in verifying Bernoulli's Theorem.
2. To impact knowledge in fluid flow measuring devices like Venturimeter & Orifice meter.
3. To understand frictional losses in pipes with various diameters.
4. To acquire knowledge about various hydraulic machines like centrifugal pump, reciprocating pump, Pelton wheel, Francis turbine, Kaplan turbine etc.
5. To understand impact of jet on vanes like flat vane & semi circular vane.

Course Outcomes:
A student will be able to

1. Apply the Bernoulli's Theorem for different flow channels.
2. Calculate the flow rate of fluids by the instruments like Venturimeter and Orificemeter.
3. Calculate the frictional losses in pipes.
4. Evaluate impact of jet on vanes like Flat vane & Semi-circular vane.
5. Evaluate different performance parameters of hydraulic machines

List of Experiments

1. Verification Of Bernoulli's Theorem
2. Flow Through Venturimeter
3. Flow Through Orifice meter
4. Determination of frictional losses in a given pile line.
5. Determination of loss of head due to sudden contraction in a pipeline.
6. Performance Test on Single Stage Centrifugal Pump
7. Performance Test On Multi Stage Centrifugal Pump
8. Performance Test on Reciprocating Pump
9. Impact Of Jet On Vanes
10. Performance Test on Pelton Wheel
11. Performance Test on Francis Turbine
12. Performance Test on Kaplan Turbine
13. Turbine flow meter.

Note: Any 10 of the above 13 experiments are to be conducted.

CO-PO-PSO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A0341L.1	3	2	2	2	-	-	-	-	1	-	-	-	2	2
23A0341L.2	3	2	2	2	-	-	-	-	1	-	-	-	2	2
23A0341L.3	3	2	2	2	-	-	-	-	1	-	-	-	2	2
23A0341L.4	3	3	2	3	-	-	-	-	1	-	-	1	2	2
23A0341L.5	3	3	2	3	-	-	-	1	1	-	-	1	2	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Fundamentals of Artificial Intelligence and Machine Learning
Category: SEC
Course Code: 23A0545L
Branch/es: Mechanical Engineering
Semester: II B.Tech II-Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	1	2	2

Course Objectives: The student should be made to,
1. study the concepts of Artificial Intelligence.
2. learn the methods of solving problems using Artificial Intelligence.
3. introduce the concepts of Expert Systems and machine learning.
4. learn about computing central tendency measures and Data preprocessing techniques.
5. learn about classification and regression algorithms.
6. apply different clustering algorithms for a problem.

Course Outcomes:
At the end of the course, the student will be able to
1. Understand the foundational concepts of Artificial Intelligence and its problem-solving techniques.
2. Apply machine learning methods, including Expert Systems, to address real-world challenges.
3. Perform data preprocessing and compute central tendency measures for effective data analysis.
4. Implement classification and regression algorithms for predictive analysis and decision-making.
5. Utilize clustering algorithms to analyze data patterns and group data for various applications.

Software Required for ML: Python/R/Weka List of Experiments
Week 1:
Pandas Library
a) Write a python program to implement Pandas Series with labels.
b) Create a Pandas Series from a dictionary.
c) Creating a Pandas Data Frame.
d) Write a program which makes use of the following Pandas methods
i) describe () ii) head () iii) tail () iv) info ()
Week 2:
Pandas Library: Visualization
e) Write a program which use pandas inbuilt visualization to plot following graphs:
i. Bar plots ii. Histograms iii. Line plots iv. Scatter plots
Week 3:
Write a Program to Implement Breadth First Search using Python.
Week 4:
Write a program to implement Best First Searching Algorithm
Week 5:
Write a Program to Implement Depth First Search using Python.
Week 6:
Write a program to implement the Heuristic Search
Week 7:
Write a python program to implement A* and AO* algorithm. (Ex: find the shortest path)
Week 8:
Apply the following Pre-processing techniques for a given dataset.
a) Attribute selection
b) Handling Missing Values
c) Discretization
d) d. Elimination of Outliers

Week 9:
Apply KNN algorithm for classification and regression
Demonstrate decision tree algorithm for a classification problem and perform parameter tuning for better results
Week 10:
Apply Random Forest algorithm for classification and regression
Week 11:
Demonstrate Naïve Bayes Classification algorithm
Week 12:
Apply Support Vector algorithm for classification
Implement the K-means algorithm and apply it to the data you selected. Evaluate performance by measuring the sum of the Euclidean distance of each example from its class center. Test the performance of the algorithm as a function of the parameters K.
Week 13:
Implementation of Logistic regression for iris using sklearn
Week 14:
Performance analysis on specific dataset

Prescribed Textbooks:

1. Prateek Joshi,Artificial Intelligence with Python,Packt Publishing, 2017.
2. Xiao, Perry. Artificial intelligence programming with Python: from zero to hero. John Wiley & Sons.

Reference Books:

1. Stuart J. Russell and Peter Norvig, Artificial Intelligence A Modern Approach, Fourth Edition, Pearson.
2. Martin C. Brown (Author), “Python: The Complete Reference” McGraw Hill Education, Fourth edition
3. 2. R. NageswaraRao , “Core Python Programming” Dreamtech Press India Pvt Ltd 2018.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and	Life-long learning	**PSO1**	**PSO2**
23A0545L.1	3	3	3	3	3	3	-	-	3	-	-	-	-	-
23A0545L.2	3	3	3	3	3	3	-	-	3	-	-	-	-	-
23A0545L.3	3	3	3	3	3	3	-	-	3	-	-	-	-	-
23A0545L.4	3	3	3	3	3	3	-	-	3	-	-	-	-	-
23A0545L.5	3	3	3	3	3	3	-	-	3	-	-	-	-	-

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Design Thinking & Innovation
Category: HSSM
Couse Code: 23A994AT
Branch/es: ECE, EEE, CSE(DS), AIDS, CSE, CSE(AI), AIML, CE, ME
Semester: II B.Tech II-Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
1	-	2	2

Course Objectives:
The objective of this course is to familiarize students with design thinking process as a tool for breakthrough innovation. It aims to equip students with design thinking skills and ignite the minds to create innovative ideas, develop solutions for real-time problems

Course Outcomes:
At the end of the course, the student will be able to
1. comprehend the fundamentals of Design Thinking and innovation
2. apply the design thinking techniques for solving problems in various sectors.
3. analyse to work in a multidisciplinary environment
4. evaluate the value of creativity
5. formulate specific problem statements of real time issues

Unit 1 Introduction to Design Thinking 12
Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design. Introduction to design thinking, history of Design Thinking, New materials in Industry.

Unit 2 Design Thinking Process 8
Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brainstorming, product development
Activity: Every student presents their idea in three minutes, every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development.

Unit 3 Innovation 8
Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations- Creativity to Innovation- Teams for innovation- Measuring the impact and value of creativity.
Activity: Debate on innovation and creativity, Flow and planning from idea to innovation, Debate on value-based innovation.

Unit 4 Product Design 10
Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications- Innovation towards product design- Case studies
Activity: Importance of modelling, how to set specifications, Explaining their own product design

Unit 5 Design Thinking in Business Processes 10
Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business – Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs- Design thinking for Startups- Defining and testing Business Models and Business Cases- Developing & testing prototypes.
Activity: How to market our own product, About maintenance, Reliability and plan for startup.

Prescribed Textbooks:

1. Tim Brown, Change by design, Harper Bollins (2009)
2. Idris Mootee, Design Thinking for Strategic Innovation, 2013, John Wiley & Sons.

Reference Books:

1. David Lee, Design Thinking in the Classroom, Ulysses press
2. Shrutin N Shetty, Design the Future, Norton Press
3. William Lidwell, Universal Principles of Design- Kritinaholden, Jill Butter.
4. Chesbrough. H, The Era of Open Innovation – 2013

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	**PSO1**	**PSO2**
23A994AT.1	1	-	-	-	-	-	-	-	-	-	-	1	-	-
23A994AT.2	-	2	2	-	1	1	-	-	-	-	1	1	-	-
23A994AT.3	-	1	2	-	-	-	-	-	1	1	-	1	-	-
23A994AT.4	-	3	-	-	-	-	-	-	1	1	-	1	-	-
23A994AT.5	-	3	3	3	-	-	-	-	-	-	1	1	-	-

Evaluation: There shall be external evaluation for 70 marks and internal evaluation for 30 marks. The external evaluation shall have the pattern similar to the evaluation pattern of theory courses. The internal evaluation shall be activity based, in the form of presentations / reports as per the curriculum and shall be evaluated for 15 marks by the concerned teacher and 15 marks for internal tests. There shall be two internal tests. The internal test shall be of 20 marks for subjective paper and 10 marks for objective paper, total shall be condensed to 15 marks.

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Machining Processes
Category: Professional Core
Couse Code: 23A0351T
Branch/es: Mechanical Engineering
Year & Semester: III Year I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
1. To gain knowledge on working principle of different metal cutting processes and familiarize with cutting forces, machining calculations and cutting fluids.
2. To make the student learn about principles of lathe and Drilling machines.
3. To make the student learn about principles of Grinding and Milling machines.
4. To acquire knowledge in the elementary mechanism and machinability of materials with different mechanical and Electrical energy-based Machining Processes.
5. To make student familiar with various advanced machining operations.

Course Outcomes:
At the end of the course, the student will be able to
1. Operate various machines like lathe, drilling, grinding, slotting, shaping, etc
2. Explain the working principles, types, operations, and tooling of conventional machine tools and perform basic machining time calculations.
3. Illustrate advanced machining processes, cutting tools and cutting fluids for a specific material and part features.
4. Differentiate Electrical Energy Based machining processes, mechanism of metal removal, machine tool selection.
5. Describe the principles, process parameters, applications, advantages, and limitations of chemical, electrochemical, and thermal energy-based machining processes.

Unit 1 Elementary treatment of metal cutting theory 10

Elementary treatment of metal cutting theory – Elements of cutting process – Geometry of single point tool and angles, chip formation and types of chips – built up edge and its effects, chip breakers. Mechanics of orthogonal cutting –Merchant's Force diagram, cutting forces – cutting speeds, feed, depth of cut, heat generation, tool life, coolants, machinability –economics of machining. cutting Tool materials and cutting fluids –types and characteristics.

Unit 2 Lathe and Reciprocating Machine Tools 09

Engine lathe – Principle of working- specification of lathe – types of lathes – work holders and tool holders – Taper turning, thread cutting operations and attachments for Lathes. Drilling, Boring Machines, Shaping, Slotting and planning machines - Principles of working, specifications, types, Tools and tool holding devices – operations performed, machining time calculation.

Unit 3 Milling & Abrasives Machining 12

Milling machine – Principles of working – specifications – classifications of milling machines – methods of indexing, milling cutters - machining operation, Accessories to milling machines. Grinding machine –Theory of grinding – classification– cylindrical and surface grinding machine – Tool and cutter grinding machine – Grinding wheel specification - types of abrasives – bonds, Truing and Dressing of wheels. Lapping, Honing and Broaching machines – comparison of grinding, lapping and honing. Principles of design of Jigs and fixtures and uses, Classification of Jigs & Fixtures – Principles of location and clamping –types.

Unit 4 Mechanical Energy Based Processes 10

Mechanical Energy Based Processes: Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultra Sonic Machining – Working Principle, Description of Equipment, Process Parameters, Metal

Removal Rate, Applications, Advantages and Limitations. Electrical Energy Based Processes: Electric Discharge Machining – Wire cut EDM - Working Principles, Process Parameters, Applications Advantages and Limitations.

Unit 5 Chemical and Electro Chemical Energy Based Processes 10

Chemical and Electro Chemical Energy Based Processes: Chemical Machining and Electro Chemical Machining – Working Principle, Etchants, Maskants, Techniques of Applying - Process Parameters, Electro Chemical Grinding, Electro Chemical Honing, Applications, Advantages and Limitations. Thermal Energy Based Processes: Laser Beam Machining and Drilling, Plasma Arc Machining, Electron Beam Machining – Working Principle, Process Parameters, Applications, Advantages and Limitations.

Prescribed Textbooks:

1. Manufacturing Technology-Kalpakzian- Pearson Seventh edition. (2018)
2. Production Technology by R.K. Jain and S.C. Gupta, Khanna Publishers, 17th edition.

Reference Books:

1. Pandey P.C and Shan H.S., Modern Machining Processes, 1/e, McGraw Hill, New Delhi, 2007.
2. Benedict G.F., Non-traditional Manufacturing Processes, 1/e, CRC Press, 1987.
3. Production Technology by H.M.T. (Hindustan Machine Tools), TMH, 1st edition, 2001
4. Manufacturing Technology Vol II by P.N. Rao, Tata McGraw Hill, 4th edition, 2013
5. Machine Technology Machine tools and operations by Halmi A Yousuf & Harson, CRC Press Taylor and Francies.
6. Workshop Technology – Vol II, B.S.Raghu Vamshi, Dhanpat Rai & Co, 10th edition, 2013
7. Jain V.K., Advanced Machining Processes, 1st Edition, Allied Publishers Pvt. Ltd., New Delhi, 2007.

Online Learning Resources:

- https://nptel.ac.in/courses/112/107/112107078/
- https://youtu.be/t3y_Ys3LgGM
- https://www.youtube.com/watch?v=E4VZ_rFqpG4&t=1s
- https://youtu.be/-tcaR7oSx_w
- https://youtu.be/Uybg6VDLoRQ
- https://youtu.be/Uybg6VDLoRQ

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A0351T.1	3	2	2	1	1	-	-	-	2	1	1	2	3	2
23A0351T.2	2	3	2	2	1	-	-	-	2	1	1	2	3	3
23A0351T.3	3	2	3	2	1	-	1	-	1	2	1	3	3	2
23A0351T.4	3	3	2	2	2	-	1	-	1	2	1	2	2	3
23A0351T.5	3	2	2	2	2	-	1	-	1	2	2	2	2	3

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Thermal Engineering
Category: Professional Core
Couse Code: 23A0352T
Branch/es: Mechanical Engineering
Year & Semester: III Year I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
1. To Gain knowledge on basic concepts of an I C Engine.
2. To Impart the knowledge of Engine subsystems.
3. To Acquaint with concept of combustion in SI & CI engines.
4. To Familiarize about various methods for measurement of engine performance.
5. To Provide insight on Air compressors.

Course Outcomes:
At the end of the course, the student will be able to
1. Summarize the concepts of IC engines.
2. Comprehend the Various engine subsystems.
3. Comprehend the combustion in SI & CI engines.
4. Calculate the performance of IC Engines.
5. Calculate the performance of air compressors.

Unit 1 Introduction to I.C. Engines 06
Definition of Engine and Heat Engine, I.C Engine Classification – Parts of I.C. Engines, Working of I.C. Engines, Two Stroke & Four Stroke I.C. Engines SI & CI Engines, Valve and Port Timing Diagrams.

Unit 2 Fuel, Cooling & Lubrication systems 10
Fuel System: S.I. Engine: Fuel Supply Systems, carburettor types Air Filters, Mechanical and Electrical Fuel Pump – Filters– Gasoline Injection Systems.
Cooling & Lubrication Systems: Cooling Requirements, Air Cooling, Liquid Cooling, Thermo Syphon, Water and Forced Circulation System, Lubrication Systems-Flash, Pressurized and Mist Lubrication. Ignition **System:** Function of an Ignition System, Battery coil Ignition System, Magneto Coil Ignition System, Electronic Ignition System using Contact Breaker, Electronic Ignition using Contact Triggers – Spark Advance and Retard Mechanism.

Unit 3 Combustion in SI & CI Engines 10
Combustion in SI engine: Normal Combustion and Abnormal Combustion – Importance of Flame Speed and Effect of Engine Variables – Type of Abnormal Combustion, Pre-Ignition and Knocking (Explanation) – Fuel Requirements and Fuel Rating, Anti Knock Additives, Combustion Chambers.
Combustion in CI Engines: Stages of Combustion – Delay Period and Its Importance – Effect of Engine Variables – Diesel Knock– Combustion Chambers (DI And IDI), Fuel Requirements and Fuel Rating.

Unit 4 Testing and performance of IC engines. 10
Testing and Performance: Parameters of Performance - Measurement of Cylinder Pressure, Fuel Consumption, Air Intake, Exhaust Gas Composition, Brake Power – Determination of Frictional Losses and Indicated Power – Performance Test – Heat Balance Sheet and Chart.

Unit 5 Air Compressors 12
Reciprocating Compressors, Effect of Clearance volume in Compressors, Volumetric Efficiency, Single Stage and Multi Stage Compressors, Effect of Inter cooling and Pressure Drop in Multi - Stage Compressors,

Problems Related to Reciprocating Compressors, Working principles of Roots blower, Vane type Blower, Centrifugal Compressor - Axial Flow Compressors.

Textbooks:

1. I.C. Engines - V. Ganesan- TMH- 4th edition -2017- ISBN-13. 978-1259006197
2. Thermal Engineering-Rajput-Lakshmi Publications -11th edition -2020- ISBN-13. 978-8131808047.

Reference Books:

1. Internal Combustion Engine Fundamentals- John B. Heywood- TMH-2018-ISBN: 9781260116106
2. IC Engines – Mathur& Sharma – DhanpathRai & Sons -2017-ISBN-13: 978-9383182428
3. Engineering fundamentals of IC Engines – Pulkrabek- Pearson- PHI 2nd edition -2015- ISBN-13: 978-9332549494
4. Thermal Engineering-Rudra Moorthy – TMH 1st edition -2017-ISBN-13: 978-0070494985
5. Thermodynamics & Heat Engines- B. Yadav- Central Book Depot., Allahabad -2002-ISBN-13: 978-8185444031

Online Learning Resources:

- https://nptel.ac.in/courses/112103316
- https://youtube.com/playlist?list=PLwdnzlV3ogoWV-_n1YItO933MxgPXfEiM&si=QcuZlil5MRldeTiD
- https://youtu.be/FDmYCI_xYIA?si=vS1kdhqc5WCRnl21
- https://youtube.com/playlist?list=PLfq4fiRrJSn5leKEZoUF-2vBkMG37iGs8&si=nZVdvgmACy-lVvSC

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A0352T.1	3	2	-	-	-	-	-	-	-	-	-	1	2	-
23A0352T.2	3	2	-	-	-	-	-	-	-	-	-	1	2	1
23A0352T.3	3	3	2	1	-	-	1	-	-	-	-	1	2	2
23A0352T.4	3	3	2	2	-	-	-	-	-	-	-	1	2	2
23A0352T.5	3	3	2	2	-	-	-	-	-	-	-	1	2	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Metrology and Measurements
Category: Professional Core
Couse Code: 23A0353T
Branch/es: Mechanical Engineering
Year & Semester: III Year I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To explain the system of limits, fits &tolerances and design of gauges
2. To identify the use of flatness and surface gauges
3. To know the measurement of screw thread, Gear profiles
4. To describe the Measurement of Displacement and Strain
5. To illustrate the measuring process of Pressure, Force and Torque

Course Outcomes:

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

1. Summarize the concepts of limits, fits, limit gauges and linear & angular measuring instruments
2. Explain the concepts of flatness and surface roughness measurements.
3. Describe the measurement of screw thread and Gear profiles.
4. Summarize the measuring process of Displacement and Strain
5. Summarize the measuring process of Pressure, Force and Torque

Unit 1 Concept of measurement **15**

Concept of Measurement: Concept of feedback Control systems -generalized measurement system, units and standards, measuring instruments, sensitivity, readability, range of accuracy, precision, static and dynamic response, repeatability, systematic and random errors, correction, calibration, terminology and limits fits and tolerances, hole basis and shaft basis system, interchangeability.

Linear and Angular Measurement**:** Linear measuring instruments: Vernier instruments, micrometers, slip gauges, tool makers microscope. Comparators: Mechanical, pneumatic and electrical. Angular measurements: Sine bar, bevel protractor and angle dekkor, rollers and spheres used to determine the tapers.

Limit Gauges and Gauge Design**:** Plug, Ring, Snap, Gap, Taper gauges. Taylor's principle. Design of Go and No-Go gauges.

Unit 2 Screw Thread and Gear Measurement **07**

Screw thread measurements: Elements of threads, errors in screw threads, various methods for measuring external and internal screw threads, screw thread gauges.

Gear Measurement**:** Gear tooth terminology, measurement of gear elements-run out, lead, pitch backlash, profile, pressure angle, tooth thickness, diameter of gear, constant chord and base tangent method.

Coordinate Measuring Machine (CMM)- Construction and features.

Unit 3 Flatness and Surface Roughness measurement **08**

Flatness Measurement: Measurement of flatness – straight edges – surface plates, optical flat and autocollimators, interferometers and their applications.

Surface Roughness Measurement: Terminology systems, differences between surface roughness and surface waviness- Numerical assessment of surface finish - CLA, R.M.S Value-Ra, Rz values, Methods of measurement of surface finish-profilograph, Talysurf, BIS symbols for indication of surface roughness.

Unit 4 Measurement of Displacement and Strain **08**

Measurement of Displacement: Theory and construction of various transducers to measure displacement – Piezo-electric, inductive, capacitance, resistance, ionization and photoelectric transducers, calibration

procedures.
Measurements of Strain**:** Various types of electrical strain gauges, gauge factor, method of usage of resistance strain gauge for bending, compressive and tensile strains, usage for measuring torque, strain gauge rosettes.

Unit 5 Measurement of Force, Torque and Pressure 10

Measurement of Force: Direct method - analytical balance, platform balance; elastic members – load cells, cantilever beams and proving rings.
Measurement of Torque: Torsion bar dynamometer, servo controlled dynamometer and absorption dynamometer.
Measurement of Pressure: Standards and calibration, basic methods of pressure measurement, dead weight gauges and manometers, High- and low-pressure measurement, Elastic transducers.

Textbooks:

1. Engineering Metrology, R.K. Jain, Khanna Publishers, special edition 2022. ISBN-13 : 978-8174091536
2. Basic Principles - Measurements and Control Systems. S.Bhaskar, Anuradha Publications, 2007. ISBN-13 : 978-8189638900

Reference Books:

1. Mechanical Measurements, Beckwith, Marangoni, Linehard, , PHI, 2013, ISBN-13 : 978-9332518520
2. Metrology & Measurement, Anand K Bewoor & Vinay A Kulkarni, 15/e, McGrawHill, 2017 . ISBN-13 : 978-0070140004
3. Mechanical Measurements & Control, D.S. Kumar, Metropolitan Publishers, 5/e, 2015.

Online Learning Resources:

- https://www.digimat.in/nptel/courses/video/112104250/L47
- https://www.digimat.in/nptel/courses/video/112106138/L01
- https://www.digimat.in/nptel/courses/video/112106179/L01
- https://www.youtube.com/watch?v=tczyyM4Dykc
- https://www.youtube.com/watch?v= UsAiZ mRC1M
- https://www.youtube.com/watch?v=oCkax I19X8

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	**PSO1**	**PSO2**
23A0353T.1	3	2	1	1	-	-	-	-	-	-	-	-	2	2
23A0353T.2	3	2	1	1	-	-	-	-	-	-	-	-	2	2
23A0353T.3	3	2	1	1	-	-	-	-	-	-	-	-	2	2
23A0353T.4	3	2	1	1	-	-	-	-	-	-	-	-	2	2
23A0353T.5	3	2	1	1	-	-	-	-	-	-	-	-	2	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Introduction To Quantum Technologies and Applications
Category: Professional Core
Couse Code: 23A0554T
Branch/es: Mechanical Engineering
Year & Semester: III Year I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To introduce fundamental quantum concepts like superposition and entanglement.
2. To understand theoretical structure of qubits and quantum information.
3. To explore conceptual challenges in building quantum computers.
4. To explain principles of quantum communication and computing.
5. To examine real-world applications and the future of quantum technologies.

Course Outcomes:

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

1. Explain core quantum principles in a non-mathematical manner.
2. Compare classical and quantum information systems.
3. Identify theoretical issues in building quantum computers.
4. Discuss quantum communication and computing concepts.
5. Recognize applications, industry trends, and career paths in quantum technology.

Unit 1 Introduction to Quantum Theory and Technologies 12

The transition from classical to quantum physics, Fundamental principles explained conceptually: Superposition, Entanglement, Uncertainty Principle, Wave-particle duality, Classical vs Quantum mechanics – theoretical comparison, Quantum states and measurement: nature of observation, Overview of quantum systems: electrons, photons, atoms. The concept of quantization: discrete energy levels, Why quantum? Strategic, scientific, and technological significance. A snapshot of quantum technologies: Computing, Communication, and Sensing, National and global quantum missions: India‘s Quantum Mission, EU, USA, China

Unit 2 Theoretical Structure of Quantum Information Systems 08

What is a qubit? Conceptual understanding using spin and polarization, Comparison: classical bits vs quantum bits, Quantum systems: trapped ions, superconducting circuits, photons (non-engineering view),Quantum coherence and decoherence – intuitive explanation, Theoretical concepts: Hilbert spaces, quantum states, operators – only interpreted in abstract, The role of entanglement and non-locality in systems, Quantum information vs classical information: principles and differences, Philosophical implications: randomness, determinism, and observer role

Unit 3 Building a Quantum Computer – Theoretical Challenges and Requirements 08

What is required to build a quantum computer (conceptual overview)?,Fragility of quantum systems: decoherence, noise, and control, Conditions for a functional quantum system: Isolation, Error management, Scalability, Stability, Theoretical barriers: Why maintaining entanglement is difficult, Error correction as a theoretical necessity, Quantum hardware platforms (brief conceptual comparison),Superconducting circuits, Trapped ions, Photonics, Vision vs reality: what‘s working and what remains elusive. The role of quantum software in managing theoretical complexities

Unit 4 Quantum Communication and Computing – Theoretical Perspective 08

Quantum vs Classical Information, Basics of Quantum Communication, Quantum Key Distribution (QKD), Role of Entanglement in Communication, The Idea of the Quantum Internet – Secure Global Networking,

Introduction to Quantum Computing, Quantum Parallelism (Many States at Once), Classical vs Quantum Gates, Challenges: Decoherence and Error Correction, Real-World Importance and Future Potential.

Unit 5 Applications, Use Cases, and the Quantum Future 10

Real-world application domains: Healthcare (drug discovery), Material science, Logistics and optimization, Quantum sensing and precision timing, Industrial case studies: IBM, Google, Microsoft, Psi Quantum, Ethical, societal, and policy considerations, Challenges to adoption: cost, skills, standardization, Emerging careers in quantum: roles, skillsets, and preparation pathways, Educational and research landscape – India's opportunity in the global quantum race

Textbooks:

1. Michael A. Nielsen, Isaac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press, 10th Anniversary Edition, 2010.
2. Eleanor Rieffel and Wolfgang Polak, Quantum Computing: A Gentle Introduction, MIT Press, 2011.
3. Chris Bernhardt, Quantum Computing for Everyone, MIT Press, 2019.

Reference Books:

1. David McMahon, Quantum Computing Explained, Wiley, 2008.
2. Phillip Kaye, Raymond Laflamme, Michele Mosca, An Introduction to Quantum Computing, Oxford University Press, 2007.
3. Scott Aaronson, Quantum Computing Since Democritus, Cambridge University Press, 2013.
4. Alastair I.M. Rae, Quantum Physics: A Beginner's Guide, Oneworld Publications, Revised Edition, 2005.
5. Eleanor G. Rieffel, Wolfgang H. Polak, Quantum Computing: A Gentle Introduction, MIT Press, 2011.
6. Leonard Susskind, Art Friedman, Quantum Mechanics: The Theoretical Minimum, Basic Books, 2014.
7. Bruce Rosenblum, Fred Kuttner, Quantum Enigma: Physics Encounters Consciousness, Oxford University Press, 2nd Edition, 2011.
8. GiulianoBenenti, GiulioCasati, GiulianoStrini, Principles of Quantum Computation and Information, Volume I: Basic Concepts, World Scientific Publishing, 2004.
9. K.B. Whaley et al., Quantum Technologies and Industrial Applications: European Roadmap and Strategy Document, Quantum Flagship, European Commission, 2020.
10. Department of Science & Technology (DST), Government of India, National Mission on Quantum Technologies & Applications – Official Reports and Whitepapers, MeitY/DST Publications, 2020 onward.

Online Learning Resources:

- IBM Quantum Experience and Qiskit Tutorials
- Coursera – Quantum Mechanics and Quantum Computation by UC Berkeley
- edX – The Quantum Internet and Quantum Computers
- YouTube – Quantum Computing for the Determined by Michael Nielsen
- Qiskit Textbook – IBM Quantum

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A0554T.1	3	2	1	1	2	1	1	1	1	2	1	3	3	2
23A0554T.2	3	3	1	2	2	1	1	1	1	2	1	3	3	2
23A0554T.3	3	3	1	2	3	2	1	1	1	2	1	3	3	3
23A0554T.4	3	3	1	2	3	2	1	1	1	3	1	3	3	3
23A0554T.5	2	2	1	1	2	3	2	2	2	3	2	3	2	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Tool Design
Category: Professional Elective-I
Couse Code: 23A035AT
Branch/es: Mechanical Engineering
Semester: III Year I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
1. To understand the fundamentals of tool engineering and the role of tool design in manufacturing
2. To analyze the principles of metal cutting and apply them to cutting tool design
3. To design various jigs and fixtures using proper locating and clamping principles
4. To evaluate and design different types of press tool dies for sheet metal operations.
5. To develop tooling and fixture strategies suitable for CNC machining systems.

Course Outcomes:
At the end of the course, the student will be able to
1. Understand tool design fundamentals, select appropriate materials, and design effective tools to develop durable, precise tools for various manufacturing applications.
2. Analyze the principles of metal cutting and apply them to cutting tool design.
3. Design various jigs and fixtures using proper locating and clamping principles.
4. Evaluate and design different types of press tool dies for sheet metal operations
5. Develop tooling and fixture strategies suitable for CNC machining systems.

Unit 1 Introduction To Tool Design **08**

Introduction –Tool Engineering – Tool Classifications– Tool Design Objectives – Tool Design in manufacturing- Challenges and requirements- Standards in tool design-Tool drawings -Surface finish – Fits and Tolerances - Tooling Materials- Ferrous and Nonferrous Tooling Materials- Carbides, Ceramics and Diamond –Nonmetallic tool materials-Designing with relation to heat treatment.

Unit 2 Design Of Cutting Tools **08**

Mechanics of Metal cutting –Oblique and orthogonal cutting- Chip formation and shear angle - Single-point cutting tools – Milling cutters – Hole making cutting tools- Broaching Tools - Design of Form relieved and profile relieved cutters-Design of gear and thread milling cutters.

Unit 3 Design Of Jigs and Fixtures **10**

Introduction – Fixed Gages – Gage Tolerances –selection of material for Gauges – Indicating Gages – Automatic gages – Principles of location – Locating methods and devices – Principles of clamping – Drill jigs – General considerations in the design of drill jigs – Drill bushings – Methods of construction –Types of Fixtures – Vice Fixtures – Milling Fixtures – Boring Fixtures – Broaching Fixtures.

Unit 4 Design Of Press Tool Dies **06**

Types of Dies –Method of Die operation–Clearance and cutting force calculations- Blanking and Piercing die design – Pilots – Strippers and pressure pads- Presswork materials – Centre of pressure -Strip layout – Short-run tooling for Piercing – Bending dies – Drawing dies-Design and drafting.

Unit 5 Tool Design For CNC Machine Tools **08**

Introduction –Tooling requirements for Numerical control systems – Fixture design for CNC machine tools-Sub plate and tombstone fixtures-Universal fixtures– Cutting tools– Tool holding methods– Automatic tool changers and tool positioners – Tool presetting– General explanation of the Brown and Sharp machine.

Prescribed Textbooks:

1. Tool Design, Cyrll Donaldson, George H.LeCain, V.C. Goold, Tata McGraw Hill Publishing Company Ltd., 2000.
2. Jig and Fixture Design, E.G.Hoffman, Thomson Asia Pvt Ltd, Singapore, 2004.

Reference Books:

1. A Text book of Production Engineering, P.C.Sharma, S.Chand Publications, 1999.
2. Tooling data‖, Prakash Hiralal Joshi, —Wheeler Publishing, 2000
3. Design of Jigs, Fixtures and Press tools, Venkataraman K., — TMH, 2005.
4. Manufacturing Technology, Haslehurst M., — The ELBS, 1978.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	**PSO1**	**PSO2**
23A035AT.1	3	2	3	2	2	-	-	1	1	-	1	3	2
23A035AT.2	3	3	3	2	2	-	-	1	1	-	1	3	2
23A035AT.3	3	2	3	2	2	-	-	1	1	-	1	3	2
23A035AT.4	3	2	3	2	2	-	-	1	1	-	1	3	2
23A035AT.5	3	3	3	2	3	-	-	1	1	-	1	3	3

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Automobile Engineering
Category: Professional Elective-I
Couse Code: 23A035BT
Branch/es: Mechanical Engineering
Year & Semester: III Year I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
1. To impart the knowledge on I C Engine, Automobile chassis and Body.
2. To familiarize different fuel systems and types of ignitions systems.
3. To gain knowledge on Principles of Steering system and Suspension system.
4. To awareness about on wheels, Tyres and braking system.
5. To provide insight on Automobile electrical system.

Course Outcomes:
At the end of the course, the student will be able to
1. Summarize the different parts and develop the automobile systems to analyze engine components
2. Identify the working of various parts in ignition system to apply the different vehicles and design the ignition and fuel injection systems.
3. Demonstrate how the steering and the suspension systems works, types of steering and suspension systems and its applications.
4. Recognize the different types of wheels and braking systems. Choose the suitable tyres and brakes for different applications.
5. Utilize different electrical systems in automobiles. Apply advanced electrical circuits. Create advanced Global Positioning System (GPS), Hybrid vehicle, Fuel Cell.

Unit 1 Introduction to vehicle structure and engine components 10

Vehicle construction -Chassis and body - Specifications - Engine - Types - Construction - Location of engine - Cylinder arrangement - Construction details - Cylinder block - Cylinder head - Cylinder liners - Piston – piston rings - Piston pin - Connecting rod - Crankshaft - Valves. Lubrication system - Types - Oil pumps - Filters. Crankcase ventilation.

Unit 2 Ignition and fuel supply systems 09

Ignition system -Coil and Magneto - Spark plug - Distributor – Electronic ignition system - Fuel system - Carburetor - Fuel pumps - Fuel injection systems - Mono point and Multi point – Unit Injector – Nozzle types - Electronic Fuel Injection system (EFI) – GDI, MPFI, DTSI.

Unit 3 Steering and suspension system 09

Principle of steering -Steering Geometry and wheel alignment - Steering linkages – Steering gearboxes - Power steering - front axle - Suspension system - Independent and Solid axle – coil, leaf spring and air suspensions - torsion bar - shock absorbers.

Unit 4 Wheels, Tyres and Braking System 09

Wheels and Tyres - Construction - Type and specification - Tyre wear and causes - Brakes - Needs – Classification –Drum and Disc Mechanical - Hydraulic and pneumatic - Vacuum assist – Retarders – Anti-lock Braking System (ABS).

Unit 5 Automobile electrical systems and advances in automobile engineering 09

Battery-General electrical circuits- Active Suspension System (ASS) - Electronic Brake Distribution (EBD) – Electronic Stability Program (ESP), Traction Control System (TCS) - Global Positioning System (GPS), Hybrid vehicle, Fuel Cell.

Textbooks:

1. Automotive Mechanics, William. H. Crouse, 10/e, McGraw-Hill, 2006.
2. Automobile Engineering, Kirpal Singh, Vol.1&2, Standard Publications, 13/e, 2020.

Reference Books:

1. Automotive Hand Book, Bosch, 6/e, SAE Publications, 2007.
2. The motor vehicle, K. Newton and W. Steeds, 13/e, Butterworth-Heinemann Publishing Ltd, 1989.
3. Automotive Mechanics Principles and Practices, Joseph Heitner, 2/e, CBS publishing 2004.
4. Automotive Engineering Fundamentals" Richard Stone, Jeffrey K. Ball, SAE International, 2004.
5. Automotive Engineering: Powertrain, Chassis System and Vehicle Body, David A. Corolla, Butterworth-Heinemann Publishing Ltd, 2009.

Online Learning Resources:

- https://nptel.ac.in/courses/107106088
- https://nptel.ac.in/courses/107106080
- https://hindustanuniv.ac.in/assets/pdf/ug/CBCS/cbcs-automobile-2018.pdf
- https://ed.iitm.ac.in/~shankarram/Course_Files/ED5160/ED5160.htm
- https://dbatu.ac.in/wp-content/uploads/2020/07/B-Tech-Automobile_Final-Yr_22.06.2020-pdf
- https://www.youtube.com/channel/UCGLlbmSTaLNUPhDwsMe-SgQ

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	**PSO1**	**PSO2**
23A035BT.1	2	2	2	2	-	-	-	1	-	1	-	1	2	1
23A035BT.2	2	2	2	2	-	-	-	1	-	1	-	1	2	1
23A035BT.3	2	2	2	2	-	-	-	1	-	1	-	1	2	1
23A035BT.4	2	2	2	2	-	-	-	1	-	1	-	1	2	1
23A035BT.5	2	2	2	2	-	-	-	1	-	1	-	1	2	1

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Mechanical Behaviour of Materials
Category: Professional Elective-I
Course Code: 23A035CT
Branch/es: Mechanical Engineering
Year & Semester: III Year I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To explain the structure of material over the effects of mechanical properties.
2. To analyze the defects inside the structure and their effects on the mechanical properties.
3. To train the methods for characterization of the mechanical behavior of materials.
4. To impart knowledge about strengthening mechanisms of materials.
5. To explain mechanisms of failures of materials (fracture, fatigue and creep) and their relationship with the different types of stress.

Course Outcomes:

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

1. Analyze the elastic behaviour of engineering materials, recall Hooke‘s law and apply the dislocation theory, forces on and between dislocations.
2. Apply dispersion strengthening and fiber strengthening mechanisms, differentiate strain aging and dynamic strain aging and create grain size strengthening and solid solution strengthening
3. Identify the various modes of fracture and clarify the basic mechanism of ductile and brittle fracture, Identify importance of Griffith‘s theory. Calculate factors effecting on DBTT.
4. Explain fatigue behaviour and testing. Discuss the factors affecting fatigue. Apply fracture mechanics in design.
5. Identify the various structural changes during creep and predict the metallurgical factors affecting creep and creep different testing.

Unit 1 Elastic and plastic behavior **10**

Elastic behavior of materials – Hooke‘s law, plastic behavior: dislocation theory – Burger‘s vectors and dislocation loops, dislocations in FCC, HCP and BCC lattice, stress fields and energies of dislocations, forces on and between dislocations, slip and twinning.

Unit 2 Strengthening mechanisms **09**

Cold Working, Grain Size Strengthening, Solid Solution Strengthening, Martensitic Strengthening, Precipitation Strengthening, Dispersion Strengthening, Fiber Strengthening, Examples. Yield Point Phenomenon, Strain aging and Dynamic strain aging.

Unit 3 Fracture and fracture mechanics **09**

Types of Fracture, Basic Mechanism of Ductile and Brittle Fracture, Griffith‘s Theory of Brittle Fracture, Ductile to Brittle Transition Temperature (DBTT), Factors Affecting DBTT, Determination of DBTT. Fracture Mechanics-Introduction, Modes of Fracture, Stress Intensity Factor, Strain Energy Release Rate, Fracture Toughness and Determination of KIC.

Unit 4 Fatigue behaviour and testing **09**

Stress Cycles, S-N Curves, Effect of Mean Stress, Factors Affecting Fatigue, Structural Changes Accompanying Fatigue, Cumulative Damage, HCF / LCF, Thermo-mechanical Fatigue, Application of Fracture Mechanics to Fatigue Crack Propagation-Paris law- Fatigue Testing Machines.

Unit 5 Creep behavior and testing **10**

Creep Curve, Stages in Creep Curve and Explanation, Structural Changes during Creep, Creep Mechanisms,

Metallurgical Factors Affecting Creep, High Temperature Alloys, Stress Rupture Testing, Creep Testing Machines.

Textbooks:

1. Mechanical Metallurgy, Dieter, G.E., —McGraw-Hill, SI Edition, 2017, ISBN-13: 978-1259064791
2. The Testing of Engineering Material, Davis. H. E., Troxell G.E., Hauck.G. E. W., — McGraw-Hill, 2015. ISBN: 0-70-015656-5

Reference Books:

1. The Structure & Properties of Materials, vol-3: Mechanical Behavior, H W & John Wulff Hayden, John Wiley and Sons, 1983, ISBN: 047136469X
2. The Plastic Deformation of Materials, Honey Combe R. W. K., Edward Arnold Publishers, 2022, ISBN-10:0713134682
3. Testing of Metallic Materials‖, Suryanarayana, A. V. K., —BS Publications, 2018. ISBN: 9788178001340

Online Learning Resources:

- https://nptel.ac.in/courses/113104105
- https://nptel.ac.in/courses/113104104
- https://youtube.com/playlist?list=PLyqSpQzTE6M9QPU_tubmtQ97e7zRpaMlD&si=H5qNNyv3nYL8jztY
- https://youtube.com/playlist?list=PLxQw8LdroTlPNimLKW-MWldJQHVLBESGs&si=ULCr6KGQwMPXhNC2
- https://youtube.com/playlist?list=PL-g1KbXtGBBvF3G4lQuY0zSGBFHh4-5kF&si=47R1eQ_zAWcO-9A

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A035CT.1	3	2	2	2	-	-	-	1	-	1	-	1	1	2
23A035CT.2	3	3	2	2	-	-	-	1	-	1	-	1	2	2
23A035CT.3	3	3	2	2	-	-	-	1	-	1	-	1	3	2
23A035CT.4	3	2	2	3	-	-	-	1	-	1	-	1	1	3
23A035CT.5	3	2	2	2	-	-	-	1	-	1	-	1	2	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Work Study and Ergonomics
Category: Professional Elective-I
Couse Code: 23A035DT
Branch/es: Mechanical Engineering
Year & Semester: III Year I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
1. To develop concepts related to principles of productivity & work study as a tool for increasing the efficiency and effectiveness in organizational systems.
2. To study the existing method, compare and propose a new method.
3. To provide the usage of the various tools and techniques used in work measurement
4. To develop basic ideas of ergonomics and its design.
5. To develop concepts related Man-Machine Interfaces and Design of Displays and controls.

Course Outcomes:
At the end of the course, the student will be able to
1. Describe the basic concepts of productivity, work content and work study and define the objective and scope of Work Study.
2. Describe the various charts and to construct the charts on the basis of present method and develop a new / proposed method and identify the unnecessary movements.
3. Explain the basic work measurement techniques and to gain knowledge of measurement of work, rating and imbibe the concept of allowance in estimating Standard Time
4. Evaluate the basic concepts of Ergonomics and demonstrate a sound knowledge of Ergonomics in engineering applications.
5. Describe a sound knowledge of Man-Machine Interfaces and design of displays and controls in engineering systems

Unit 1 Productivity and Work Study **08**

Productivity and Work Study: Definition of productivity, task of management, productivity of materials, land, building, machine and power, factors affecting the productivity, work content, basic work content, excess work content, how manufacturing job is made up, work content due to excess product and process, ineffective time due to short comings on part of the management. Definition, Objective and scope of Work Study: Work study and management, work study and work.

Unit 2 Method Study & Work Measurement **10**

Method Study: Definition, objective and scope of method study, activity recording and tools, recording tools: Out Line Process Chart, Flow Process Chart, Flow diagram, String Diagram, Travel Chart, Multiple Activity Chart, Two- Handed process chart. Principles of Motion Economy: Introduction, Classification of movements. Two- hand process chart, Micromotion study, Therbligs, SIMO Chart. Special Charts: Cycle graph and Chrono cycle graph - development, definition and installation of the improved method.

Work Measurement: Definition, objectives, work measurement techniques. Work sampling – Need, confidence levels, and sample size determination, conducting study with problems

Unit 3 Time study **08**

Time study - Definition, time study equipment, selection of job, steps in time study. Breaking jobs into elements, recording information. Rating: Systems of rating, standard rating, standard performance, scales of rating. Allowances: Standard time determination, predetermined motion time study (PMTS), factors affecting rate of working, problems on allowances.

Unit 4 Introduction to Ergonomics **08**

Human factors and ergonomics, psychology, engineering, bio mechanics, industrial design, graphics design, statistics, operation research and anthropometry Morphology of design and its relationship with cognitive

abilities of human being. Physical Ergonomics: human anatomy, and some of the anthropometric, physiological and bio mechanical characteristics as they relate to physical activity. Cognitive: mental processes, such as perception, memory, reasoning, and motor response, mental workload, and decision-making. Organizational ergonomics: optimization of socio-technical systems, including their organizational structures, policies, processes. Communication, work design, design of working times, teamwork, cooperative work, and new work programs. Environmental ergonomics: human interaction with the environment- characterized by climate, temperature, pressure, vibration, light.

Unit 5 Man-Machine Interaction 08

Man-Machine Interaction; Man-Machine interaction cycle, Man-machine interfaces, displays factors that control choice of display, visual displays- qualitative displays; moving pointer displays, moving scale displays, digital displays Indicators, auditory displays, tactile displays. Factors affecting effectiveness of displays. Quantitative displays, check- reading displays, representational displays. Types of controls and their integration with displays. Design guidelines for displays and controls: viewing distance, Illumination, angle of view, reach etc., general design checklist for displays and controls. Standards for ergonomics in engineering and design, displays and controls.

Textbooks:

1. Introduction to Work Study – ILO, George Kanawaty, 4th edition 1992, ISBN: 9221071081
2. Human Factor in Engineering and Design, Mark. S. Sanders and Ernest. J McCornick. McGraw- Hill Book Co., Inc., New York, 1993, ISBN:978-0070549012

Reference Books:

1. Work Study and Ergonomics. S. Dalela and Sourabh, —Standard publishers 2013
2. Human Factors Design Handbook, Wesley Woodson, Peggy Tillman and Barry Tillman, McGraw-Hill; 2ndedition, 1992
3. Motion and Time Study, Ralph M. Barnes, —Wiley International, 7th Edition.
4. Human Factors in Engineering Design, Mark S. Sanders and Ernest J. McCormick, —4th ed. 2013.
5. Methods Standards and Work Design, B. Niebel and Freivalds, Niebel ‘s McGraw-Hill, 12th Ed. 2009

Online Learning Resources:

- https://youtu.be/b05FPBjFH6A?si=dWB1YOLOmSMRBSX7
- https://youtube.com/playlist?list=PLLy_2iUCG87BbIF6sF5sy_ZZLFoUcnncb&si=n1NAnFTtiocc9vtK
- https://youtube.com/playlist?list=PLuF8VVHesRxXBZzQpQSzvJI7eM_SduxwR&si=j2vyTNYybgvXrDiy

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A035DT.1	3	3	3	3	-	-	-	-	-	-	-	2	2
23A035DT.2	2	2	2	2	-	-	-	-	-	-	-	2	2
23A035DT.3	3	3	3	3	-	-	-	-	-	-	-	2	2
23A035DT.4	2	2	2	2	-	-	-	-	-	-	-	1	1
23A035DT.5	3	3	3	3	-	-	-	-	-	-	-	2	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Nano Technology
Category: Professional Elective-I
Couse Code: 23A035ET
Branch/es: Mechanical Engineering
Year & Semester: III Year I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To understand the fundamentals of nano science and nanotechnology, including the history, classification and analyze the structural aspects of nanomaterials.
2. To gain knowledge of the synthesis and fabrication techniques used in nano science, and methods for realizing semiconductor nanostructures.
3. To understand advanced characterization techniques used for analysing the structural, morphological, and electronic properties of nanomaterials.
4. To explore carbon nanomaterials properties and wide-ranging applications.
5. To familiarize with the diverse applications of nanotechnology, with emphasis on nanostructured thin films and quantum dots.

Course Outcomes:

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

1. Define and classify nanomaterials. Explain the historical development and scope of Nano science, and nanotechnology. Analyze the band structure and electronic behavior of nanomaterials.
2. Explain the synthesis processes for bulk polycrystalline and single crystal materials. Differentiate between bottom-up and top-down fabrication approaches. Identify and select the requirements for semiconductor nanostructure fabrication and techniques.
3. Understand and explain the principles and applications of X-ray diffraction (XRD). Analyze optical properties of nanomaterials. Evaluate appropriate characterization technique.
4. Discuss and characterize various carbon nanomaterials and its applications to analyze the types, synthesis methods, and evaluate the impact of carbon nanomaterials in emerging technologies.
5. Identify and describe major applications, evaluate the impact in energy production, conversion, and environmental sustainability and analyze their applications and explore interdisciplinary applications of nano materials**.**

Unit 1 Introduction and Properties of Materials 10

History of nano science, definition of nano meter, nano materials, nano technology. Classification of nano materials. Crystal symmetries, crystal directions, crystal planes. Band structure.

Properties of Materials: Mechanical properties, electrical properties, dielectric properties, thermal properties, magnetic properties, opto electronic properties. Effect of size reduction on properties, electronic structure of nano materials.

Unit 2 Synthesis and Fabrication 10

Synthesis of bulk polycrystalline samples, growth of single crystals. Synthesis techniques for preparation of nano particle – Bottom-Up Approach – sol gel synthesis, hydro thermal growth, thin film growth, PVD and CVD; Top-Down Approach – Ball milling, micro fabrication, lithography. Requirements for realizing semiconductor nano structures, growth techniques for nano structures.

Unit 3 Characterization Techniques 09

X-Ray diffraction and Scherrer method, scanning electron microscopy, transmission electron microscopy, scanning probe microscopy, atomic force microscopy, piezoresponse microscopy, X-ray photoelectron spectroscopy, XANES and XAFS, angle resolved photoemission spectroscopy, diffuse reflectance spectra, photoluminescence spectra, Raman spectroscopy.

Unit 4 Carbon Nano Technology **08**

Characterization of carbon allotropes, synthesis of diamond – nucleation of diamond, growth and morphology. Applications of nano crystalling diamond films, grapheme, and applications of carbon nano tubes.

Unit 5 Applications of Nano Technology **09**

Applications in material science, biology and medicine, surface science, energy and environment. Applications of nano structured thin fins, applications of quantum dots.

Prescribed Textbooks:

1. Nano science and nano technology / M.S Ramachandra Rao, Shubra Singh/Wiley publishers.
2. Introduction to Nanotechnology by Risal Singh, Shipra Mital Gupta, Oxford Higher Education, First Publication 2016.

Reference Books:

1. Introduction to Nano Technology /Charles P. Poole, Jr., Frank J.Owens/Wiley publishers.
2. Nanotechnology /Jermy J Ramsden/Elsevier publishers (2015)
3. Nano Materials/A.K.Bandyopadhyay/ New Age
4. Nano The Essentials, T.Pradeep, McGrawHill, 2014
5. Nanotechnology the Science of Small / M.A Shah, K.A Shah/Wiley Publishers.

Online Learning Resources:

- https://youtube.com/playlist?list=PLyqSpQzTE6M8682dGkNTN8936vSY4CbqZ&si=8S682KjXK7_xITpT
- https://youtu.be/OLa8DQkKlyU?si=I6R1Of59MArQyPUb
- https://youtu.be/u1ojNgPCHGs?si=mIlgQm4OdwZnHUo3

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A035ET.1	3	2	1	2	2	0	0	0	1	1	1	2	2	2
23A035ET.2	3	2	2	3	2	0	1	0	1	1	1	2	3	3
23A035ET.3	3	3	2	3	3	1	1	0	1	2	1	2	3	2
23A035ET.4	2	2	2	2	3	1	1	0	1	2	1	2	3	2
23A035ET.5	2	3	3	2	2	2	3	1	2	3	2	3	3	3

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Thermal Engineering Lab
Category: PC
Couse Code: 23A0352L
Branch/es: Mechanical Engineering
Year & Semester: III Year I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	3	1.5

Course Objectives:

- To impart knowledge on working principles of various thermal equipment's like compressors, IC Engines, Boilers etc.,
- To study the working principle of IC engines, performance and characteristics in terms of heat balancing, economical speed variations, air fuel ratio etc.,

Course Outcomes:

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

1. Calculate the performance of 4-Stroke Diesel and Petrol engine.
2. Calculate the Engine friction of 4-Stroke Multi cylinder Engine and Air/Fuel ratio and Volumetric efficiency of I.C. Engines.
3. Calculate the heat balance of the IC Engines.
4. Calculate the efficiencies and performance characteristics of the engines.
5. Study the boilers and identify of the engine parts.

List of Experiments:

1. Draw the Valve / Port Timing Diagrams of an I.C. Engines
2. Performance Test on a 4 -Stroke Diesel Engines
3. Performance Test on a 4-Stroke Petrol engine
4. Performance Test on a 4-Stroke Multi cylinder Petrol engine
5. Evaluation of Engine friction by conducting Morse test on 4-Stroke Multi cylinder Engine
6. Retardation and motoring test on 4- stroke engine
7. Heat balance sheet on four stroke single cylinder diesel engine.
8. Heat balance sheet on four stroke single cylinder petrol engine.
9. Heat balance sheet on four stroke multi cylinder petrol engine.
10. Air/Fuel Ratio and Volumetric Efficiency of an I.C. Engines.
11. Performance Test on Reciprocating Air – Compressor Unit
12. Dismantling / Assembly of Engines to identify the parts and their position in an engine.
13. Performance test on refrigeration test rig.
14. Viscosity of the oil through saybolt viscometer apparatus
15. (a) Calorific value of fuel using bomb calorimeter.
    (b) Flash and fire point by Cleveland open cup apparatus.
16. Exhaust Emission test on IC Engines
17. Performance Test on Variable Compression Ratio Engines, economical speed test.

Study Experiment:

1. Study of Boilers

Note: Any 14 out of 17 Experiments can be conducted.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	**PSO1**	**PSO2**
23A0352L.1	3	2	3	1	-	1	1	1	2	2	1	2	3	2
23A0352L.2	3	3	3	1	-	1	1	1	2	2	1	2	3	2
23A0352L.3	3	2	3	1	-	1	1	1	2	2	1	2	3	2
23A0352L.4	3	3	3	1	-	1	1	1	2	2	1	2	3	2
23A0352L.5	2	1	2	1	-	2	2	1	2	2	1	2	2	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Dynamics Lab
Category: PC
Couse Code: 23A0354L
Branch/es: Mechanical Engineering
Year & Semester: III Year I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	3	1.5

Course Objectives:

1. To supplement the principles learnt in kinematics and Dynamics of Machinery.
2. To understand how certain measuring devices are used for dynamic testing.

Course Outcomes:

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

1. Ability to demonstrate the principles of kinematics and dynamics of machinery
2. Determine the Mass moment of inertia, Range sensitivity.
3. Drawing of Cam profile, determination of torsional, undamped and damped natural frequencies.
4. Determining of influence of coefficient and balancing of rotating , reciprocating masses.
5. Verify the laws of springs and forced vibration of cantilever beam.

List of Experiments:

1. To study Kinematics of Four Bar, Slider Crank, Crank Rocker, Double crank, Double rocker, Oscillating cylinder Mechanisms
2. Determination of Mass moment of inertia of Fly wheel and Axle system
3. Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors
4. Cams – Cam profile drawing, Motion curves and study of jump phenomenon
5. Determination of torsional natural frequency of single Rotor systems. Un damped and Damped Natural frequencies
6. Determination of torsional natural frequency of Double Rotor systems. Un damped and Damped Natural frequencies
7. Multi degree freedom suspension system – Determination of influence coefficient
8. Balancing of rotating masses
9. Balancing of reciprocating masses
10. Determination of natural Frequency and verification of Laws of springs
11. Forced Vibration of Cantilever beam – Mode shapes and natural frequencies
12. To find experimentally the Gyroscopic couple on Motorized Gyroscope and compare with applied couple
13. To determine critical speed or whirling speed of a rotating shaft and to verify the value theoretically
14. To study Different types of Gears and Gear Trains
15. To study various types of steering mechanisms

Note: Any 10 experiments need to be performed

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	**PSO1**	**PSO2**
23A0354L.1	3	3	2	3	-	-	-	1	-	-	-	-	3	3
23A0354L.2	2	3	2	3	-	-	-	-	-	-	-	-	3	3
23A0354L.3	3	3	2	3	-	-	-	-	-	-	-	-	2	2
23A0354L.4	3	2	2	3	-	-	-	-	-	-	-	-	3	3
23A0354L.5	3	3	2	3	-	-	-	-	-	-	-	-	2	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Machine Tools & Metrology lab
Category: SEC
Couse Code: 23A0355L
Branch/es: Mechanical Engineering
Year & Semester: III Year I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	1	2	2

Course Objectives:
1. To understand the parts of various machine tools and about different shapes of products that can be produced on them.
2. To measure bores, angles and tapers.
3. To perform alignment tests on various machines.

Course Outcomes:
At the end of the course, the student will be able to
1. Gain knowledge about the parts of various machine tools and about different shapes of products that can be produced on them.
2. Measure bores, angles and tapers.
3. Perform alignment tests on various machines

Machine Tools Lab
1. Introduction of general-purpose machines -Lathe, drilling machine, Milling machine, Shaper, Planing machine, Slotting machine, cylindrical grinder, Surface grinder and Tool and cutter grinder.
2. Operations on Lathe machines- Step turning, Knurling, Taper turning, Thread cutting and Drilling.
3. Operations on Drilling machine - Drilling, reaming, tapping, rectangular drilling, circumferential drilling.
4. Operations on Shaping machine - (i) Round to square (ii) Round to Hexagonal.
5. Operations on Slotter - (i) Keyway (T –slot) (ii) Keyway cutting.
6. Operations on milling machines - (i) Indexing (ii) Gear manufacturing.

Metrology Lab
1. Calibration of vernier callipers, micrometers, vernier height gauge and dial gauges.
2. Measurement of bores by internal micrometers and dial bore indicators.
3. Use of gear tooth vernier calliper for tooth thickness inspection and flange micrometer for checking the chordal thickness of spur gear.
4. Machine tool alignment test on the lathe.
5. Machine tool alignment test on drilling machine.
6. Machine tool alignment test on milling machine.
7. Angle and taper measurements with bevel protractor, Sine bar, rollers and balls.
8. Use of spirit level in finding the straightness of a bed and flatness of a surface.
9. Thread inspection with two wire/ three wire method & tool makers microscope.
10. Surface roughness measurement with roughness measuring instrument.

Online Learning Resources:
1. https://www.youtube.com/watch?v=sG6GCfX7L3c&pp=ygUeTWFjaGluZSBUb29scyAgbGFiIGV4cGVyaW1lbnRz
2. https://www.youtube.com/watch?v=mafthRhz1iM&pp=ygUeTWFjaGluZSBUb29scyAgbGFiIGV4cGVyaW1lbnRz
3. https://www.youtube.com/watch?v=5--saq-oYBE&list=PLrcSDk_gQ7jiQCfWEzw93ZMaxHkg2v-CC
4. https://www.youtube.com/watch?v=m60m2TcbTgc&pp=ygUZbWV0cm9sb2d5IGxhYiBleHBlcmltZW50cw%3D%3D

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	**PSO1**	**PSO2**
23A0355L.1	3	2	2	1	1	0	0	0	2	1	1	2	3	2
23A0355L.2	2	3	1	2	2	0	1	0	2	1	1	2	2	3
23A0355L.3	2	2	2	3	2	0	1	0	2	2	2	3	3	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Tinkering Lab for Mechanical Engineers
Category: ES
Couse Code: 23A0356L
Branch/es: Mechanical Engineering
Year & Semester: III Year I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	2	1

Course Objectives:
1. To encourage Innovation and Creativity
2. To provide Hands-on Learning and Impart Skill Development
3. To foster Collaboration and Teamwork
4. To enable Interdisciplinary Learning, Prepare for Industry and Entrepreneurship.
5. To impart Problem-Solving mind-set

Course Outcomes:
At the end of the course, the student will be able to
1. Apply fundamental engineering concepts to design, develop, and implement prototypes using electronic, mechanical, and programming tools for real-world applications.
2. Integrate hardware and software components such as sensors, actuators, microcontrollers, and 3D printing technologies to build functional systems
3. Demonstrate problem-solving skills and creativity in developing innovative solutions for societal, industrial, and environmental challenges.
4. Collaborate effectively in interdisciplinary teams to plan, execute, and present prototype-based projects.
5. Evaluate the performance of developed prototypes through testing, analysis, and iterative improvement, ensuring functionality, reliability, and sustainability.

List of Experiments:
1. Make your own parallel and series circuits using breadboard for any application of your choice
2. Design and 3D print a Walking Robot
3. Design and 3D Print a Rocket
4. Temperature & Humidity Monitoring System (DHT11 + LCD)
5. Water Level Detection and Alert System
6. Automatic Plant Watering System
7. Bluetooth-Based Door Lock System
8. Smart Dustbin Using Ultrasonic Sensor
9. Fire Detection and Alarm System
10. RFID-Based Attendance System
11. Voice-Controlled Devices via Google Assistant
12. Heart Rate Monitoring Using Pulse Sensor
13. Soil Moisture-Based Irrigation
14. Smart Helmet for Accident Detection
15. Milk Adulteration Detection System
16. Water Purification via Activated Carbon
17. Solar Dehydrator for Food Drying
18. Temperature-Controlled Chemical Reactor
19. Ethanol Mini-Plant Using Biomass
20. Smart Fluid Flow Control (Solenoid + pH Sensor)
21. Portable Water Quality Tester
22. AI Crop Disease Detection
23. AI-based Smart Irrigation
24. ECG Signal Acquisition and Plotting

25. AI-Powered Traffic Flow Prediction
26. Smart Grid Simulation with Load Monitoring
27. Smart Campus Indoor Navigator
28. Weather Station Prototype
29. Firefighting Robot with Sensor Guidance
30. Facial Recognition Dustbin
31. Barcode-Based Lab Inventory System
32. Growth Chamber for Plants
33. Biomedical Waste Alert System
34. Soil Classification with AI
35. Smart Railway Gate
36. Smart Bin Locator via GPS and Load Sensors
37. Algae-Based Water Purifier
38. Contactless Attendance via Face Recognition

Applied Robot Control Lab:

39. Perform an experiment on igus robot arm for pick and place operation in an industrial application.
40. Perform an experiment on igus robot arm for food supply in restaurant applications.
41. Perform an experiment on igus robot arm for palletization operation in warehouse applications.

- **Note:** The students can also design and implement their own ideas, apart from the list of experiments mentioned above
- **Note:** A minimum of 8 to 10 experiments must be completed by the student

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	**PSO1**	**PSO2**
23A0356L.1	3	2	3	2	3	1	2	1	2	2	1	3	3	3
23A0356L.2	3	3	3	3	3	1	2	1	2	2	1	3	3	3
23A0356L.3	2	3	3	2	3	2	3	2	3	3	2	3	3	2
23A0356L.4	1	2	3	2	2	2	2	2	3	3	3	2	2	2
23A0356L.5	2	3	3	3	3	2	3	1	2	2	2	3	3	3

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Sustainable Energy Technologies
Category: Open Elective – I
Couse Code: 23A035FT
Branch/es: CE, EEE, ECE, CSE, AIDS, AIML, CSE-DS, CSE-AI
Year & Semester: III B.Tech. I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To demonstrate the importance the impact of solar radiation, solar PV modules.
- To understand the principles of storage in PV systems.
- To discuss solar energy storage systems and their applications.
- To get knowledge in wind energy and bio-mass.
- To gain insights in geothermal energy, ocean energy and fuel cells.

Course Outcomes:
At the end of the course, the student will be able to
6. Illustrate the importance of solar radiation and solar PV modules.
7. Discuss the storage methods in PV systems.
8. Explain the solar energy storage for different applications.
9. Understand the principles of wind energy, and bio-mass energy.
10. Attain knowledge in geothermal energy, ocean energy and fuel cells.

Unit 1 **09**

SOLAR RADIATION: Role and potential of new and renewable sources, the solar energy option, Environmental impact of solar power, structure of the sun, the solar constant, sun-earth relationships, coordinate systems and coordinates of the sun, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data, numerical problems.

SOLAR PV MODULES AND PV SYSTEMS: PV Module Circuit Design, Module Structure, Packing Density, Interconnections, Mismatch and Temperature Effects, Electrical and Mechanical Insulation, Lifetime of PV Modules, Degradation and Failure, PV Module Parameters, Efficiency of PV Module, Solar PV Systems-Design of Off Grid Solar Power Plant. Installation and Maintenance.

Unit 2 **09**

STORAGE IN PV SYSTEMS: Battery Operation, Types of Batteries, Battery Parameters, Application and Selection of Batteries for Solar PV System, Battery Maintenance and Measurements, Battery Installation for PV System.

Unit 3 **09**

SOLAR ENERGY COLLECTION: Flat plate and concentrating collectors, classification of concentrating collectors, orientation.

SOLAR ENERGY STORAGE AND APPLICATIONS: Different methods, sensible, latent heat and stratified storage, solar ponds, solar applications- solar heating/cooling technique, solar distillation and drying, solar cookers, central power tower concept and solar chimney

Unit 4 **09**

WIND ENERGY: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, betz criteria, types of winds, wind data measurement.

BIO-MASS: Principles of bio-conversion, anaerobic/aerobic digestion, types of bio-gas digesters, gas yield, utilization for cooking, bio fuels, I.C. engine operation and economic aspects.

Unit 5 **09**

GEOTHERMAL ENERGY: Origin, Applications, Types of Geothermal Resources, Relative Merits.

OCEAN ENERGY: Ocean Thermal Energy; Open Cycle & Closed Cycle OTEC Plants, Environmental Impacts, Challenges.

FUEL CELLS: Introduction, Applications, Classification, Different Types of Fuel Cells Such as Phosphoric Acid Fuel Cell, Alkaline Fuel Cell, PEM Fuel Cell, MC Fuel Cell.

Prescribed Textbooks:

3. Solar Energy – Principles of Thermal Collection and Storage/Sukhatme S.P. and J.K.Nayak/TMH.
4. Non-Conventional Energy Resources- Khan B.H/ Tata McGraw Hill, New Delhi, 2006.

Reference Books:

4. Principles of Solar Engineering - D.Yogi Goswami, Frank Krieth& John F Kreider / Taylor & Francis.
5. Non-Conventional Energy - Ashok V Desai /New Age International (P) Ltd.
6. Renewable Energy Technologies -Ramesh & Kumar /Narosa.
7. Non-conventional Energy Source- G.D Roy/Standard Publishers.

Online Learning Resources:

- https://nptel.ac.in/courses/112106318
- https://youtube.com/playlist?list=PLyqSpQzTE6M-ZgdjYukayF6QevPv7WE-r&si=-mwIa2X-SuSiNy13
- https://youtube.com/playlist?list=PLyqSpQzTE6M-ZgdjYukayF6QevPv7WE-r&si=Apfjx6oDfz1Rb_N3
- https://youtu.be/zx04Kl8y4dE?si=VmOvp_OgqisILTAF

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and	Life-long learning	PSO1	PSO2
23A035FT.1	3	2	2	2	2	1	3	1	1	1	1	2	1	1
23A035FT.2	3	2	2	2	2	1	2	1	1	1	1	2	1	1
23A035FT.3	3	2	2	2	2	2	3	1	1	1	1	2	1	1
23A035FT.4	3	2	2	2	2	1	3	1	1	1	1	2	1	1
23A035FT.5	3	2	2	2	2	1	3	1	1	1	1	2	1	1

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Heat Transfer
Category: Professional Core
Couse Code: 23A0361T
Branch/es: Mechanical Engineering
Year & Semester: III Year II Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
1. To impart the knowledge of basic laws of conduction, convection, radiation heat transfer and their applications.
2. To familiarize the concepts of convective heat transfer.
3. To gain insight of the phase change processes.
4. To conversant about heat transfer in various heat exchangers.
5. To provide fundamental knowledge about the principles of radiation heat transfer and mass transfer.

Course Outcomes:
At the end of the course, the student will be able to
1. Solve the problems of conduction heat transfer.
2. Solve the problems of convection heat transfer.
3. Solve the problems of heat transfer during change of phase.
4. Analyze the performance of heat exchangers.
5. Analyze the radiative heat exchange and diffusive transport in engineering systems.

Unit 1 Conduction **18**

Basic modes of heat transfer- rate equations- generalized heat conduction equation-various forms - steady state heat conduction solution for plane and composite slabs - cylinders - critical thickness of insulation- heat conduction through fins of uniform cross section- fin effectiveness and efficiency.
Unsteady State Heat Transfer Conduction- Transient heat conduction- lumped system analysis and use of Heisler charts.

Unit 2 Convection **12**

Convection: Basic concepts of convection–heat transfer coefficients - types of convection –forced convection and free convection.
Free Convection: development of hydrodynamic and thermal boundary layer along a vertical plate – use of empirical relations for convective heat transfer on plates and cylinders in horizontal and vertical orientation.
Forced convection: In external flow–concepts of hydrodynamic and thermal boundary layer- use of empirical correlations for flow over plates and cylinders. Fluid friction – heat transfer analogy, approximate solution to laminar boundary layer equation for external flow. Internal flow – Use of empirical relations for convective heat transfer in horizontal pipe flow-problems.

Unit 3 Boiling and Condensation **06**

Different regimes of boiling- nucleate, transition and film boiling – condensation – film wise and drop wise condensation-problems.

Unit 4 Heat Exchangers **08**

Types of heat exchangers- parallel flow- counter flow- cross flow heat exchangers- overall heat transfer coefficient- LMTD and NTU methods- fouling in heat exchangers-problems.

Unit 5 Radiation & Mass Transfer **16**

Radiation heat transfer – Thermal radiation – laws of radiation - Black and Gray bodies – shape factor- radiation exchange between surfaces - Radiation shields - Greenhouse effect- simple problems.

Mass Transfer: Conservation laws and constitutive equations - Fick's law of diffusion, isothermal equi-mass - Equimolal diffusion- - diffusion of gases and liquids- mass transfer coefficient.

Prescribed Textbooks:

1. Fundamentals of Engineering Heat & Mass transfer, R.C.Sachdeva- New Age International Publishers- 2017- ISBN-13: 9386070968-978 .
2. Heat Transfer, J.P.Holman,- - 9/e- Tata McGraw-Hill, 2001- ISBN-13 : 978-0072406559

Reference Books:

1. Heat Transfer- A Practical Approach, Cengel. A.Yunus- 4/e- Tata McGraw-Hill, 2007- ISBN-13: 978-007312930.
2. Heat Transfer, P.K. Nag- 3/e-Tata McGraw-Hill- 2011- ISBN-13: .0070702530-978
3. A Text book of Heat Transfer, S.P. Sukhatme- Universities Press, 4/e- 2005.- ISBN-13: 8173715440-978
4. A Text book of Heat & Mass Transfer, Er.R.K.Rajput- S.Chand publishers-7/e,2018 -ISBN-13: -978 9352533848

Online Learning Resources:

- https://ocw.mit.edu/courses/mechanical-engineering/2-051-introduction-to-heat-transfer-fall- 2015/
- https://www.youtube.com/watch?v=qa-PQOjS3zA&list=PL5F4F46C1983C6785
- https://www.youtube.com/watch?v=sKnE5qvz0fc&list=PLbRMhDVUMngeygd_uWiLqa3fzA2h7vdRx
- https://www.youtube.com/watch?v=4bh4efqyzpo&list=PL3zvA_WajfGCwYlesmh4UAl8KtsxXVQYn
- https://www.youtube.com/watch?v=Yc2eSffzhBI&list=PLwdnzlV3ogoVX_S_8DyKa7RudEazDL0o
- https://www.coursera.org/lecture/thermodynamics-intro/02-04-heat-transfer-gyDfJ

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	**PSO1**	**PSO2**
23A0361T.1	3	3	1	2	-	-	-	-	-	-	-	2	2	2
23A0361T.2	3	3	1	2	-	-	-	-	-	-	-	2	2	2
23A0361T.3	3	3	1	2	-	-	-	-	-	-	-	2	2	2
23A0361T.4	3	3	1	3	-	-	-	-	-	-	-	2	3	3
23A0361T.5	3	3	1	3	-	-	-	-	-	-	-	2	2	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: CAD/CAM
Category: Professional Core
Couse Code: 23A0362T
Branch/es: Mechanical Engineering
Year & Semester: III Year II Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
1. To introduce the fundamentals of CAD/CAM, computer graphics, and transformation techniques.
2. To understand and apply geometric modeling techniques such as solid, surface, and feature-based modeling for visualizing components prior to manufacturing or fabrication.
3. To comprehend NC/CNC systems, machine tool structures, control techniques, and CNC part programming including APT-based methods.
4. To recognize the significance of Group Technology, Flexible Manufacturing Systems, and Computer-Aided Quality Control.
5. To learn computer-aided process planning and production planning systems, and explore emerging trends like reconfigurable, sustainable, and lean manufacturing.

Course Outcomes:
At the end of the course, the student will be able to
1. Summarize the fundamental concepts of CAD/CAM and computer graphics, including coordinate systems and geometric transformations.
2. Summarize and differentiate key geometric modeling techniques such as wireframe, surface, and solid modeling.
3. Write NC and CNC part programs using standard codes, canned cycles, compensation techniques, and APT-based programming for various machining operations.
4. Explain the significance of Group Technology, Flexible Manufacturing System and Computer-Aided Quality Control,
5. Summarize the concepts of computer-aided process planning methods, computer-integrated production planning systems, and emerging trends in modern manufacturing such as reconfigurable, sustainable, and lean manufacturing.

Unit 1 Introduction To Computer Graphics 08

Overview of CAD/CAM: Product cycle, CAD, CAM and CIM. CAD Tools, CAM Tools, Utilization in an Industrial Environment, Evaluation criteria. CAD data structure, Data base management systems (database structure for graphics modeling).
Computer Graphics: Co-ordinate systems, Graphics package functions, 2D and 3D transformations, clipping, hidden line / surface removal color, shading.

Unit 2 Curve Representation 10

Geometric Modeling: Representation techniques, Parametric and non-parametric representation, various construction methods, wire frame modeling, synthetic curves and their representations, surface modeling, synthetics surfaces and their representations. Solid modeling, solid representation, fundamentals, introduction to boundary representations, constructive solid geometry representations

Unit 3 Numerical Control 10

Numerical Control: NC, NC Modes, NC Elements, NC Machine tools and their structure, Machining center, types (working Principle for 3,4 and 5 Axis) and features. Controls in NC, CNC systems, DNC systems. Adaptive control machining systems, types of adaptive control.

CNC Part Programming: Fundamentals, NC word, NC Nodes, canned cycles, cutter radius compensation, length compensation, computed assisted part programming using APT: Geometry statements, motion statements, post process statements, auxiliary statements, macro statement program for simple components.

Unit 4 Group Technology, Flexible Manufacturing System & CAQC 10

Group Technology & FMS: Part Family, Classification and Coding, advantages & limitations, Group technology machine cells, benefits. FMS: Introduction, components of FMS, material handling systems, Computer control systems, advantages. Computer Aided Quality Control: Terminology in Quality control, Inspection and testing, Contact inspection methods - optical and non-optical, integration of CAQC with CAD and CIM.

Unit 5 Computer Integrated Production Planning 10

Computer Aided Processes Planning: Retrieval type and Generative type, benefits Machinability data systems, Computer generated time standards.

Computer integrated production planning: Capacity planning, shop floor control, MRP-I, MRP- II, CIMS benefits. Trends in manufacturing systems: Concepts of Reconfigurable manufacturing, Sustainable manufacturing and lean manufacturing.

Prescribed Textbooks:

1. CAD/CAM: Principles and applications, P. N. Rao, 3/e, Tata McGraw-Hill, Delhi, 2017.
2. CAD/CAM, Mikell P. Groover, Emory W. Zimmers, 5/e, Pearson Prentice Hall of India, Delhi, 2008.

Reference Books:

1. CAD/CAM: Theory and Practice, Ibrahim Zeid, R.Siva Subramanian, 2/e, Tata McGraw-Hill, Delhi, 2009.
2. CAD/CAM/CIM, P. Radhakrishnan, S. Subramanyan& V. Raju, 3/e, New Age International Publishers, 2008.
3. Computer Aided Manufacturing, 3/e, Tien Chien Chang, Pearson, 2008.

Online Learning Resources:

- https://onlinecourses.nptel.ac.in/noc20_me44/preview
- https://www.youtube.com/watch?v=EgKc9L7cbKc
- https://www.youtube.com/watch?v=KXFpTb9cBpY
- https://web.iitd.ac.in/~hegde/cad/lecture/L01_Introduction.pdf
- https://www.vssut.ac.in/lecture_notes/lecture1530947994.pdf
- https://www.iare.ac.in/sites/default/files/lecture_notes/CAD_CAM_LECTURE_NOTES.pdf

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A0362T.1	2	2	1	1	-	-	-	-	3	-	-	-	2	2
23A0362T.2	2	2	1	1	-	-	-	-	3	-	-	-	3	3
23A0362T.3	3	3	3	3	-	-	-	-	3	-	-	-	3	3
23A0362T.4	2	2	1	1	-	-	-	-	3	-	-	-	2	2
23A0362T.5	2	2	1	1	-	-	-	-	3	-	-	-	2	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Design of Machine Members
Category: Professional Core
Couse Code: 23A0363T
Branch/es: Mechanical Engineering
Year & Semester: III Year II Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To understand the mechanical engineering design process for static and dynamic loads under various loading conditions.
2. To explore the design principles and analysis of bolted and welded joints and butt welds under various loading conditions.
3. To study the design principles of power transmission shafts and couplings, focusing on the analysis of shafts subjected loads, as well as the design of various types of couplings.
4. To explain the design principles of friction clutches, brakes, and springs, design of different brakes, clutches, helical and leaf springs under various loading conditions.
5. To demonstrate the design principles of sliding and rolling contact bearings, gears, spur gears, beam strength, and load considerations.

Course Outcomes:

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

1. Apply design principles for components subjected to static and dynamic loads, analyze and design for fatigue failure using relevant criteria
2. Design and analyze bolted and welded joints, considering factors such as different types of loads, including eccentric loading scenarios.
3. Design power transmission shafts and couplings for fluctuating loads, and selecting appropriate couplings such as flange, bushed pin, and universal couplings.
4. Design friction clutches, brakes, and springs, applying the various theories and analyze the working for mechanical applications.
5. Design and analyze the sliding and rolling contact bearings, spur gears, considering beam strength, dynamic, and wear load factors.

Unit 1 Introduction, Design for Static and Dynamic loads 10

Mechanical Engineering Design: Design process, design considerations, codes and standards of designation of materials, selection of materials.

Design for Static Loads: Modes of failure, design of components subjected to axial, bending, torsional and impact loads. Theories of failure for static loads.

Design for Dynamic Loads: Endurance limit, fatigue strength under axial, bending and torsion, stress concentration, notch sensitivity. Types of fluctuating loads, fatigue design for infinite life. Soderberg, Goodman and modified Goodman criterion for fatigue failure. Fatigue design under combined stresses.

Unit 2 Design of Bolted and Welded Joints 09

Design of Bolted Joints: Threaded fasteners, preload of bolts, various stresses induced in the bolts. Torque requirement for bolt tightening, gasketed joints and eccentrically loaded bolted joints.

Welded Joints: Strength of lap and butt welds, Joints subjected to bending and torsion. Eccentrically loaded welded joints.

Unit 3 Power transmission shafts and Couplings **10**

Power Transmission Shafts: Design of shafts subjected to bending, torsion and axial loading. Shafts subjected to fluctuating loads using shock factors.

Couplings: Design of flange and bushed pin couplings, universal coupling.

Unit 4 Design of Clutches, Brakes and Springs **10**

Friction Clutches: Torque transmitting capacity of disc and centrifugal clutches. Uniform wear theory and uniform pressure theory.

Brakes: Different types of brakes. Concept of self-energizing and self-locking of brake. Band and block brakes, disc brakes.

Springs: Design of helical compression, tension, torsion and leaf springs.

Unit 5 Design of Bearings and Gears **10**

Design of Sliding Contact Bearings: Lubrication modes, bearing modulus, McKee's equations, design of journal bearing. Bearing Failures.

Design of Rolling Contact Bearings: Static and dynamic load capacity, Stribeck's Equation, equivalent bearing load, load-life relationships, load factor, selection of bearings from manufacturer's catalogue.

Design of Gears: Spur gears, beam strength, Lewis equation, design for dynamic and wear loads.

Textbooks:

1. Design of Machine Elements, V.B.Bhandari, 3/e, Tata McGraw Hill, 2010.
2. Machine Design an Integrated approach, R.L. Norton, 2/e, Pearson Education, 2004.

Reference Books:

1. Machine Design, R.K. Jain, Khanna Publications, 1978.
2. Mechanical Engineering Design, J.E. Shigley, 2/e, Tata McGraw Hill, 1986.
3. Design data handbook, K. Mahadevan &K.Balaveera Reddy, CBS Publications, 4/e, 2018.
4. Machine design, Dr. N. C. Pandya &Dr. C. S. Shah, 17/e, Charotar Publishing House Pvt. Ltd, 2009.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	**PSO1**	**PSO2**
23A0363T.1	3	2	2	2	-	-	-	-	-	-	-	-	2	3
23A0363T.2	3	3	2	3	-	-	-	-	-	-	-	-	2	2
23A0363T.3	3	3	3	3	-	-	-	-	-	-	-	-	2	2
23A0363T.4	3	3	3	3	-	-	-	-	-	-	-	-	3	2
23A0363T.5	3	3	3	3	-	-	-	-	-	-	-	-	2	1

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Engineering Fracture Mechanics
Category: Professional Elective-II
Course Code: 23A036AT
Branch/es: Mechanical Engineering
Year & Semester: III Year II Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To understand the Engineering Fracture Mechanics (EFM principles and fatigue crack growth models, with a focus on analyzing and preventing spectacular structural failures.
2. To explore the principles of crack growth and fracture mechanisms, and their applications in material failure analysis.
3. To review the theory of elasticity and explore Westergaard ‘s solution for stress and displacements in Mode I fracture, along with the relationship between the stress intensity factor (K) and the energy
4. To familiarize multi-parameter stress fields for Mode I, Mode II, and mixed-mode fractures, explore the calculation of stress intensity factors (SIF) for various geometries.
5. To study fracture toughness testing, crack growth models, analysis, failure assessment diagrams, and mixed-mode fracture, along with methods for crack arrest and repair.

Course Outcomes:

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

1. Apply LEFM, EPFM, and fatigue crack growth models to assess and prevent catastrophic structural failures at different loads.
2. Apply Griffith's theory, calculate energy release rates, and analyze crack propagation mechanisms in materials to predict and prevent fractures in engineering applications.
3. Analyze and apply the theory of elasticity and displacement in Mode I fracture, and understand the connection between the stress intensity factor (K) and the energy release rate (G).
4. Analyze and calculate multi-parameter stress fields for different fracture modes and apply Irwin ‘s and Dugdale‘s models to understand deformation around crack tips.
5. Perform fracture toughness testing, apply crack growth models, and understand crack closure and failure assessment diagrams.

Unit 1 **10**

Engineering Fracture Mechanics Course outline and Spectacular Failures, Introduction to Linear Elastic Fracture Mechanics and Elasto Plastic Fracture Mechanics, Fatigue Crack Growth Model

Unit 2 **09**

Crack Growth and Fracture Mechanisms, Griffith TMs Theory of Fracture, Energy Release Rate

Unit 3 **10**

Review of Theory of Elasticity, Westergaard Solution for Stress and Displacements for Mode I, Relationship between K and G

Unit 4 **09**

Introduction to multi parameter stress field for Mode I, Mode II and Mixed Modes, SIF for Various Geometries, Modeling Plastic Deformation, Irwin TMs model, Dugdale Model

Unit 5 **10**

Fracture Toughness Testing, Paris Law and Sigmoidal curve, Crack Closure, Crack Growth Models, J-Integral, Failure Assessment Diagram, Mixed Mode Fracture, Crack Arrest and Repair Methodologies

Prescribed Textbooks:

1. Prashant Kumar, Elements of Fracture Mechanics, Tata McGraw Hill, New Delhi, India, 2009.
2. K. R.Y. Simha, Fracture Mechanics for Modern Engineering Design, Universities Press (India) Limited,2001.

Reference Books:

1. D. Broek, Elementary Engineering Fracture Mechanics, Kluwer Academic Publishers, Dordrecht, 1986.
2. T.L. Anderson, Fracture Mechanics "Fundamentals and Applications, 3rd Edition, Taylor and Francis Group, 2005.
3. K. Ramesh, e-Book on Engineering Fracture Mechanics, IIT Madras, 2007.

Online Learning Resources:

- https://nptel.ac.in/courses/112106065
- https://youtube.com/playlist?list=PLA218B83235A4AD5C&si=XI175OWGIvdMCQH9
- https://youtube.com/playlist?list=PLA218B83235A4AD5C&si=ruHP1MIsJGNAyMYV
- https://youtube.com/playlist?list=PLfIFNJ1DPG4ks5AjeCgpbm8nLGM1Pgxer&si=F-fj413KzPAkjPSs

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A036AT.1	3	2	2	2	-	-	-	1	-	1	-	1	2	2
23A036AT.2	2	3	2	2	-	-	-	1	-	1	-	1	2	2
23A036AT.3	3	3	2	2	-	-	-	1	-	1	-	1	3	2
23A036AT.4	2	2	2	3	-	-	-	1	-	1	-	1	2	3
23A036AT.5	3	2	2	2	-	-	-	1	-	1	-	1	2	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Introduction of Turbo Machinery
Category: Professional Elective-II
Couse Code: 23A036BT
Branch/es: Mechanical Engineering
Year & Semester: III Year II Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
1. To comprehend the principles, classifications, and governing equations of turbomachinery.
2. To gain the knowledge on gas turbine cycles.
3. To gain knowledge on the principles of similarity analysis and cascade theory in turbomachinery, for performance evaluation of compressor and turbine blades.
4. To import the awareness on axial and centrifugal compressors and pumps, considering different parameters
5. To gain insight on axial flow turbine design and performance parameters, and use computational fluid dynamics (CFD) as a tool for analyzing turbomachinery.

Course Outcomes:
At the end of the course, the student will be able to
1. Analyze the fundamental concepts of fluid motion in rotating systems to design and evaluate the performance of various turbo machines.
2. Evaluate various gas turbine cycles and engine configurations for optimum propulsion and power generation applications
3. Apply similarity principles and cascade analysis techniques to evaluate blade performance, estimate aerodynamic losses, and optimize turbo machine blade designs.
4. Evaluate the performance of axial and centrifugal compressors and pumps, and thermodynamic principles for improved efficiency and functionality.
5. Evaluate axial flow turbines and apply CFD techniques to simulate and analyze fluid flow and thermal behavior in turbo machinery systems.

Unit 1 Introduction and Classification **06**
Introduction and Classification: Axial flow, radial flow and mixed flow machines, the equations of motion in rotating frame of reference, effects of Coriolis and Centrifugal forces, momentum and energy equation, Euler work and illustrative examples.

Unit 2 Gas Turbine Cycle **05**
Gas Turbine Cycle: Brayton Cycle, regenerative cycle, reheat, inter-cooling, turboprop, turbojet and turbofan engine, thrust augmentation and illustrative examples.

Unit 3 Similarity and Cascade Analysis **10**
Similarity Analysis: Similarity rules, specific speed, Cordier diagram and illustrative examples.
Cascade Analysis: Two-dimensional cascade theory, lift and drag, blade efficiency, estimation of loss, compressor and turbine cascade, blade geometry and illustrative examples.

Unit 4 Axial Flow Compressor & Centrifugal Pump and Compressor **15**
Axial Flow Compressor: Two-dimensional pitch line design and analysis, h-s diagram, degree of reaction, the effect of Mach number, performance and efficiency, three-dimensional flow, tip clearance, losses, compressor performance and illustrative examples.

Centrifugal Pump and Compressor: Theoretical analysis and design, the effect of circulation and Coriolis forces, reversal eddies, slip factor, head and efficiency, diffuser, introduction to the combustion system and illustrative examples.

Unit 5 Axial Flow and CFD Applied to Turbomachinery Flows 12

Axial Flow Turbine: Two-dimensional pitch line design, stage loading capacity, degree of reaction, stage efficiency, turbine performance, blade cooling, and illustrative examples.

CFD Applied to Turbomachinery Flows: Governing equations, numerical methods, and test cases illustrating flow and heat transfer related to turbo machines.

Textbooks:

1. Fluid Mechanics and Thermodynamics of Turbomachinery, S. L. Dixon and C. A. Hall, Butterworth-Heinemann, Seventh Edition, 2014, ISBN: 9780124159549.
2. Gas Turbine Theory, H. Cohen, GFC Rogers and HIH Saravanamuttoo, Addison Wesley Longman Limited, 4th Edition, 1996, ISBN: 1292093099.

Reference Books:

1. Fundamentals of Turbomachinery, Venkanna B. K Prentice Hall India Learning Private Limited, 2009.
2. Principles of Turbomachinery, Seppo A. Korpela, 2nd Edition, (2019) John Wiley and Son‘s, USA.
3. Radial Flow Turbocompressors, Michael Casey, Chris Robinson, (2021), Cambridge University Press

Online Learning Resources:

- https://www.youtube.com/watch?v=GIvV6XWaG-A
- https://www.youtube.com/playlist?list=PLbMVogVj5nJQQp3QLuzbcHrt0XncZZTiE
- https://www.youtube.com/watch?v=wlPXZrP9vR8&list=PLCoE5wxWtHFYiVGswvsWRaHjv18vxZzE2

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	**PSO1**	**PSO2**
23A036BT.1	3	3	3	-	-	1	-	-	-	1	1	1	3	2
23A036BT.2	3	3	2	-	-	2	-	-	-	1	1	1	3	2
23A036BT.3	3	3	3	-	-	1	-	-	-	1	1	1	3	2
23A036BT.4	3	3	3	-	-	1	-	-	-	1	1	1	3	2
23A036BT.5	3	3	3	-	2	1	-	-	-	1	1	1	3	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Control Systems
Category: Professional Elective
Couse Code: 23A036CT
Branch/es: Mechanical Engineering
Year & Semester: III Year II Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To gain the knowledge on fundamentals of control systems, mathematical modelling, and transfer function derivation for electro-mechanical components
2. To gain the knowledge on system representation, and to introduce classical control design techniques
3. To equip students with the ability to represent and simplify control, and to design effective controllers for achieving desired system performance
4. To gain the knowledge and skills to analyze control system stability and performance in the frequency domain, using Bode, polar, and transfer functions
5. To State-space analysis of different models from block diagrams, and concepts of controllability, observability, and state transition matrices

Course Outcomes:

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

1. Model dynamic systems, distinguish between loop controls, analyze feedback effects, and derive transfer functions for DC/AC servo motors and synchro devices
2. Analyze and simplify control systems, and create effective controllers such as lag, lead, lead-lag, and PID to meet system performance specifications
3. Analyze and simplify control systems using block diagrams and signal flow graphs, and design appropriate controllers to achieve desired system performance
4. Analyze the frequency response of control systems using Bode, polar, and evaluate system stability and performance such as gain margin and phase margin
5. Develop state-space models from block diagrams, analyze system controllability and observability, and solve time-invariant state equations using the state transition matrix

Unit 1 Basics In Control System and Transfer Function 10

Introduction of Control Systems, Various types of systems (Open Loop and closed loop) and their differences- Classification and Feed-Back Characteristics of control system- Effects of feedback. Mathematical models – Differential equations, Translational and Rotational mechanical systems. Transfer Function of DC Servo motor - AC Servo motor- Synchro transmitter and Receiver

Unit 2 Representation Of Transfer Function And Control Design Techniques 10

Block diagram representation of systems considering electrical systems as examples. Block diagram algebra – Representation by Signal flow graph - Reduction using Mason‘s gain formula. Compensation techniques – Lag, Lead, Lead-Lag Controllers design, PID Controllers

Unit 3 Time Response Analysis 10

Standard test signals - Time response of first order systems – Characteristic Equation of Feedback control systems, Transient response of second order systems - Time domain specifications – Steady state response - Steady state errors and error constants – Effects of proportional derivative, proportional integral systems. STABILITY ANALYSIS: The concept of stability – Routh‘s stability criterion – qualitative stability and

conditional stability – limitations of Routh's stability. The root locus concept - construction of root loci effects of adding poles and zeros to G(s) H(s) on the root loci

Unit 4 Frequency Response Analysis 10

Introduction, Frequency domain Specifications-Bode diagrams Determination of Frequency domain specifications and transfer function from the Bode Diagram-Phase margin and Gain margin Stability Analysis from Bode Plots. **STABILITY ANALYSIS IN FREQUENCY DOMAIN**: Polar Plots-Nyquist Plots-Stability Analysis

Unit 5 State Space Analysis 10

Concepts of state, state variables and state model, derivation of state models from block diagrams, Diagonalization- Solving the Time invariant state Equations- State Transition Matrix and it's Properties – Concepts of Controllability and Observability

Prescribed Textbooks:

1. I. J. Nagrath, M .Gopal (2011), Control Systems Engineering, 5th edition, New Age International (P) Limited, New Delhi, India
2. Benjamin. C. Kuo (2003), Automatic Control Systems, 8th edition, John Wiley and Son's, USA

Reference Books:

1. K. Ogata (2008), Modern Control Engineering, 4th edition, Prentice Hall of India Pvt. Ltd, New Delhi. 2. N. K. Sinha (2008), Control System
2. Prof. Vishwajit K. Barbudhe Control system Engineering National Press (2020)
3. Richard Dorf and Robert Bishop Modern Control Systems Pear son, 13th edition (2016)

Online Learning Resources:

- https://nptel.ac.in/courses/107106081
- https://nptel.ac.in/courses/108107115
- https://nptel.ac.in/courses/108103007
- https://nptel.ac.in/courses/115108104

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Life-long learning	PSO1	PSO2
23A036CT.1	3	3	3	3	-	-	-	-	-	-	-	2	2
23A036CT.2	3	3	3	3	-	-	-	-	-	-	-	2	2
23A036CT.3	3	3	3	3	-	-	-	-	-	-	-	3	3
23A036CT.4	3	3	3	3	-	-	-	-	-	-	-	2	2
23A036CT.5	3	3	3	3	-	-	-	-	-	-	-	2	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Operations Research
Category: Professional Elective -II
Couse Code: 23A036DT
Branch/es: Mechanical Engineering
Year & Semester: III Year II Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To understand OR with focus on model classification, formulation, and LP solution techniques.
2. To formulate and solve transportation, assignment, and Traveling Salesman problems.
3. To apply fundamentals of game theory, job sequencing, and scheduling techniques.
4. To analyze queuing models with Poisson arrivals and exponential service times for single and multichannel systems.
5. To apply replacement and maintenance strategies, and dynamic programming in optimization.

Course Outcomes:

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

1. Build and compare different mathematical models of the real time situations by using different Research models. Solve the LP problems and find Multiple Optimal Solutions
2. Implement Transportation and Assignment problems to solve the real time industry needs
3. Choose the best strategy of Game theory and capable of identifying the suitable techniques. Solve the Job Sequencing Problem
4. Apply different Queuing models to optimize the queuing length. Define the queuing and inventory terminology to solve the different inventory and queuing problems
5. Apply concepts of replacement and maintenance analysis and solve optimization problems using dynamic programming techniques

Unit 1 Introduction to Operations Research & LP **11**

OR definition - Classification of Models, modeling – Methods of solving OR Models, limitations and applications of OR models

Linear Programming (LP): Problem Formulation, Graphical Method, Simplex Method, Big-M Method, Two–Phase Simplex Method, Special Cases of LP- Degeneracy, Infeasibility and Multiple Optimal Solutions; Concept of dual theorem

Unit 2 Transportation and Assignment Problems **11**

Transportation and Assignment Problems Transportation Problem – Formulation; Different Methods of Obtaining Initial Basic Feasible Solution –North West Corner Rule, Least Cost Method, Vogel's Approximation Method; Optimality Method – Modified Distribution (MODI) Method; Special Cases – Unbalanced Transportation Problem, Degenerate Problem.

Assignment Problem – Formulation, Hungarian Method for Solving Assignment Problems, Traveling Salesman problem

Unit 3 Game theory & Job Sequencing **10**

Game theory & Job Sequencing Game theory: Optimal solution of two-person zero sum games, the max min and min max principle. Games without saddle points, mixed strategies. Reduction by principles of dominance, arithmetic, algebraic method and graphical method.

Job Sequencing: Introduction to Job shop Scheduling and flow shop scheduling, Solution of Job Sequencing Problem, Processing of n Jobs through two machines, Processing of n Jobs through m machines, graphical method

Unit 4 Queuing Theory & Inventory Control 09

Queuing Theory: Introduction – Terminology, Arrival Pattern, Service Channel, Population, Departure Pattern, Queue Discipline, Birth & Death Process, Single Channel Models with Poisson Arrivals, Exponential Service Times with infinite and finite queue length; Multichannel Models with Poisson Arrivals, Exponential Service Times with infinite queue length.

Inventory Control: Introduction, Deterministic models – EOQ model with and without shortages, Production model, Buffer stock and discount inventory models with single price breaks. Selective inventory control.

Unit 5 Replacement and Maintenance Analysis & Dynamic Programming 09

Replacement and Maintenance Analysis: Introduction – Types of Maintenance, Make or buy decision. Types of Replacement Problems, Determination of Economic Life of an Asset, and Simple Probabilistic Model for Items which completely fail-Individual Replacement Model, Group Replacement Model.

Dynamic Programming (DP): Introduction –Bellman 's Principle of Optimality – Applications of Dynamic Programming – Shortest Path Problem – Capital Budgeting Problem – Solution of Linear Programming Problem by DP

Prescribed Textbooks:

1. Operations Research, Prem kumar Gupta and Hira, 3/e, S Chand Company Ltd., New Delhi, 2003
2. Operations Research: Theory, Methods and Applications, Sharma S.D.15/e, Kedar Nath Ram Nath, 2010

Reference Books:

1. Introduction to Operations Research, Hiller F.S., and Liberman G.J., 7/e, Tata McGraw Hill, 2010
2. Operations Research: Theory and Applications, Sharma J.K., 4/e, Laxmi Publications, 2009
3. Operations Research, Taha H.A., 9/e, Prentice Hall of India, New Delhi, 2010
4. Operations Research, Pannerselvam R., 2/e, Pentice Hall of India, New Delhi, 2006
5. Resource Management Techniques: Operations Research, Sundaresan.V, and Ganapathy Subramanian.K.S, A.R Publications, 2015

Online Learning Resources:

- http://www2.informs.org/Resources/
- http://www.mit.edu/~orc/
- http://www.ieor.columbia.edu/
- http://www.universalteacherpublications.com/univ/ebooks/or/Ch1/origin.htm
- http://www.wolfram.com/solutions/OperationsResearch/

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A036DT.1	3	3	3	3	-	-	-	1	-	-	-	-	2	2
23A036DT.2	3	3	3	3	-	-	-	1	-	-	-	-	2	2
23A036DT.3	3	3	3	3	-	-	-	1	-	-	-	-	3	3
23A036DT.4	3	3	3	3	-	-	-	1	-	-	-	-	2	2
23A036DT.5	3	3	3	3	-	-	-	1	-	-	-	-	2	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Smart Materials
Category: Professional Elective – II
Couse Code: 23A036ET
Branch/es: Mechanical Engineering
Year & Semester: III Year II Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To understand the fundamental characteristics of different metals and gain insight into smart materials, including their classification and real-world applications.
2. To acquire knowledge of various types of smart materials, including electro-rheological fluids and shape memory materials.
3. To explore the processing techniques of smart materials and fluids, with emphasis on synthesis and fabrication methods such as metallization and UV curing.
4. To develop an understanding of different types of sensors, including advanced carbon nanotube and polymer-based sensors.
5. To comprehend the principles, types, and applications of actuators used in smart systems, including electro-thermal actuators.

Course Outcomes:

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

1. Explain and distinguish between traditional engineering materials and smart materials, and identify appropriate smart materials for various engineering applications.
2. Explain the working principles, properties, and applications of different smart materials and evaluate their suitability for specific engineering and technological applications.
3. Describe and apply suitable processing and fabrication techniques for different smart materials in engineering applications.
4. Identify, describe, and equate different sensor technologies and select appropriate sensors for engineering applications.
5. Demonstrate the working mechanisms of various actuators compare and select suitable actuation methods for different smart materials for create system applications.

Unit 1 **08**

Introduction: Characteristics of metals, polymers and ceramics. Introduction to smart materials. Classification of smart materials, Components of a smart System, Applications of smart material.

Unit 2 **08**

Smart Materials Piezoelectric materials, Electro strictive Materials, Magnetostrictive materials, Magnetoelectric materials, Magnetorheological Electrorheological fluids, Shape Memory materials.

Unit 3 **08**

Processing of Smart Materials Semiconductors and their processing, Metals and metallization techniques, Ceramics and their processing, Polymers and their synthesis, UV radiation curing of polymers, fluids.

Unit 4 **08**

Sensors Introduction, Conductometric sensors, Capacitive sensors, Piezoelectric sensors, Magnetostrictive sensors, Piezoresistive sensors, Optical sensors, Resonant sensors, semiconductor-based sensors, Acoustic sensors, polymerize sensors, Carbon nanotube sensors.

Unit 5 **08**

Actuators Introduction, Electrostatic transducers, Electromagnetic transducers, Electrodynamic transducers, Piezoelectric transducers, Electro-strictive transducers, Magneto-strictive transducers, Electro thermal actuators, Comparison of actuation, Applications

Prescribed Textbooks:

1. Smart Material Systems and MEMS: Design and Development Methodologies, V. K. Varadan, K. J. Vinoy, S. Gopalakrishnan, John Wiley and Sons, England, 2006
2. Smart Structures and Materials, Brain Culshaw, Artech House, London, 1996
3. Smart Materials and Structures, Mukesh V. Gandhi, Brian S. Thompson, , Springer, May- 1992.

Reference Books:

1. Smart Structures: Analysis and Design, A. V. Srinivasan, Cambridge University Press, Cambridge, New York, 2001.
2. Smart Structures, P. Gauenzi, Wiley, 2009.
3. Piezoelectric Sensorics: Force, Strain, Pressure, Acceleration and Acoustic Emission Sensors, Materials and Amplifiers, G. Gautschi, Springer, Berlin, New York, 2002
4. Analysis and Performance of Fiber Composites, B. D. Agarwal and L. J. Broutman, John Wiley & Sons
5. Engineering aspects of Shape memory Alloys, T. W. Duerig, K. N. Melton, D. Stockel,C.

Online Learning Resources:

- https://nptel.ac.in/courses/112104173/
- www.iop.org/EJ/article/0964-1726/5/3/002/sm6301.ps.gz
- https://nptel.ac.in/courses/112104173/
- https://nptel.ac.in/courses/112104251/

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and	Life-long learning	PSO1	PSO2
23A036ET.1	3	2	2	-	-	1	-	-	-	-	-	2	2	2
23A036ET.2	3	3	2	2	-	-	-	-	-	-	-	2	2	3
23A036ET.3	3	2	3	2	2	-	-	-	-	-	-	2	3	3
23A036ET.4	3	2	2	2	3	-	-	-	-	-	-	2	2	2
23A036ET.5	3	2	3	2	2	-	-	-	-	-	-	2	2	3

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Power Plant Engineering
Category: Professional Elective-III
Couse Code: 23A036FT
Branch/es: Mechanical Engineering
Year & Semester: III Year II Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
1. To familiarize the sources of energy, power plant economics and environmental aspects.
2. To outline the working components of different power plant.
3. To gain knowledge of working mechanism of diesel and gas turbine power plants.
4. To impart types of nuclear power plants, and outline working principle and advantages and hazards.
5. To provide insight of renewable energy sources; characteristics, working principle, classify types, layouts, and plant operations.

Course Outcomes:
At the end of the course, the student will be able to
1. Summarize sources of energy, power plant economics, and environmental aspects.
2. Comprehend working components of a steam power plant.
3. Comprehend the working mechanism of diesel and gas turbine power plants.
4. Summarize types of renewable energy sources and their working principle.
5. Comprehend the working principle of nuclear power plants.

Unit 1 Introduction to the Sources of Energy **08**

Resources and Development of Power in India. Convectional and non- conventional energy sources, Power Plant Economics and Environmental Considerations: Capital Cost, Investment of Fixed Charges, Operating Costs, General Arrangement of Power Distribution, Load Curves, Load Duration Curve. Definitions of Connected Load, Maximum Demand, Demand Factor, Average Load, Load Factor, Diversity Factor - Tariff - Related Exercises. Effluents from Power Plants and Impact on Environment - Pollutants and Pollution Standards - Methods of Pollution Control. Inspection And Safety Regulations

Unit 2 Steam Power Plant **10**

Introduction to Boilers- Modern High Pressure and Supercritical Boilers - Analysis of Power Plant Cycles - Modern Trends in Cycle Improvement - Waste Heat Recovery, Fluidized Bed Boilers., Fuel and Handling Equipments, Types of Coals, Coal Handling, Choice of Handling Equipment, Coal Storage, Ash Handling Systems.

Steam Power Plant: Combustion Process: Properties of Coal - Overfeed and Under Feed Fuel Beds, Travelling Grate Stokers, Spreader Stokers, Retort Stokers, Pulverized Fuel Burning System and Its Components, Combustion Needs and Draught System, Cyclone Furnace, Design and Construction, Dust Collectors, Cooling Towers and Heat Rejection. Analysis of Pollution from Thermal Power Plants - Pollution Controls.CO_2 Recorders

Unit 3 Diesel Power Plant **08**

Diesel Power Plant, Construction, Plant lay out with auxiliaries, fuel storage. GAS TURBINE PLANT: Introduction - Classification - Construction - Layout with Auxiliaries - Principles of Working Closed and Open Cycle Gas Turbines. Advantages And Disadvantages Combined Cycle Power Plants.

Unit 4 Hydro Electric Power Plant **09**

Water Power - Hydrological Cycle / Flow Measurement - Drainage Area Characteristics - Hydrographs - Storage and Pondage - Classification of Dams and Spill Ways. Hydro Projects Plant: Types - Typical Layouts - Plant Auxiliaries - Plant Operation Pumped Storage Plants.

Unit 5 Power from Non-Conventional Sources **08**

Power from Non-Conventional Sources: Utilization of Solar Collectors- Working Principle, Wind Energy - Types of Turbines - HAWT & VAWT-Tidal Energy. MHD power Generation.

Nuclear Power Station: Nuclear Fuel - Nuclear Fission, Chain Reaction, Breeding and Fertile Materials - Nuclear Reactor -Reactor Operation. Types of Reactors: Pressurized Water Reactor, Boiling Water Reactor, Sodium-Graphite Reactor, Fast breeder Reactor, Homogeneous Reactor, Gas Cooled Reactor, Radiation Hazards and Shielding - Radioactive Waste Disposal.

Textbooks:

1. Power Plant Engineering, P.K. Nag, —3rd edition, TMH, 2013, ISBN, 0070435995
2. Power plant technology, Wakil, M.M.EI TMH Publications. ISBN: 978-93-329-0125-4

Reference Books:

1. A Text Book of Power Plant Engineering, Rajput, 4th edition, Laxmi Publications, 2012, ISBN-10: 8170086523.
2. Power plant Engineering, Ramalingam, Sci tech Publishers, 2013, ISBN of 978-81-87328-77-3.
3. Power Plant Engineering, P.C. Sharma, S.K. Kataria Publications, 2012, ISBN, 978-93-5014-384-1.
4. A course in Power Plant Engineering, Arora and S.Domakundwar, Dhanpat Rai & Co (p) Ltd, 2014, ISBN: 9788177001075

Online Learning Resources:

- https://nptel.ac.in/courses/112107291
- https://youtube.com/playlist?list=PLLy_2iUCG87BT8H9uMufjrcPF5e6Qd2bz&si=RQhZwEibgqXK2dRL
- https://youtube.com/playlist?list=PLLy_2iUCG87BT8H9uMufjrcPF5e6Qd2bz&si=LjgzdabT7tIsCwJC
- https://youtu.be/IdPTuwKEfmA?si=PyF04z9beiVGkXAS

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A036FT.1	3	3	1	-	-	-	1	-	1	1	2	2	2
23A036FT.2	3	3	2	-	-	-	1	-	1	1	2	2	2
23A036FT.3	3	3	2	-	-	-	1	-	1	1	2	2	2
23A036FT.4	3	2	2	-	-	-	1	-	1	1	2	2	2
23A036FT.5	3	2	2	-	-	2	1	-	1	1	2	2	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Industrial Safety
Category: Professional Elective-III
Couse Code: 23A036GT
Branch/es: Mechanical Engineering
Year & Semester: III Year II Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
1. To understand the concepts of industrial safety and management.
2. To demonstrate the accident preventions and protective equipment.
3. To understand and apply the knowledge of safety acts
4. To gain knowledge about fire prevention and protection systems
5. To understand and apply fire safety principles in buildings

Course Outcomes:
At the end of the course, the student will be able to
1. Describe the concepts of industrial safety and management
2. Summarize the smart machines and smart sensors
3. Analyze causes and prevention methods for occupational diseases.
4. Describe fire prevention and protection systems.
5. Describe how to apply the fire safety principles in buildings

Unit 1 Introduction to the Development of Industrial Safety & Management 08
History and development of Industrial safety: Implementation of factories act, Safety and productivity, Safety organizations. Safety committees and structure, Role of management and role of Govt. in industrial safety.

Unit 2 Accident Preventions and Protective Equipment 08
Personal protective equipment, Survey the plant for locations, Part of body to be protected, Education and training in safety, Prevention causes and cost of accident, Housekeeping, First aid, Accident reporting, Investigations. Industrial psychology in accident prevention, Safety trials, Safety related to operations.

Unit 3 Safety Acts 08
Features of Factory Act, Introduction of Explosive Act, Boiler Act, ESI Act, Workman‘s compensation Act, Industrial hygiene, Occupational safety, Diseases prevention, Ergonomics, Occupational diseases, stress, fatigue, health, safety and the physical environment, Engineering methods of controlling chemical hazards, safety and the physical environment, Control of industrial noise and protection against it, Code and regulations for worker safety and health, codes for safety of systems.

Unit 4 Fire Prevention and Protection 08
Sources of ignition – fire triangle – principles of fire extinguishing – active and passive fire protection systems – various classes of fires – A, B, C, D, E-Fire extinguishing agents- Water, Foam, Dry chemical powder, Carbon-dioxide Halon alternatives Halocarbon compounds-Inert gases, dry powders – types of fire extinguishers – fire stoppers –hydrant pipes – hoses – monitors – fire watchers – layout of stand pipes – fire station-fire alarms and sirens – maintenance of fire trucks – foam generators – escape from fire rescue operations – fire drills –first aid for burns.

Unit 5 Building Fire Safety **08**

Objectives of fire safe building design, Fire load, fire resistant material and fire testing – structural fire protection – structural integrity – concept of egress design -exit– width calculations – fire certificates – fire safety requirements for high rise buildings.

Textbooks:

1. Occupational Safety Management and Engineering Willie Hammer–PrenticeHall (2000), ISBN-13: 978-1551642956
2. Reliability, Maintenance and Safety Engineering by Dr.A. K.Guptha, 2015, ISBN-13: 978-8131805213

Reference Books:

1. Installation, Servicing and Maintenance Bhattacharya, S.N.-S.Chand and Co.
2. Fire Safety in Building, Jain VK , New Age International 1996.
3. Handbook on Industrial Fire Safety, Purandare D.D & Abhay D.Purandare, —P&A publications, NewDelhi, 2006
4. A Text book of Reliability and Maintenance Engineering by Alakesh Manna
5. McElroy,FrankE.,—Accident Prevention Manual for Industrial Operations, NSC, Chicago, 1988.
6. Green, A.E.,—High Risk Safety Technology‖, John Wiley and Sons, 1984

Online Learning Resources:

- https://nptel.ac.in/courses/110105094
- https://youtube.com/playlist?list=PLbRMhDVUMngdXebaRB59KdKwstzuAovua&si=FcbDQzZK6i_3TASD
- https://youtube.com/playlist?list=PLbRMhDVUMngdXebaRB59KdKwstzuAovua&si=6RaMiYhEkp5-EfAH
- https://youtube.com/playlist?list=PLln3BHg93SQ8RYKhe9czOHq1hVjpEWMts&si=5y0WMqX3wrvvispg

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A036GT.1	2	2	2	2	-	-	-	-	-	-	-	2	2
23A036GT.2	2	2	2	2	-	-	-	-	-	-	-	2	2
23A036GT.3	3	3	3	3	-	-	-	-	-	-	-	1	1
23A036GT.4	3	3	3	3	-	-	-	-	-	-	-	2	2
23A036GT.5	3	3	3	3	-	-	-	-	-	-	-	2	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Design of Automobile Transmission Systems
Category: Professional Elective-III
Couse Code: 23A036HT
Branch/es: Mechanical Engineering
Semester: III Year II Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
1. To explain the various elements involved in a transmission system.
2. To explain the design procedures of different types of joints.
3. To design the system based on the input and the output parameters.
4. To produce working drawings of the system involving pulleys, gears, clutches and brakes.
5. To design concepts of IC engine parts like Pistons, connecting rod and crank shaft.

Course Outcomes:
At the end of the course, the student will be able to
1. Design and select suitable flexible power transmission elements and analyze the load conditions, and performance requirements.
2. Design procedure for keys and cotter joints.
3. Analyze and design different types of gears by evaluating their efficiency, ensuring reliable performance in mechanical power transmission systems.
4. Create speed reducers and multi-speed gearboxes by developing structural and ray diagrams, selecting appropriate gear combinations for various mechanical applications
5. Design the different IC engine parts subjected to different loads.

Unit 1 Flexible power transmission systems **08**
Flexible power transmission systems: Design of Belts – Flat Belts and Pulleys – V Belts and Pulleys – Design of chain drives – Wire ropes.

Unit 2 Design of Keys, Cotter and Knuckle Joints **08**
Keys: Design of sunk, saddle, Kennedy and woodruff keys.
Cotter and Knuckle Joints: Socket and spigot joint, Sleeve and Cotter joints, Gib and Cotter joint, Knuckle joint.

Unit 3 Helical, bevel and worm gears **08**
Helical, bevel and worm gears: Parallel Helical Gears – Kinematics – Tooth proportions – Force analysis – Stresses in Helical gear – Design of helical gear – Crossed Helical gears – Straight Bevel gears – Kinematics – Force analysis – Stresses in straight bevel gear tooth – Design of bevel gear – Worm gearing – Kinematics – Forces - Friction and Efficiencies – Stresses in worm gear tooth.

Unit 4 Design of gear boxes **06**
Design of gear boxes: Design of Speed reducers – Design of multi speed gear boxes for machine tools – Structural and ray diagrams.

Unit 5 Design of IC engine components **10**
Piston - Forces analysis of piston - Design and proportions of Trunk type piston.
Connecting rod–forces acting on connecting rod - design of connecting rod.
Crank and Crank shafts-types of Crank shafts -design of Center crank shafts.

Textbooks:

1. Mechanical Engineering Design, Joseph Edward Shigley and Charles, R. Mischke, McGraw –Hill International Editions, 2000.
2. Machine Design, Robert L. Norton, an integrated approach, (5th Edition) Pearson publisher, 2000

Reference Books:

1. Design Data‖, PSG College of Technology, DPV Printers, Coimbatore, 2005.
2. Hand Book of Gear Design‖, Malisa, Tata Mc Graw Hill, International Edition, 2000.
3. Design of Machine Elements, V.B. Bhandari, Tata Mc Graw Hill, 2001

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	**PSO1**	**PSO2**
23A036HT.1	3	3	3	2	3	-	-	1	1	2	2	3	3
23A036HT.2	3	3	3	3	3	--	-	1	1	1	2	3	3
23A036HT.3	3	3	3	3	3	-	-	1	1	1	2	3	3
23A036HT.4	3	3	3	3	3	-	-	1	1	2	2	3	3
23A036HT.5	3	3	3	3	3	-	-	1	1	2	2	3	3

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Mechanics and Manufacturing of Composite Materials
Category: Professional Elective-III
Course Code: 23A036IT
Branch/es: Mechanical Engineering
Year & Semester: III Year II Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To gain knowledge on fundamentals of composite materials, including their classification, and to familiarize them with various fiber-reinforced plastic processing techniques used in manufacturing.
2. To understand the micro- and macro-mechanical behavior of composite laminas.
3. To equip theoretical and analytical tools for evaluating the strength and mechanical behavior of composite laminates.
4. To introduce metal matrix composites (MMCs), focusing on reinforcement materials, base metal selection, fabrication techniques.
5. To gain knowledge on deep understanding of micromechanics-based failure analysis in unidirectional composite laminas, and the selection of appropriate failure criteria.

Course Outcomes:

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

1. Classify and describe the characteristics of different types of composite materials, and explain and apply various fiber-reinforced plastic processing methods.
2. Evaluate the elastic moduli of composite laminas, apply Hooke's law to different material types and solve numerical problems.
3. Analyze the failure of composite laminates, and perform macro-mechanical analysis using Classical Laminate Theory (CLT), for various laminate configurations through numerical problem-solving.
4. Identify and select appropriate reinforcements and base metals for MMCs, understand and apply various fabrication processes.
5. Analyze and evaluate the failure mechanisms of unidirectional lamina using micromechanical models and apply suitable failure theories through practical examples.

Unit 1 Introduction to Composite Materials & Fiber Reinforced Plastic Processing **10**

Introduction to Composite Materials: Definition, classification and characteristics of composite Materials – fibrous composites, laminated composites, particulate composites. Applications: Automobile, Aircrafts. missiles. Space hardware, Electrical and electronics, Marine, recreational and sports equipment, future potential of composites.

Fiber Reinforced Plastic Processing: Lay-up and curing, fabricating process, open and closed mould process, hand lay-up techniques; structural laminate bag molding, production procedures for bag molding; filament winding, pultrusion, pulforming, thermo-forming, injection molding, blow molding.

Unit 2 Micro Mechanical Analysis of a Lamina and Macro Mechanics of a Lamina **09**

Micro Mechanical Analysis of a Lamina: Micro Mechanical Analysis of a Lamina: Introduction, Evaluation of the four elastic moduli by Rule of mixture, Numerical problems. Macro Mechanics of a Lamina: Hooke's law for different types of materials, Number of elastic constants, Two - dimensional relationship of compliance and stiffness matrix. Hooke's law for two-dimensional angle lamina, engineering constants - Numerical problems. Stress-Strain relations for lamina of arbitrary orientation, Numerical problems.

Unit 3 Biaxial Strength Theories and Macro Mechanical Analysis of Laminate 10

Biaxial Strength Theories: Maximum stress theory, Maximum strain theory, Tsai-Hill theory, Tsai, Wu tensor theory, Numerical problems.

Macro Mechanical Analysis of Laminate: Introduction, code, Kirchoff hypothesis, CL T, A, B, and D matrices (Detailed derivation), Special cases of laminates, Numerical problems.

Unit 4 Metal Matrix Composites, Fabrication Process for MMC's & Study Properties of MMC's 09

Metal Matrix Composites: Metal Matrix Composites: Reinforcement materials, types, characteristics and selection base metals selection. Need for production MMC ‘s and its application.

Fabrication Process for MMC's: Powder metallurgy technique, liquid metallurgy technique and secondary processing, special fabrication techniques.

Study Properties of MMC's: Physical Mechanical, Wear, machinability and Other Properties. Effect of size, shape and distribution of particulate on properties.

Unit 5 Failure Theories 10

Micromechanics of Failure of Unidirectional Lamina, Anisotropic Strength and Failure Theories, Importance of Shear Strength, Choice of Failure Criteria, Examples.

Textbooks:

1. K.K. Chawla, Composite Materials, Springer-Verlag, New York, 1998.
2. B.T. Astrom, Manufacturing of Polymer Composites, Chapman & Hall, 1997.

Reference Books:

1. Frank L Matthews and R D Rawlings, Composite Materials: Engineering and Science, Taylor and Francis, 2006.
2. D. Hull and T.W. Clyne, Introduction to Composite Materials, Cambridge University Press, 1996.
3. M.R. Piggott, Load Bearing Fibre Composites, Pergamon press, Oxford, 1998.
4. F. Ashby and D.R.H. Jones, Engineering Materials, Pergamon press, 1999.
5. R.W. Davidge and A. Kelly, Mechanical behavior of ceramics, Cambridge university press, 1999.

Online Learning Resources:

- https://nptel.ac.in/courses/112104221
- https://nptel.ac.in/courses/112104229
- https://nptel.ac.in/courses/112104161
- https://onlinecourses.nptel.ac.in/noc22_me40/preview

CO-PO Mapping:

Course Outcomes		Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A036IT.1		3	2	2	2	-	-	-	1	-	1	-	1	2	2
23A036IT.2		2	3	2	2	-	-	-	1	-	1	-	1	2	2
23A036IT.3		3	3	2	2	-	-	-	1	-	1	-	1	3	2
23A036IT.4		2	2	2	3	-	-	-	1	-	1	-	1	2	3
23A036IT.5		3	2	2	2	-	-	-	1	-	1	-	1	2	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Introduction to hybrid and electric vehicles
Category: Professional Elective-III
Couse Code: 23A036JT
Branch/es: Mechanical Engineering
Year & Semester: III Year II Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To gain knowledge of electric vehicle systems, battery technologies, and battery management systems.
2. To import the availing of the electric vehicle power plants and drive control techniques essential for efficient electric vehicle propulsion.
3. To facilize about the hybrid and electric vehicle technologies, including their historical evolution and energy efficiency optimization.
4. To gain comprehensive knowledge of electric and hybrid electric vehicle systems, and real-world applications ranging from passenger cars to heavy-duty and fuel cell vehicles.
5. To gain insight of hybrid and electric vehicle systems with effective energy management strategies for efficient and sustainable vehicle operation.

Course Outcomes:

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

1. Analyze the electric vehicle propulsion and energy storage systems, evaluate battery performance and management strategies.
2. Implement electric machine operation, design and analyze control power electronic converters, and apply drive control strategies in electric vehicle applications.
3. Analyze hybrid and electric drivetrain configurations, evaluate and create various electric motor drives and hybrid vehicle propulsion systems.
4. Compare hybrid and electric vehicle architectures, understand control strategies for various drive systems, and evaluate the role of emerging technologies in improving vehicle efficiency and sustainability.
5. Evaluate hybrid and electric vehicle systems, and applying control and communication principles across various electric and hybrid vehicle architectures.

Unit 1 Electric Vehicle Propulsion and Energy Sources 08

Introduction to electric vehicles, vehicle mechanics - kinetics and dynamics, roadway fundamentals propulsion system design - force velocity characteristics, calculation of tractive power and energy required, electric vehicle power source - battery capacity, state of charge and discharge, specific energy, specific power, Ragone plot. battery modeling - run time battery model, first principle model, battery management system- soc measurement, battery cell balancing. Traction batteries - nickel metal hydride battery, Li-Ion, Lipolymer battery.

Unit 2 Electric Vehicle Power Plant and Drives 06

Introduction electric vehicle power plants. Induction machines, permanent magnet machines, switch reluctance machines. Power electronic converters-DC/DC converters - buck boost converter, isolated DC/DC converter. Two quadrant chopper and switching modes. AC drives- PWM, current control method. Switch reluctance machine drives - voltage control, current control.

Unit 3 Hybrid And Electric Drive Trains 08

Introduction hybrid electric vehicles, history and social importance, impact of modern drive trains in energy supplies. Hybrid traction and electric traction. Hybrid and electric drive train topologies. Power flow control and energy efficiency analysis, configuration and control of DC motor drives and induction motor drives, permanent magnet motor drives, switch reluctance motor drives, drive system efficiency.

Unit 4 Electric and Hybrid Vehicles - Case Studies 10

Parallel hybrid, series hybrid -charge sustaining, charge depleting. Hybrid vehicle case study – Toyota Prius, Honda Insight, Chevrolet Volt. 42 V system for traction applications. Lightly hybridized vehicles and low voltage systems. Electric vehicle case study - GM EV1, Nissan Leaf, Mitsubishi Miev. Hybrid electric heavy-duty vehicles, fuel cell heavy duty vehicles.

Unit 5 Electric And Hybrid Vehicle Design 10

Introduction to hybrid vehicle design. Matching the electric machine and the internal combustion engine. Sizing of propulsion motor, power electronics, drive system. Selection of energy storage technology, communications, supporting subsystem. Energy management strategies in hybrid and electric vehicles - energy management strategies- classification, comparison, implementation.

Textbooks:

1. Electric and Hybrid Vehicles: Design Fundamentals, Iqbal Hussein, 2nd edition, CRC Press, 2003, ISBN: 143981175X
2. Electric and Hybrid Vehicles: Technologies, Modeling and Control - A Mechatronic Approach, Amir Khajepour, M. Saber Fallah, Avesta Goodarzi, illustrated edition, John Wiley & Sons, 2014, ISBN : 9781118341513.

Reference Books:

1. Electric Vehicle Technology‖, Explained, James Larminie, John Lowry, Wiley, 2003.
2. Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, John G. Hayes, G. Abas Goodarzi, 1st edition, Wiley- Blackwell, 2018.
3. Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, CRC Press, 2004.

Online Learning Resources:

- https://nptel.ac.in/courses/108103009
- https://www.youtube.com/playlist?list=PL9-f9hWLZS62VF18qPQ1gC7NqIAjaClsl
- https://www.youtube.com/watch?v=UgtjRob5qMg&list=PLyqSpQzTE6M9spod-H7Q69wQ3uRm5thr
- https://www.youtube.com/watch?v=h5ysddrlXLw

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A036JT.1	3	2	2	-	-	1	1	0	-	-	1	2	3	2
23A036JT.2	3	3	2	-	-	1	1	1	-	-	1	2	3	2
23A036JT.3	2	2	3	-	-	1	2	1	-	-	2	3	3	2
23A036JT.4	3	2	2	-	-	2	2	1	-	-	2	3	3	2
23A036JT.5	2	2	3	-	-	2	3	1	-	-	2	3	3	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Heat Transfer Lab
Category: Professional Core
Couse Code: 23A0361L
Branch/es: Mechanical Engineering
Year & Semester: III Year II Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	3	1.5

Course Objectives:

1. To gain insight various equipment undergoing different modes of heat transfer.
2. To impart the knowledge of heat exchangers.
3. To familiarize about transient heat conduction and heat pipe apparatus.
4. To provide practical knowledge on boiling and condensation equipment.

Course Outcomes:

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

1. Calculate the thermal conductivity of metal bar, insulating powder, lagged pipe and composite wall.
2. Calculate the fin efficiency, effectiveness and performance of heat exchangers.
3. Calculate convective heat transfer coefficient in free, forced convection, unsteady state heat conduction, and drop and film wise condensation.
4. Calculate the Stefan Boltzmann constant and emissivity of gray body.
5. Calculate the Critical heat flux for pool boiling, heat transfer in Heat pipe and two phase heat flow.

List of experiments:

1. Determine the overall heat transfer coefficient across the width of composite wall
2. Determine the thermal conductivity of a metal rod
3. Determine the thermal conductivity of insulating powder material through concentric sphere apparatus
4. Determine the thermal conductivity of insulating material through lagged pipe apparatus
5. Determine the efficiency of a pin fin in natural and forced convection.
6. Determine the heat transfer coefficient for a vertical cylinder in natural convection
7. Determine the heat transfer coefficient in forced convection of air in a horizontal tube.
8. Determine the heat transfer coefficients on film and drop wise condensation apparatus.
9. Determine the effectiveness of a parallel and counter flow heat exchanger.
10. Study the pool boiling phenomenon and different regimes of pool boiling.
11. Determine the emissivity of the test plate surface.
12. Experiment on Stefan-Boltzmann apparatus
13. Determine the heat transfer rate coefficient in fluidized bed apparatus.

Note: Any 12 out of 13 Experiments can be conducted.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PS01	PSO2
23A0361L.1	3	3	1	2	-	-	-	-	1	-	-	1	2	2
23A0361L.2	3	3	1	2	-	-	-	-	1	-	-	1	2	2
23A0361L.3	3	3	1	2	-	-	-	-	1	-	-	1	2	2
23A0361L.4	3	3	1	2	-	-	-	-	1	-	-	1	2	2
23A0361L.5	3	3	1	2	-	-	-	-	1	-	-	1	2	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: CAD/CAM Lab
Category: Professional Core
Couse Code: 23A0362L
Branch/es: Mechanical Engineering
Year & Semester: III Year II Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	3	1.5

Course Objectives:

1. To develop students skills in drafting and understanding orthographic, isometric views, and CAD file formats like DXE and IGES.
2. To enable the creation of 3D part models using basic and advanced features in CAD tools.
3. To gain hands-on experience in assembly modeling using both feature-based and Boolean-based methods.
4. To familiarize with CAM software for generating NC code for various machining processes.
5. To expertise industrial manufacturing via the use of post-processors and NC machines for real-time machining.

Course Outcomes:

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

1. Create accurate 2D technical drawings using orthographic and isometric projections, and interpret file formats like DXE and IGES.
2. Develop 3D part models using features such as protrude, revolve, shell, and sweep, and demonstrate and evaluate parent-child relationships.
3. Construct and analyze assemblies using feature-based and Boolean operations for simple mechanical systems and create complex mechanical assemblies.
4. Generate NC code for complex surfaces using CAM tools and study the function of various post-processors.
5. Transfer NC code to CNC machines. Perform and evaluate basic machining tasks such as turning and milling and generate new technics by using modern tools.

List of Experiments:

1. Drafting: Development of part drawings for various components in the form of orthographic and isometric. Representation of Dimensioning and tolerances scanning and plotting. Study of script, DXE AND IGES FILES.
2. Part Modelling: Generation of various 3D Models through Protrusion, revolve, shell sweep. Creation of various features. Study of parent child relation.
3. Assembly modelling: Feature based and Boolean based modelling surfaces, Assembly Modelling of simple components and Design of simple components.
4. CAM:
   a) Study of various post processors used in NC Machines.
   b) Development of NC code for free form and sculptured surfaces using CAM packages.
   c) Machining of simple components on NC lathe and Mill by transferring NC Code / from a CAM packages.

   NOTE: Through Any Four Software Packages from the following: Use of Auto CAD, Micro Station, CATIA, Pro-E, I-DEAS, CAEFEM, Gibbs CAM, Master CAM etc.
5. Evaluation of Stress/Strain for a plate with a hole.

Prescribed Textbooks:

1. CAD/CAM: Principles and applications, P. N. Rao, , 3/e, Tata McGraw-Hill, Delhi, 2017, ISBN-10: 9780070681934

Reference Books:

1. CAD/CAM, Mikell P. Groover, Emory W. Zimmers, 5/e, Pearson Prentice Hall of India, Delhi, 2008, ISBN-13: 9788177584165

Online Learning Resources:

- https://www.mygreatlearning.com/academy/learn-for-free/courses/catia
- https://www.learnvern.com/catia-course
- https://www.udemy.com/topic/cnc/?srsltid=AfmBOor4s-mXTnRKgM8Ifq2vyXfBr00OyjGw5nugmcL-JY8LZ6HwXBcP
- https://gcodetutor.com/
- https://academy.titansofcnc.com/
- https://www.youtube.com/watch?v=qyao_TgXrHg

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	**PSO1**	**PSO2**
23A0362L.1	3	2	2	3	3	3	-	2	3	2	2	3	3	3
23A0362L.2	3	2	2	3	3	3	-	2	3	2	2	3	3	3
23A0362L.3	3	3	3	3	3	2	-	2	3	2	2	3	3	3
23A0362L.4	3	2	2	3	3	3	-	2	3	2	2	3	3	3
23A0362L.5	3	2	2	3	3	3	-	2	3	2	2	3	3	3

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: 3D Printing Lab
Category: Skill Enhancement Course
Couse Code: 23A0364L
Branch/es: Mechanical Engineering
Year & Semester: III Year II Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	1	2	3

Course Objectives:

1. To introduce the fundamentals of prototyping and provide an overview of 3D printing technologies, machines, and processes.
2. To develop skills in 3D modeling, STL file preparation, slicing, and process parameter selection.
3. To provide hands-on experience in 3D printing using various materials, process settings, and post-processing techniques.
4. To enable students to apply reverse engineering concepts using 3D scanning and printing of real-life objects.

Course Outcomes:

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

1. Demonstrate understanding of 3D printer components, working principles, safety norms, and basic CAD preprocessing for additive manufacturing.
2. Analyze the influence of key FDM process parameters (infill, layer thickness, orientation) on printing time, mechanical strength, surface finish, and dimensional accuracy.
3. Operate resin-based 3D printers and evaluate the quality of intricate printed components.
4. Compare properties and performance of common 3D printing materials (ABS, PLA, Resin etc.) and apply post-processing techniques for improved part quality.
5. Apply reverse engineering techniques to scan, reconstruct, and replicate physical components using 3D scanning and printing technologies.

- Module 1: Introduction to 3D Printing & CAD Preprocessing
  1. Experiment 1: Introduction to 3D Printers – Components, Working Principles, and Safety Guidelines
  2. Experiment 2: CAD Modeling of Engineering Components and Conversion to STL Format
  3. Experiment 3: Slicing and Tool Path Generation using Cura/Prusa Slicer
- Module 2: Process Parameters in Fused Deposition Modeling (FDM)
  4. Experiment 4: Effect of Infill Percentage on Printing Time and Strength
  5. Experiment 5: Effect of Layer Thickness on Surface Finish and Build Time
  6. Experiment 6: Effect of Orientation on Support Structure and Dimensional Accuracy
- Module 3: Resin-Based 3D printing
  7. Experiment 7: 3D Printing of Intricate Objects using SLA/DLP Resin Printers
- Module 4: Material Studies and Post-processing
  8. Experiment 8: Comparative Study of ABS, PLA, and Resin Materials – Dimensional Accuracy & Surface Finish
  9. Experiment 9: Post-processing Techniques – Support Removal, Surface Cleaning, and Defect Identification
- Module 5: Advanced 3D Printing Techniques
  10. Experiment 10: Printing of Multi-material or Dual-extruder Objects
  11. Experiment 11: Design and Printing of Functional Assembly with 2–3 Interfacing Parts

- Module 6: Reverse Engineering and Reconstruction
  12. Experiment 12: 3D Scanning of Physical Objects using Handheld or Desktop Scanners
  13. Experiment 13: Surface Reconstruction and Editing of Scanned Mesh Data
  14. Experiment 14: Replication of Reverse-Engineered Part via 3D Printing

Prescribed Textbooks:

1. 3D Printing and Additive Manufacturing Principles and Applications, Chee Kai Chua and Kah Fai Leong, 5th edition, World Scientific Publications, 2017, ISBN-10: 9813146761
2. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Ian Gibson, David W Rosen, Brent Stucker, 2nd edition, Springer, 2010, ISBN-10: 1493921126

Reference Books:

1. Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing, Andreas Gebhardt, 1st edition, Hanser Publishers, 2012, ISBN-10: 156990507X
2. Additive Manufacturing, Amit Bandyopadhyay and Susmita Bose, 2nd edition, CRC Press, 2021, ISBN-10: 1032238593

Online Learning Resources:

- https://www.hubs.com/knowledge-base/introduction-fdm-3d-printing/
- https://slideplayer.com/slide/6927137/
- https://www.mdpi.com/2073-4360/12/6/1334
- https://www.centropiaggio.unipi.it/sites/default/files/course/material/2013-11-29%20-%20FDM.pdf
- https://lecturenotes.in/subject/197
- https://www.cet.edu.in/noticefiles/258_Lecture%20Notes%20on%20RP-ilovepdf-compressed.pdf
- https://www.vssut.ac.in/lecture_notes/lecture1517967201.pdf
- https://www.youtube.com/watch?v=NkC8TNts4B4

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A0364L.1	3	1	1	2	3	2	-	2	3	2	2	3	3	2
23A0364L.2	3	3	3	3	3	2	-	2	3	2	2	3	3	2
23A0364L.3	3	3	3	3	1	2	-	2	3	2	2	3	3	2
23A0364L.4	3	2	1	1	2	2	-	2	3	2	2	3	3	2
23A0364L.5	3	3	3	3	3	2	-	2	3	2	2	3	3	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering

Title of the Course: Technical paper writing and IPR
Category: Mandatory Course
Couse Code: 23A0365T
Branch/es: Mechanical Engineering
Year & Semester: III Year II Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
2	0	0	0

Course Objectives:
1. To enable the students to practice the basic skills of research paper writing.
2. To make the students understand the importance of IP and to educate them on the basic concepts of Intellectual Property Rights.
3. To practice the basic skills of performing quality literature review.
4. To help them in knowing the significance of real life practice and procedure of Patents.
5. To enable them learn the procedure of obtaining Patents, Copyrights, & Trade Marks.

Course Outcomes:
At the end of the course, the student will be able to
1. Identify key secondary literature related to their proposed technical paper writing.
2. Explain various principles and styles in technical writing.
3. Use the acquired knowledge in writing a research/technical paper.
4. Analyze rights and responsibilities of holder of Patent, Copyright, Trademark, International Trademark etc.
5. Evaluate different forms of IPR available at national & international level & Develop skill of making search of various forms of IPR by using modern tools and techniques.

Unit 1 **08**
Principles of Technical Writing: styles in technical writing; clarity, precision, coherence and logical sequence in writing-avoiding ambiguity- repetition, and vague language -highlighting your findings-discussing your limitations -hedging and criticizing -plagiarism and paraphrasing.

Unit 2 **08**
Technical Research Paper Writing: Abstract- Objectives-Limitations-Review of Literature- Problems and Framing Research Questions- Synopsis.

Unit 3 **08**
Process of research: publication mechanism: types of journals- indexing-seminars- conferences- proof reading –plagiarism style; seminar & conference paper writing; Methodology-discussion-results- citation rules.

Unit 4 **09**
Introduction to Intellectual property: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.
Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting and evaluating trade mark, trade mark registration processes.

Unit 5 **08**

Law of copy rights: Fundamentals of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.
Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer. Patent law, intellectual property audits.

Prescribed Textbooks:

1. Deborah. E. Bouchoux, Intellectual Property Rights, Cengage Learning India, 2013
2. Meenakshi Raman, Sangeeta Sharma. Technical Communication: Principles and practices, Oxford

Reference Books:

1. R.Myneni, Law of Intellectual Property, 9th Ed, Asia law House, 2019
2. Prabuddha Ganguli,Intellectual Property Rights Tata Mcgraw Hill, 2001
3. P.Naryan,Intellectual Property Law, 3rd Ed ,Eastern Law House, 2007
4. Adrian Wallwork. English for Writing Research PapersSecond Edition. Springer Cham Heidelberg New York ,2016
5. Dan Jones, Sam Dragga, Technical Writing Style

Online Learning Resources:

- https://theconceptwriters.com.pk/principles-of-technical-writing/
- https://www.ewh.ieee.org/soc/emcs/acstrial/newsletters/summer10/TechPaperWriting.html
- https://www.ewh.ieee.org/soc/emcs/acstrial/newsletters/summer10/TechPaperWriting.html
- https://www.manuscriptedit.com/scholar-hangout/process-publishing-research-paper-journal/
- https://www.icsi.edu/media/website/IntellectualPropertyRightLaws&Practice.pdf
- https://lawbhoomi.com/intellectual-property-rights-notes/
- https://www.extension.purdue.edu/extmedia/ec/ec-723.pdf

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	**PSO1**	**PSO2**
23A0365T.1	2	1	-	-	2	-	-	-	1	-	-	2	2	1
23A0365T.2	2	-	-	-	-	-	1		3	-	-	2	1	-
23A0365T.3	3	-	-	-	2		1		3	-	-	2	2	1
23A0365T.4	2	2	-	1		2	2		1	-	-	2	1	2
23A0365T.5	3	2	-	2	3		2	1	2	-	-	3	2	2