ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET

(An Autonomous Institution)

ACADEMIC REGULATIONS (R20), COURSE STRUCTURE AND SYLLABI

For the students admitted to

B. Tech., Regular Four Year Mechanical Engineering Degree Programme from the Academic Year 2020-21

and

B. Tech., Lateral Entry Scheme from the Academic Year 2021-22

VISION AND MISSION OF THE INSTITUTION

Vision

We impart futuristic technical education and instil 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

MECHANICAL ENGINEERING REGULAR DEGREE PROGRAMME

APPLICABLE FOR THE STUDENT BATCHES ADMITTED FROM THE ACADEMIC YEAR 2020-21

APPLICABLE FOR THE STUDENTS (Lateral Entry) ADMITTED FROM THE ACADEMIC YEAR 2021-22

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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 University Grants Commission (UGC), New Delhi, All India Council for Technical Education (AICTE), New Delhi and Jawaharlal Nehru Technological University 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 2020-21.

2. APPLICATION AND COMMENCEMENT

- The regulations are quite comprehensive and include definitions of key terms, semester system, credit system, grading system and other relevant details.
- The regulations detailed herein shall apply to all the regular under-graduate programmes offered by the Institute.
- The regulations shall be applicable and come into force to the student batches admitted from the academic year 2020-21 and Lateral Entry students admitted from the academic year 2021-22
- The Institute may revise, amend or change the regulations, scheme of examinations and syllabi, from time to time, if found necessary and on approval by the Academic Council of the Institute, keeping the recommendations of the BoS in view.
- Any or all such amendments shall be effective from such date and to such batches of students including those already undergoing the programme, as may be approved through Academic Council of the Institute.
- These regulations shall be called R20 Regulations.

3. ELIGIBILITY FOR ADMISSION

3.1 ADMISSION INTO ENGINEERING UNDER GRADUATION PROGRAMMES (REGULAR)

The eligibility criteria for admission into engineering under graduate programmes offered at AITS shall be as prescribed by the Government of Andhra Pradesh. The criteria are given below:

- The candidate shall be an Indian National / NRI.
- The candidate should have completed 16 years of age as on 31st December of the academic year for which the admissions are being conducted.
- The candidate should have passed the qualifying examination (10+2) or equivalent as on the date of admission recognized by Board of Intermediate, Andhra Pradesh.
- Seats in each programme in the Institute are classified into two categories i.e., **Category – A** and **Category – B** as per the GOs of Andhra Pradesh.

Category – A Seats

These seats shall be filled through counselling as per the rank secured by a candidate in the Common Entrance Test (EAMCET) conducted by the Government of Andhra Pradesh and as per other admission criteria laid down in the GOs.

Category – B Seats

These seats shall be filled by the Institute as per the GOs issued by the Government of Andhra Pradesh from time to time

3.2 ADMISSION INTO SECOND YEAR (Lateral Entry Scheme)

A candidate shall be admitted into the third semester (II year I semester) based on the rank secured by the candidate in the Engineering Common Entrance Test (ECET) by the Government of Andhra Pradesh and as per other admission criteria laid down in the GOs.

4. Medium of Instruction

The medium of instruction shall be **English** for all the courses including their content delivery and examinations, seminars, presentations and project evaluation as prescribed in the programme curriculum.

5. B.TECH. PROGRAMME STRUCTURE

The structure of the B.Tech. Programmes on offer at AITS are based on the **Choice Based Credit System (CBCS)** as defined by the UGC and the curriculum / course structure as suggested by the AICTE and APSCHE in its Model Curriculum.

Semester Scheme

- The B. Tech Programmes offered at AITS follow **semester scheme** pattern.
- The duration of a B. Tech. Programme shall be of **4 academic** years for 4 year B. Tech programmes **and 3 academic years** for 3 year B. Tech programmes in lateral entry scheme**.**
- Each academic year shall have **2 semesters** i.e., odd and even semesters and shall be counted as first semester, second semester, and third semester and so on up to eighth semester.
- Each semester shall consist of **16 weeks** of academic work excluding internal examinations.
- Each semester is structured to provide credits totalling to **160 credits** for the entire B.Tech. Programme.
- Each semester shall have **Continuous Internal Evaluation (CIE)** and **Semester End Examination (SEE)** for both Theory and Lab courses.
- Each student is required to secure a total of **160 credits with a CGPA ≥ 5** for the completion of the UG programme and the award of the B.Tech. Degree.
- A student after securing admission into a 4 year B.Tech Programme at AITS shall pursue and acquire the B.Tech. degree in a **minimum period of four academic years i.e., 8 semesters** and a **maximum period of eight academic years i.e., 16 semesters** starting from the date of commencement of I year I

semester, failing which the student shall forfeit the seat in B.Tech. Programme.

- A student after securing admission into a 3 year B. Tech Programme (Lateral Entry) at AITS shall pursue and acquire the B.Tech. Degree in a **minimum period of three academic years i.e., 6 semesters** and a **maximum period of six academic years i.e., 12 semesters** starting from the date of commencement of II year I semester, failing which the student shall forfeit the seat in B.Tech. programme

6. PROGRAMMES OFFERED BY THE INSTITUTE

The following B. Tech. programmes are offered as specializations by the Institute from 2020-2021.

SNo	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	22

7. COURSES AND CREDIT STRUCTURE

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

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

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

Each course is assigned certain number of credits based on following criterion

Type of Class	Semester	
	Periods per Week	Credits
Theory (Lecture/Tutorial)	01	01
	02	02
	03	03
	04	04
Practical	02	01
	03	1.5
	04	02
Project Work / Internship	-	16.5

Every course of the B. Tech. programme shall be offered by a specific section / department. The unique codes of the section / department offering the courses are given in the Table.

Course offering Department	Code
Basic Science Courses	C
Humanities and Social Science Courses including Management Courses	
Civil Engineering	1
Electrical and Electronics Engineering	2
Mechanical Engineering	3
Electronics & Communication Engineering	4
Computer Science & Engineering	5
Artificial Intelligence and Data Science	22

Every B. Tech. Programme of study shall be designed to have theory and laboratory courses. In addition, a student shall carry out internship, project, socially relevant project, and other mandatory courses as prescribed in the curriculum of the Programmes.

7.1 Types of Courses:

TYPE OF COURSES	COURSE CATEGORY	CODE	DEPARTMENT
			Mechanical Engineering
Foundation	Engineering Sciences	ESC	24
	Basic Sciences	BSC	21
	Humanities & Social Sciences and Management	HSMC	10.5
Core	Professional Core	PCC	51
Project	Project (12)	PROJ	16.5
	Internship (4.5)		
Elective courses	Professional Elective	PEC	15
	Open Elective (including two MOOCs)	OEC	12
Mandatory Courses	Mandatory	MC	-
	Skill Oriented Courses	SC	10
Total Credits			160

7.1.1 Foundation Courses

Engineering Science courses, Basic Science Courses and Humanities courses are termed as Foundation Courses and are mostly offered at I and II Year.

7.1.2 Professional Core Courses

Professional Core Course is to be completed by all students of respective programme before they can move on to the next semester.

7.1.3 Professional Core Electives

University Grants Commission has come up with the Choice Based Credit System (CBCS) in which the students have a choice to choose from the prescribed courses, which are referred as Professional elective and Open Elective courses. All the Professional and Open elective courses shall be offered for 3 credits.

Students have to register for a total of 5 professional core electives courses (PEC-1 to PEC-5) from the list of track-wise professional elective course as prescribed in the course structure of the programme. The following points are considered for a Professional Elective Course.

- Maximum strength of a class /section for each semester shall be 72.
- A course may be offered to the students, only if a minimum of 24 students (1/3 of the section strength) opt for it.
- The selection of course based on the choice for students shall be on 'first come first serve' through on line and off line registration.
- The Head of the department or concerned shall decide, whether or not to offer such course keeping in view the resources available in the department offering the course.

7.1.4 Open Electives

Choice Based Credit System (CBCS) is promoted in such a way that different open elective courses should be offered by every department in engineering to other departments. This interdisciplinary of learning open elective courses by other department students will have learning awareness and job-oriented benefits. Students require the opportunity to choose any open elective course from different departments and apply their knowledge to acquire jobs in that field of course. Learning and employment benefits are not only through their own course subjects but also through open elective courses.

Every student shall earn prescribed credits by choosing one of the open elective courses from the list of Open Electives given in the Curriculum. Further students from a particular program/branch can opt for one Open Elective (OEC1) offered by their concerned department. However, one Open Electives (OEC2) is inter-disciplinary and shall be offered by other branches.

Two Open electives (OEC3 & OEC4) are to be chosen from the repository of **inter-disciplinary MOOCs** courses offered by NPTEL or any other recognized Institutions/Organization. Students shall consult their class mentors before opting for an open elective course (MOOCs)

The following guidelines are pertaining to Open Elective Courses.

- Maximum strength of a class /section for each semester shall be 72.
- A course may be offered to the students, only if a minimum of 24 students (1/3 of the section strength) opt for it. The minimum number of students is required to register the course to offer opted course in the department.
- The selection of course based on the choice for students shall be on 'first come first serve' through on line and off line registration.
- The Head of the department or concerned shall decide, whether or not to offer such course keeping in view the resources available in the department offering the course.

7.1.5 Massive Open Online Courses as Open Elective

- MOOCs (Massive Open Online Courses) are introduced to meet with the global requirements and to inculcate the habit of self-learning and in compliance with the UGC guidelines
- A student shall be permitted to pursue up to a maximum of two electives courses under MOOCs during programme. Each of courses must be of minimum 12 weeks in duration.
- Concerned departments **shall declare the list of inter-disciplinary** courses that a student can pursue through MOOCs at the beginning of the corresponding semester.
- Students interested in pursuing MOOCs shall register for the course and submit this information at their department office at the start of the corresponding semester.
- Course content for the selected MOOCs shall be drawn from the respective MOOCs offering Portal.
- Course progress shall be monitored by the Mentors designated by the HoD.
- Grade obtained through the evaluation of the MOOC shall be considered for the CGPA calculation.
- Three credits shall be awarded to the student upon successful completion of MOOC.
- In case a student fails to complete the MOOCs he/she shall re-register for the same with the same provider, already offered that course. In case that provider discontinues to offer the course, Institution shall conduct an offline examination in the same format, which student already appeared in online examination, as per the MOOC syllabus.

7.1.6 Skill Oriented Courses

- There shall be 5 skill oriented course offered during 3rd to 7th semester. Among the 5 skill oriented courses, 4 courses shall focus on the basic advanced skills related to the domain courses and remaining 1 shall be a soft skills course.
- Skill oriented / skill advanced courses carry 2 credits
- For skill oriented/skill advanced course, 2 theory and 2 practical hours may be allotted as per the decision of concerned BOS.

- Out of the 5 skill courses 2 shall be skill-oriented courses from the same domain and shall be completed in 2nd year. Of the remaining 3 skills course, 1 shall be necessarily be a soft skill course and the remaining 2 shall be skill advanced courses either from the same domain or job oriented skill course, which can be of inter-disciplinary nature.
- A pool of interdisciplinary job-oriented skill course shall be designed by a common Board of studies by the participating departments and the syllabus along with the pre-requisites shall be prepared for each of the laboratory infrastructure requirements,
- The student shall be given an option to choose either the skill courses being offered by the institute or to choose a certificate course being offered by Industries/Professional Bodies/ APSSDC or any other accredited bodies as approved by the concerned BOS.
- If a student chooses to take a certificate course offered by Industries/Professional Bodies/ APSSDC or any other accredited bodies, in lieu of the skill advanced course offered by the department, the credits shall be awarded to the student upon producing the course completion certificate from Industries/Professional Bodies/ APSSDC as approved by the concerned BOS.
- 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 oriented course in all the calculations of mandatory attendance requirements upon producing a valid certificate as approved by the concerned BOS, the student is deemed to have fulfilled the attendance requirements of the course and acquire the credits assigned to the course.
- A committee shall be formed at the level of the institute to evaluate the grades/marks given for a course by external agencies and convert to the equivalent marks/grades. The recommended conversions and appropriate grades/marks are to be approved by the Academic Council

7.1.7 Mandatory Courses

- A student shall pursue mandatory courses as specified in the course structure of the B.Tech. Programme.
- These courses are among the compulsory courses and do not carry any credits.
- A student has to secure 40 marks out of 100 in the Internal Examination, shall be necessary requirement for the student to qualify for the **award of Degree**.
- Result of mandatory courses shall be declared with **"Pass"** or **"Fail"** performance in the Comprehensive Marks Memo.
- No marks or letter grade shall be allotted.
- Attendance in the mandatory course shall be considered while calculating aggregate attendance.

7.1.8 Universal Human Values (UHV) Courses

- Universal Human Values-I shall be offered during the Student Induction Programme with no credits.
- Universal Human Values-II course carries 3 credits. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self-assessment, peer assessment etc. will be used in evaluation.
- A student has to secure 40% marks out of 100 in the CIE and SEE together to qualify for the award of the degree. The distribution shall be 50 marks for continuous internal assessment and 50 marks for semester end examination.
- Internal evaluation shall be conducted for the course during semester and shall be evaluated for 50 marks and distributions of marks as follows:
    - Assessment by faculty mentor: 10 marks
    - Self-assessment: 10 marks
    - Assessment by peers: 10 marks
    - Socially relevant project/Group Activities/Assignments: 20 marks

8. Evaluation Process

The performance of a student in each semester shall be evaluated course-wise with a maximum of 100 marks for both Theory and Lab Course.

- For a Theory course, the distribution shall be 30 marks for Internal Evaluation and 70 marks for End-Examinations. The distribution is detailed in 8.1.1.
- For a Lab course, the distribution shall be 30 marks for Internal Evaluation and 70 marks End-Examinations. The distribution is detailed in 8.1.3
- Project Work shall be evaluated for 200 marks. Mandatory courses with no credits shall be evaluated for 100 marks.

8.1 Internal Evaluation

For a Theory Course, 30 marks are allotted for Internal Evaluation. Two Internal examinations (Theory Internal Examinations) shall be conducted for a Theory Course during a semester and they shall be evaluated for 30 marks of which 25 marks are given for Internal Examination and 5 marks for assignment. For Lab Course, there shall be a continuous internal evaluation during the semester for 30 marks.

8.1.1 Theory Internal Examinations

Theory internal examination shall have Part A & Part B. In Part A, which is compulsory, five short answer questions each of which carries one mark. There shall be no sub-questions or bits or fill-up the blanks. The examination shall be conducted for 2 hours.

Part B shall contain three either type questions (Total six questions from 1 to 6). Each question shall carry 10 marks. 30 marks allotted for Part B shall finally be scaled down to 20 marks. The questions shall be set/ moderated such that the student can comfortably answer each question within the stipulated time.

Question paper pattern for Internal Examination (25 Marks) shall be as follows:

PART A: Five short answer questions - 5 x 1 = 5 Marks

PART B: 30 Marks (will be scaled to 20 marks)

(i) There shall be three questions with internal Choice i.e., 'either' or 'choice'

(ii) The student shall answer three questions

First Theory Internal examination shall be conducted as per the syllabus of I & II units. The second internal examination shall be conducted as per the syllabus of III, IV and V units. 80 % weightage for the best performance and 20 % the other shall be considered.

For Example:

Marks obtained in I Internal examination: 19

Marks obtained in II Internal examination: 10

Final Internal Marks: (19x0.8) + (10x0.2) = 17.2

If the student is absent for any one Internal examination, the final internal 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 Internal: 0 (Absent); Marks obtained in second Internal: 18

Final Internal Marks: (18x0.8) + (0x0.2) = 14.4

Note: For some courses namely, Engineering Graphics and Engineering Graphics & Design, the distribution of internal evaluation and external evaluation marks shall be 30 and 70 respectively.

Of the 30 internal evaluation marks, day-to-day performance of the student shall be evaluated for 20 marks and internal examination carries 10 marks. Day-to-day work shall be evaluated by the teacher concerned based on the exercises/submissions/assignments prepared in the class. Two internal examinations shall be conducted in a semester for duration of 2 hours each for 10 marks with a weightage of 80% for better of the two and 20% for the other. The sum of day-to-day work and the internal examination marks will be the final

internal evaluation for 30 marks for the subject. End examination shall be for 70 marks and is of 3 hours duration. The question paper shall be with 5 questions, one question from each unit with internal choice. All questions carry 14 marks each.

8.1.2 Assignment (Theory)

The assignment shall contain essay type questions/numerical problems etc.., The assignments is given by the concerned class teacher for five marks from first two units. The second assignments shall give from rest of the syllabus. The first assignment should be submitted before the conduct of the first internal examination, and the second assignment should be submitted before the conduct of the second internal examination. There shall be at least two assignments in a semester and performance of one best out of two assignments to be considered.

8.1.3 Lab Internal Evaluation

Out of the 30 marks allotted for Lab Internal Evaluation, day-to-day performance of the student in the laboratory shall be evaluated for 20 marks by the concerned laboratory teacher based on experimental evaluation/record/viva. Two Lab Internal examinations shall be conducted for 10 marks by the concerned teacher. Performance of one best out of two tests to be considered.

8.1.4 Internal Evaluation of Mandatory Courses

Mandatory courses are offered with no credits. However, a student has to complete Mandatory Courses in order to be eligible for the award of the Degree. There shall be an Internal Examination for 100 marks. A student shall be declared to have passed the mandatory course only when he/she secures 40% or more in the internal examination. In case, the student fails, a supplementary examination shall be conducted.

8.1.5 Make-up Internal Evaluation

The student who has missed both the Theory Internal examinations will be permitted to appear for a Make-up Internal examination in the event of his/her producing satisfactory evidences of medical ailment. One Make-up internal test shall be conducted immediately after the II Internal examination in the same semester, covering the total syllabus of FIVE Units in the respective course.

This Make-up examination will be given a weightage of 80%. Make-up tests shall be conducted outside the working hours and there can be even two such examinations on a day.

Student absent for I Internal examinations with valid reasons he/ she should produce a supporting document to the department within a week after completion of last internal examination. And the same student absent for same subject in II Internal examination, he/ she should produce a supporting document to the department immediately in order to giving the provision for makeup examination.

Make-up internal examinations are not for improvement of marks in Theory Internal examinations. There shall be no make-up internal examinations for a Lab course.

8.2 End Evaluation

8.2.1 Theory End Evaluation

As specified in 8.0, Theory End Evaluation is done for 70 marks. End examination of theory subjects shall be conducted at the end of semester. There shall be Regular and Supplementary End Examinations. Theory End Examination shall be conducted for 70 marks and is of 3 hours duration.

Theory end examination shall have Part A & Part B. In Part A, which is compulsory, five short answer questions each unit of which carries two marks shall be given. There shall be no sub-questions or bits or fill-up the blanks.

Part B shall contain five either type questions (Total 10 questions with internal choice). 60 marks allotted for Part B and each question shall carry 12 marks. There will be one question from each unit. The examination shall be conducted for 3 hours.

Question paper pattern for Semester End Examination (70 Marks) shall be as follows:

PART A: 5 x 2 = 10 Marks

(i) There shall be one question from each unit

(ii) Part A is compulsory.

PART B: 5 x 12 = 60 Marks

(i) Five questions with internal choice will be given

(ii) There shall be one question from each unit with Internal Choice i.e., 'either' or 'choice'

(iii) Sub questions may also be given.

8.2.2 Lab End Examination

As specified in 8.0, Lab End Evaluation is done for 70 marks, in the form a Lab End Examination that shall be conducted for 3 hours in respective Laboratory. Each lab course will have its own evaluation procedure and weightage.

8.2.3 Supplementary Theory/Lab End Examinations

- Supplementary examination shall be conducted along with regular semester end examinations.
- During Semester End Examinations of even semester, supplementary examinations of odd semester shall be conducted and during semester end examinations of odd semester, supplementary examinations of even semester shall be conducted.
- The same schedule is applicable to Supplementary Lab End Examinations. Supplementary examination shall be conducted along with the next batch of students or separately.

- Advanced supplementary shall be conducted only for Final Year II semester Students in view of their higher education pursuits and placement opportunities.
- In case of seminars and comprehensive viva-voce examinations, supplementary seminar / comprehensive viva-voce will be conducted along with the next batch of students. If the next batch of students is not available, a separate supplementary examination will be conducted.

8.2.4 Challenge Evaluation, Revaluation and Recounting

Students may visit Examination Section Webpage for Norms and Procedures for Challenge Evaluation, Revaluation and Recounting of Answer Scripts. (Refer to Appendix II).

9.0 Internship and Project Evaluation

9.1 Summer Internship / Research Internship (Industry / Govt. / NGO / MSME / Online)

- A student shall carry a mandatory Internship for 2 months for 1.5 credits in 2nd year 2nd semester during summer vacation and it is evaluated during 3rd year 1st semester. A student shall carry a mandatory Industrial / Research Internship for 2 months for 3 credits in 3rd year 2nd semester during summer vacation and it is evaluated during 4th year 1st semester.
- Two summer internships each with a minimum of 6 weeks duration. Done at the end of 2nd and 3rd year, respectively are mandatory. The internship can be done by the students at local industries, Govt. Organizations, construction agencies, Industries, Hydel and thermal power projects and also in software MNCs
- 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 departments and appear for an oral presentation before the departmental committee. The report and the oral presentation shall carry 40% and 60% weightages respectively.
- In the final semester, the student should mandatorily undergo internships and parallelly he/she should work on a project with well-defined objectives. At the end of the semester the candidates 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 institute 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.
- There shall also be mandatory full internship in the final semester of the programme along with the project work.
- For other details, please refer to Appendix I.

9.2 Project Work

Project work consists of a presentation of **Abstract of the main project** in the beginning of 8th Semester. After selecting specific topic, the student shall collect the information and prepare a report, showing his/her understanding of the topic and submit the same to the department before presentation. Project shall be evaluated for a total of 200 marks. The technical presentation/report shall be evaluated by a committee consisting of Head of the Department along with two senior faculty members of the Department. A student shall acquire 12 credits assigned, if her/his report is declared Satisfactory by the committee based on Rubrics set by the Department for evaluation.

Out of a total of 200 marks for the **Project work,** The internal evaluation shall be carried for 50 marks done by a committee consisting of HOD, Project Supervisor and senior faculty member of the department and the remaining 150 marks shall be awarded by a committee consisting of HOD, project Supervisor and an External Examiner nominated by the Principal or Dean Academics. The internal evaluation shall be done on the basis of two seminars conducted in a semester as per the academic calendar and stipulated rubrics. In case, if a student fails in Project work, a re-examination shall be conducted within a month. In case he/she fails in the re-examination also, he/she shall not be permitted register for viva voce examination. Further such students shall re-appear as and when next year 8th semester supplementary examinations are conducted.

10. Curricular Framework for Honors Programme

- Students of a Department/ Discipline are eligible to opt for Honors Programme offered by the same Department/Discipline
- A student shall be permitted to register for Honors program at the beginning of 4th semester provided that the student must have acquired a minimum of 8.0 SGPA up to the end of 2nd semester without any backlogs. In case of the declaration of the 3rd semester results after the commencement of the 4th semester and if a student fails to score the required minimum of 8 SGPA, his/her registration for Honors Programme stands cancelled and he/she shall continue with the regular Programme.
- Students can select the additional and advanced courses from their respective branch in which they are pursuing the degree and get an honors degree in the same. e.g. If a Mechanical Engineering student completes the selected advanced courses from same branch under this scheme, he/ she will be awarded B.Tech (honors) in Mechanical Engineering.
- In addition to fulfilling all the requisites of a Regular B.Tech Programme, a student shall earn 20 additional credits to be eligible for the award of B.Tech (Honors) degree. This is in addition to the credits essential for obtaining the Under Graduate Degree in Major Discipline (i.e. 160 credits).

- Of the 20 additional Credits to be acquired, 16 credits shall be earned by undergoing specified courses listed as pools, with four courses, each carrying 4 credits. The remaining 4 credits must be acquired through two MOOCs, which shall be domain specific each with 2 credits and with a minimum duration of 8/12 weeks as recommended by the Board of studies.
- It is the responsibility of the student to acquire/complete prerequisite before taking the respective course. The courses offered in each pool shall be domain specific courses and advanced courses.
- The concerned BoS shall decide on the minimum enrolments for offering Honors program by the department. If minimum enrolments criteria are not met then the students shall be permitted to register for the equivalent MOOC courses as approved by the concerned Head of the department in consultation with BoS.
- Each pool can have theory as well as laboratory courses. If a course comes with a lab component, that component has to be cleared separately. The concerned BoS shall explore the possibility of introducing virtual labs for such courses with lab component. (Model pool list is enclosed in the end of the syllabus)
- MOOC courses must be of minimum 8 weeks in duration. Attendance will not be monitored for MOOC Courses. Students have to acquire a certificate from the agencies approved by the BOS with grading or marks or pass/fail in order to earn 4 credits. If the MOOC course is a pass/fail course without any grades, the grade to be assigned will be as decided by the Academies Council.
- The concerned BoS shall also consider courses listed under professional electives of the respective B. Tech Programmes for the requirement of B.Tech (Honors). However, a student shall be permitted to choose only those courses that he/she has not studied in any form during the Programme.
- If a student drops or is terminated from the Honors programme, the additional credits so far earned cannot be converted into free or core electives; they will remain extra. These additional courses will find mention in the transcript (but not in the degree certificate). In such cases, the student may choose between the actual grade or a "pass (P)" grade and also choose to omit the mention of the course as for the following: All the courses done under the dropped Minors will be shown in the transcript. None of the courses done under the dropped Minor will be shown in the transcript.

- In case student fails to meet the CGPA requirement for Degree with Honors at any point after registration, he/she will be dropped from the list of students eligible for Degree with honors and they will receive regular B.Tech degree only, however, such students will receive a separate grade sheet mentioning the additional courses completed by them.
- Honors must be completed simultaneously with a major degree Programme. A student cannot earn Honors after he/she has already earned bachelor's degree.

11. Curricular Framework for Minor Programme

- a) Students who are desirous of pursuing their special interest areas other than the choses discipline of Engineering may opt for additional courses in minor specialization groups offered by a department other than their parent department. For example, if Mechanical Engineering student select subjects from Civil Engineering under this scheme, he/she will get Major degree of Mechanical Engineering with minor degree of Civil Engineering.

  b) Student can also opt for Industry relevant tracks of any branch to obtain the Minor Degree, for example, a B.Tech Mechanical student can opt for the industry relevant tracks like Data Mining track, IOT track, Machine Learning track etc.
- The BOS concerned shall identify as many tracks as possible in the areas of emerging technologies and industrial relevance/demand. For example, the minor tracks can be the fundamental courses in CSE, ECE, EEE, CE, ME etc., or industry tracks such as Artificial Intelligence (AI), Machine Learning (ML), Data Science (DS), Robotics, Electric Vehicles, and VLSI etc.,
- The list of disciplines / branches eligible to opt for a particular industry relevant minor specialization shall be clearly mentioned by the respective BoS.
- There shall be no limit on the number of programs offered under Minor. The Institute can offer minor programs in emerging technologies based on expertise in the respective departments or can explore the possibility of collaborating with the relevant industries/agencies in offering the Programme.
- The concerned BoS shall decide on the minimum enrolments for offering Minor program by the department. If a minimum enrolments criterion is not met, then the students may be permitted to register for the equivalent MOOC courses as approved by the concerned Head of the department in consultation with BoS.
- A student shall be permitted to register for Minors Programme at the beginning of 4th semester subject to a maximum of two additional courses per semester, provided that the student must have acquired 8 SGPA up to the end of 2nd semester without any history of backlogs. It is expected that the 3rd semester results may be announced after the commencement of the 4th semester. If a student fails to acquire 8 SGPA up to 3rd semester or failed in any of the courses, his/her registration

for Minors program shall stand cancelled. An SGPA of 8 has to be maintained in the subsequent semesters without any backlog in order to keep the Minors registration active.

- A student shall earn additional 20 credits in the specified area to be eligible for the award of B.Tech degree with Minor. This is in addition to the credits essential for obtaining the Under Graduate Degree in Major Discipline (i.e. 160 credits).
- Out of the 20 credits, 16 credits shall be earned by undergoing specified course listed by the concerned BoS along with prerequisites. It is the responsibility of the student to acquire/complete prerequisite before taking the respective course. If a course comes with a lab component, that component has to be cleared separately. A student shall be permitted to choose only those courses that he/she has not studied in any form during the Programme.
- In addition to the 16 credits, students must pursue at least 2 courses through MOOCs. The courses must be of minimum 8 weeks in duration. Attendance will not be monitored for MOOC courses. Student has to acquire a certificate from the agencies approved by the BOS with grading or marks or pass/fail in order to earn 4 credits. If the MOOC course is pass/fail course without any grades, the grade to be assigned as decided by the Academic Council.
- Student can opt for the Industry relevant minor specialization as approved by the concerned departmental BoS. Student can opt the courses from Skill Development Corporation (APSSDC) or can opt the courses from an external agency recommended and approved by concerned BOS and should produce course completion certificate. The Board of studies of the concerned discipline of Engineering shall review such courses being offered by eligible external agencies and prepare a fresh list every year incorporating latest skills based on industrial demand.
- A committee should be formed at the level of Institute / Department to evaluate the grades/marks given by external agencies to a student which are approved by concerned BoS. Upon completion of courses the departmental committees should convert the obtained grades/marks to the maximum marks assigned to that course. The controller of examinations can take a decision on such conversions and may give appropriate grades.
- If a student drops (or terminated) from the Minor Programme, they cannot convert the earned credits into free or core electives, they will remain extra. These additional courses will find mention in the transcript (but not in the degree certificate). In such cases, the student may choose between the actual grade or a "pass (P)" grade and also choose to omit the mention of the course as for the following:
    - All the courses done under the dropped Minors will be shown in the transcript. None of the courses done under the dropped Miner will be shown in the transcript.

- In case a student fails to meet the CGPA requirement for B.Tech degree with Minor at any point after registration, he/ she will be dropped from the list of students eligible for degree with Minors and they will receive B.Tech degree only. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.
- Minor must be completed simultaneously with a major degree Programme. A student cannot earn the Minor after he/she has already earned bachelor's degree.

12. Attendance Requirements and Detention Policy

- A student shall maintain a minimum required attendance of 40 % in each subject and 75 % in AGGREGATE of all the subjects in a semester.
- Shortage of attendance up to 10 % i.e., attendance between 65 % to 75 % in aggregate, may be condoned by the Institute Academic Committee based on the rules prescribed by the Academic Council of the Institute from time to time.
- A stipulated fee shall be payable towards condonation of shortage of attendance.
- Shortage of attendance below 65 % shall in no case be condoned. A stipulated fee shall be payable towards condonation of shortage of attendance to the Institute as per following slab system

  1stSlab: Less than 75 % attendance but equal to or greater than 70 % a normal condonation fee can be collected from the student.

  2ndSlab: Less than 70 % but equal to or greater than 65 %, double the condonation fee can be collected from the student.

- Students whose shortage of attendance is not condoned OR who have not paid the stipulated fee OR who have not cleared any other due to the Institute in any semester are not eligible to write the Semester End Examination (SEE).
- Students, who do not meet the minimum required attendance of 65% in a semester, shall be detained in that semester and their registration for that semester shall stand cancelled. They shall not be promoted to the next semester.
- Students detained in a semester shall seek re-admission into that semester as and when offered.
- Academic regulations applicable to the semester in which re-admission is sought shall be applicable to the re-admitted student.
- In case, there are any professional electives and /or open electives, the same may also be re-registered, if offered. However, if those electives are not offered in the later semesters, then alternate electives may be chosen from the same set of elective courses offered under that category.

  Any student against whom any disciplinary action is pending shall not be permitted to attend semester end examination (SEE) in that semester.

13. Minimum Academic Requirements and Award of the Degree

The following Academic Requirements have to be satisfied in addition to the attendance requirements mentioned in section 10.

13.1 A student shall be deemed to have satisfied the minimum academic requirements and earned the credits allotted to each theory and lab courses, and project if he secures not less than 35% of marks in the end examination and a minimum of 40% of marks in the total of the internal and end examination marks taken together. In case of mandatory courses, he/she shall secure 40% of the total marks.

13.2 A student admitted in 4 year B. Tech programme, shall be promoted from 4th to 5th Semester only if he/she fulfills the academic requirements of securing a minimum of 50% credits from I year I and II-Semesters, II year I and II-Semesters examinations conducted till that time. A student admitted in 3 year B. Tech programme, shall be promoted from 4th to 5th Semester only if he/she fulfills the academic requirements of securing a minimum of 50% credits from II year I and II-Semesters examinations conducted till that time.

13.3. A student admitted in 4 year B. Tech programme, shall be promoted from 6th to 7th Semester only if he/she fulfills the academic requirements of securing a minimum of 50% credits from I year I & II-Semesters, II year I & II-Semesters and III year I & II-Semesters examinations conducted till that time.

A student admitted in 3 year B. Tech programme, shall be promoted from 6th to 7th Semester only if he/she fulfills the academic requirements of securing a minimum of 50% credits from II year I & II-Semesters and III year I & II-Semesters examinations conducted till that time. And in case a student is detained for want of credits for particular academic year by sections 11.2 and 11.3 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 5th semester or 7th semester as the case may be.

13.4 A student shall register and put up minimum academic requirement of all 160 credits and earn all 160 credits for the award of B. Tech degree

13.5 Students who fail to earn 160 credits as indicated in the course structure within eight academic years from the year of their admission shall forfeit their seat in B.Tech. course and their admission shall stand cancelled.

14. Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

The performances of students in each of the courses in the Programme are expressed in terms of letter grades based on an absolute grading system. We use 10-point grading system with letter grades. They are given in the following table.

Marks Obtained	Letter Grade	Description	Grade Points (GP)
≥90	A+	Outstanding	10
≥80 and ≤89.99	A	Excellent	9
≥70 and ≤79.99	B	Very Good	8
≥60 and ≤69.99	C	Good	7
≥50 and ≤59.99	D	Average	6
≥40 and ≤49.99	E	Pass	5
<40	F	Fail	--
Absent in the exam(s)	Ab	Absent	--

A student is eligible for the award of the B.Tech. Degree with the class as mentioned in the following table

CGPA	Class
≥7.5	First class with Distinction
≥6.5 and <7.5	First Class
≥5.5 and <6.5	Second Class
≥5.0 and <5.5	Pass

For mandatory courses, student shall be awarded "pass" or "fail "without any credit. This shall not be counted for the computation of SGPA/CGPA

14.1 Computation of SGPA

The performance of each student at the end of each semester shall be indicated in terms of SGPA. The SGPA shall be calculated as follows:

$$SGPA = \frac{Total\ earned\ weighted\ grade\ points\ in\ a\ semester}{Total\ credits\ in\ a\ semester}$$

$$SGPA = \frac{\sum_{i=1}^{p} C_{i.}.G_i}{\sum_{i=1}^{p} C_i}$$

Where

$C_{i.}$ = Number of credits allotted to a particular curse 'i'

G_i= Grade point corresponding to the letter grade awarded to the course i

$i = 1,2,\ldots.p$ represent the number of courses in a particular semester.

Note: SGPA is calculated and awarded to those students who pass all the courses in a semester.

14.2 Computation of CGPA

The performance of a student shall be obtained by calculating Cumulative Grade Point Average (CGPA), which is weighted average of the grade points obtained on all courses during the course of study

$$CGPA = \frac{Total\ earned\ weighted\ grade\ points\ for\ the\ entire\ programme}{Total\ credits\ for\ the\ entire\ program}$$

$$CGPA = \frac{\sum_{j=1}^{m} C_{j.}.G_j}{\sum_{j=1}^{m} C_j}$$

Where

$C_{j.}$ = Number of credits allotted to a particular semester 'j'

G_j = Grade point corresponding to the letter grade awarded to the semester j

$j = 1,2,\ldots.$m represent the number of semester of the entire programme.

14.3 Grade Card

The grade card issued shall contain the following

- The credits for each course offered in that semester
- The letter grade and grade point awarded in each course
- The SGPA and CGPA
- Total number of credits earned by the student up to the end of that semester

Example: - Computation /calculation of SGPA

Course name	Credits (C)	Letter grade	Grade point (GP)	Credit point (CP=C*GP)
Course 1	4	A	9	4x9=36
Course 2	3	A+	10	3*10=30
Course 3	2.5	A+	10	2.5*10=25
Course 4	1.5	C	6	1.5*6=9
Course 5	1	D	5	1*5=5
Total	12			105

Therefore, SGPA= $\frac{105}{12}$ 8.75

Example Illustration of CGPA

Semester 1	Semester 2	Semester 3	Semester 4	Semester 5
Credit: 20 SGPA : 8.75	Credit : 20 SGPA : 8.25	Credit : 22 SGPA : 7.89	Credit: 23 SGPA : 8.21	Credit : 22 SGPA : 7.86

Thus, CGPA = $\frac{20*8.75+20*8.75+22*7.89+23*8.21+22*7.86}{107} = 8.34$

Similarly, compute CGPA obtained at the end of 8th semester shall be the final CGPA secured by the student for the entire programme.

14.4 Conversion of SGPA into percentage

In case of a specific query by students/employers regarding Semester Grade Point Average (SGPA)/ Cumulative Grade Point Average (CGPA) into percentage, the following formulae will be adopted for notional conversion of CGPA into percentage.

Percentage = (CGPA - 0.50) * 10

14. Transcripts

After successful completion of the entire programme of study, a transcript containing performance of all academic years will be issued as a final record. Duplicate transcripts will also be issued, if required, after payment of requisite fee. Partial transcript will also be issued up to any point of study to a student on request.

16. Transitory Regulations

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

17. Readmission of Students

A student who has satisfied the minimum attendance requirement in any semester may repeat that semester, after obtaining written permission from the Principal and cancelling the previous record of attendance and academic performance (viz; internal evaluation and external evaluation marks) of the semester or year. This facility may be availed by any student at the maximum twice for a 4 year B. Tech, and only once by Lateral Entry student & PG student during the entire course of study

18. Minimum Instruction Days for a Semester

The minimum instruction days including exams for each semester shall be 16 weeks.

19. Student transfers

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

20. Announcement of results

- Results review committee comprising of University nominee, Principal, Dean Academics, Chairmen of various boards of studies, Controller of Examinations and Deputy Controller of Examinations will monitor the results and gives the permission for announcement of results.
- After review meeting results are loaded in to Institution website from which students can access their results by entering Hall Ticket number. And also results in form of hard copy are available with respective Heads of the departments.

21. General Instructions:

- The academic regulations should be read as a whole for purpose of any interpretation.
- Malpractices rules-nature and punishments are appended.
- Where the words "he", "him", "his", occur in the regulations, they also include "she", "her", "hers", respectively.
- In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Principal/ Governing body is final.
- Any legal issues are to be resolved in Rajampet Jurisdiction.
- The Institute 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 Institute.

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.
(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.
7.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred for four consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the subjects of the examination (including 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 others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of 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 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.
10.	Possess any lethal weapon or firearm in the	Expulsion from the examination hall and cancellation of the

	examination hall.	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.
11.	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.
12.	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.
13.	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, analyse 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 neighbourhood, 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.

1. Environment Science (mandatory non-credit course prescribed at 1/2 semester)
2. Life Sciences for Engineers (mandatory non-credit course prescribed at 3/4 semester)
3. Constitution of India (mandatory non-credit course prescribed at 5/6 semester)
4. 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 Semester)

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

Phase	Course Code	Name of the course	Lecture	Practical
Regular Phase	20A501	Proficiency classes: Familiarity with a computer	2	2
Regular Phase	20AC01	Proficiency classes: English Communication Skills	2	2
Regular Phase	20A502	Basics of Programming and Lab	3	2
Regular Phase	20AC02	Foundation classes in Mathematics	3	0
Regular Phase	20AC03	Foundation classes in Physics	3	2
Regular Phase	20AC04	Foundation classes in Chemistry	3	2
Regular Phase	20AC05	Universal Human Values I	2	0
Regular Phase	20A301	Fundamentals of Engineering Drawing	1	0
Regular Phase	-	Physical education activities – Sports and Games	0	1
Non daily	-	Creative Arts		
Non daily	-	Lectures by eminent personalities		
Non daily	-	Visits to local area		
Non daily	-	Extra-curricular activities		

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

COURSE STRUCTURE FOR B.TECH MECHANICAL ENGINEERING R20 REGULATIONS

Semester I (First year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits
				L	T	P	C
1	BSC	20AC11T	Algebra and Calculus	3	0	0	3
2	BSC	20AC14T	Engineering Chemistry	3	0	0	3
3	HSMC	20AC15T	Communicative English	3	0	0	3
4	ESC	20A311T	Engineering Graphics	1	0	4	3
5	ESC	20A511T	Problem solving through C Programming	3	0	0	3
6	BSC	20AC14L	Engineering Chemistry Lab	0	0	3	1.5
7	HSMC	20AC15L	Communicative English Lab	0	0	3	1.5
8	ESC	20A511L	Problem solving through C Programming Lab	0	0	3	1.5
9	MC	20AC16T	Environmental Science	3	0	0	0
						Total credits	19.5

Category	Credits
Basic Science courses	7.5
Engineering science courses	7.5
Humanities and social science	4.5
Total Credits	19.5

Semester II (First year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits
				L	T	P	C
1	BSC	20AC21T	Differential Equations and Vector Calculus	3	0	0	3
2	BSC	20AC24T	Engineering Physics	3	0	0	3
3	ESC	20A321T	Engineering Materials	3	0	0	3
4	ESC	20A322T	Engineering Graphics & Design	1	0	4	3
5	ESC	20A323T	Engineering Mechanics	3	0	0	3
6	BSC	20AC24L	Engineering Physics Lab	0	0	3	1.5
7	ESC	20A321L	Engineering Materials Lab	0	0	3	1.5
8	ESC	20A326L	Engineering & IT Workshop	0	0	3	1.5
						Total credits	19.5

Category	Credits
Basic Science courses	7.5
Engineering science courses	12
Total Credits	19.5

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Semester III (Second year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits
				L	T	P	C
1	BSC	20AC31T	Partial Differential Equations and Numerical Methods	3	0	0	3
2	ESC	20A235T	Basic Electrical and Electronics Engineering	3	0	0	3
3	PCC	20A331T	Mechanics of Solids	3	0	0	3
4	PCC	20A332T	Manufacturing Processes	3	0	0	3
5	PCC	20A333T	Basic Thermodynamics	3	0	0	3
6	ESC	20A235L	Basic Electrical and Electronics Engineering lab	0	0	3	1.5
7	PCC	20A331L	Mechanics of Solids Lab	0	0	3	1.5
8	PCC	20A332L	Manufacturing Processes Lab	0	0	3	1.5
9	SC	20A334L	Auto CAD	1	0	2	2
						Total credits	21.5

Category	Credits
Basic Science courses	3
Engineering science courses	4.5
Professional core Courses	12
Skill oriented course	2
Total Credits	21.5

Semester IV (Second year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits
				L	T	P	C
1	BSC	20AC41T	Probability and Statistics	3	0	0	3
2	PCC	20A341T	Theory of Machines	3	0	0	3
3	PCC	20A342T	Fluid Mechanics and Hydraulic Machines	3	0	0	3
4	PCC	20A343T	Design of Machine Elements-I	3	0	0	3
5	HSMC	20AC45T	Managerial Economics & Financial Analysis	3	0	0	3
6	PCC	20A341L	Theory of Machines Lab	0	0	3	1.5
7	PCC	20A342L	Fluid Mechanics and Hydraulic Machines Lab	0	0	3	1.5
8	PCC	20A344L	Machine Drawing lab	0	0	3	1.5
9	MC	20AC44T	Life Sciences for Engineers	3	0	0	0
10	SC	20A545L	Python Programming	1	0	2	2
						Total credits	21.5
Internship 2 Months (Mandatory) during summer vacation							

Category	Credits
Basic Science Courses	3
Professional core Courses	13.5
Humanities and social science including Management courses	3
Skill oriented course	2
Total Credits	21.5

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COURSE STRUCTURE FOR B.TECH MECHANICAL ENGINEERING R20 REGULATIONS

Semester V (Third year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits
				L	T	P	C
1	PCC	20A351T	Applied Thermodynamics	3	0	0	3
2	PCC	20A352T	Machining Processes	3	0	0	3
3	PCC	20A353T	Design of Machine Elements-II	3	0	0	3
4	OEC	20A15ET	Water Resources and Harvesting	3	0	0	3
		20A15FT	Disaster Management				
		20A25ET	Energy Auditing Conservation and Management				
		20A25FT	Electric Vehicles				
		20A45ET	Electronic Circuits & its Applications				
		20A45FT	Introduction to Communication Systems				
		20A55FT	Data Structures Using Python				
		20A55GT	Database Management System				
		20A305GT	Foundations of Artificial Intelligence and Data Science				
		20A305HT	Machine Learning				
		20AC5AT	Literature and Life				
		20AC5BT	Linear Algebra and Numerical Analysis				
		20AE5AT	Human Resource Management				
		20AE5BT	Intellectual Property Rights				
5	PEC	20A35AT	IC Engines	3	0	0	3
		20A35BT	Design of Transmission System				
		20A35CT	Industrial Management				
		20A35DT	Optimization Techniques				
6	PCC	20A351L	Thermal Engineering Lab	0	0	3	1.5
7	PCC	20A352L	Machine Tools Lab	0	0	3	1.5
8	SC	20AC51L	Professional Communication	1	0	2	2
9	MC	20AC52T	Constitution of India	3	0	0	0
10	INTERN	20A354I	Summer Internship 2 Months (Mandatory) after second year (to be evaluated during V semester)	0	0	0	1.5
						Total credits	21.5

Category	Credits
Professional core Courses	12
Professional Elective courses	3
Open Elective Course/Job oriented elective	3
Skill advanced course/ soft skill course	2
Summer Internship	1.5
Total Credits	21.5

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COURSE STRUCTURE FOR B.TECH MECHANICAL ENGINEERING R20 REGULATIONS

Semester VI (Third year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits
				L	T	P	C
1	PCC	20A361T	Heat Transfer	3	0	0	3
2	PCC	20A362T	Metrology & Measurements	3	0	0	3
3	PCC	20A363T	CAD/CAM	3	0	0	3
4	PEC	20A36AT	Automobile Engineering	3	0	0	3
		20A36BT	Design for Manufacturing				
		20A36CT	Non-Destructive Testing				
		20A36DT	Automation & Robotics				
5	OEC	20A36ET	MOOCs	3	0	0	3
6	PCC	20A361L	Heat Transfer Lab	0	0	3	1.5
7	PCC	20A362L	Metrology & Measurements Lab	0	0	3	1.5
8	PCC	20A363L	CAD/CAM Lab	0	0	3	1.5
9	SC	20A564L	Java Programming	1	0	2	2
10	MC	20AC63T	Essence of Indian Traditional Knowledge	3	0	0	0
						Total credits	21.5
Industrial/Research Internship (Mandatory) 2 Months during summer vacation							

Category	Credits
Professional core courses	13.5
Professional Elective courses	3
Open Elective Course/Job oriented elective	3
Skill advanced course/ soft skill course	2
Mandatory course	0
Industrial/Research Internship (Mandatory) 2 Months	-
Total Credits	21.5

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COURSE STRUCTURE FOR B.TECH MECHANICAL ENGINEERING R20 REGULATIONS

Semester VII (Fourth year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits
				L	T	P	C
1	PEC	20A37AT	Operations Research	3	0	0	3
		20A37BT	Turbo Machinery				
		20A37CT	Tribology				
		20A37DT	Supply Chain Management				
2	PEC	20A37ET	Non-Conventional Sources of Energy	3	0	0	3
		20A37FT	Finite Element Methods				
		20A37GT	Modern Machining Processes				
		20A37HT	Mechatronics				
3	PEC	20A37IT	Power Plant Engineering	3	0	0	3
		20A37JT	Mechanical Vibrations				
		20A37KT	Production and Operations Management				
		20A37LT	CNC and Adaptive Control				
4	OEC	20A37MT	Additive Manufacturing	3	0	0	3
		20A37NT	Entrepreneurship Development				
		20A37OT	Total Quality Management				
		20A37PT	Product Design and Development				
5	OEC	20A37QT	MOOCs (Interdisciplinary)	3	0	0	3
6	HSMC	20AC71T	Universal Human Values II	3	0	0	3
7	SC	20A371L	Refrigeration and Air Conditioning	1	0	2	2
8	INTERN	20A372I	Industrial/Research Internship 2 Months (Mandatory) after third year (to be evaluated during VII semester	0	0	0	3
						Total credits	23
Industrial/Research Internship (Mandatory) 2 Months during summer vacation							

Category	Credits
Professional Elective courses	9
Open Elective Course/Job oriented elective	6
Humanities and Social Sciences	3
Skill advanced course/ soft skill course	2
Industrial/Research Internship	3
Total Credits	23

Semester VIII (Fourth year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits
				L	T	P	C
1	PROJ	20A381P	Project work, seminar and internship in industry	0	0	0	12
Internship (6 months)							
						Total credits	12

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COURSE STRUCTURE FOR B.TECH MECHANICAL ENGINEERING R20 REGULATIONS

Semester I (First year) - Service Subjects by ME

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits
				L	T	P	C
1	ESC	20A312T	Engineering Drawing (for CE, EEE & ECE)	1	0	4	3
2	ESC	20A313L	Engineering & IT Workshop (for EEE)	0	0	3	1.5
3	ESC	20A314L	Engineering Workshop (for CSE & AIDS)	0	0	3	1.5

Semester II (First year) - Service Subjects by ME

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits
				L	T	P	C
1	ESC	20A323T	Engineering Mechanics (for CE)	3	0	0	3
2	ESC	20A324T	Engineering Drawing (for CSE & AIDS)	2	0	2	3
3	ESC	20A325T	Basic Mechanical Engineering (for CE)	3	0	0	3
4	ESC	20A326L	Engineering & IT Workshop (for CE, ME & ECE)	0	0	3	1.5

Semester V (Third year) - OEC offered to CE, EEE & ECE by ME

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits
				L	T	P	C
1	OEC	20A35ET	Non-Conventional Sources of Energy	3	0	0	3
2		20A35FT	Industrial Management & Entrepreneurship				

Semester VII (Fourth year) - OEC offered to CSE & AIDS by ME

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits
				L	T	P	C
1	OEC	20A37RT	Optimization in Engineering	3	0	0	3
2		20A37ST	Industrial Management & Entrepreneurship				

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Title of the Course Algebra and Calculus
Category BSC
Course Code 20AC11T

Year I B. Tech.
Semester I Semester
Branch CE, EEE, ME, ECE, CSE & AI&DS

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

- This course will illuminate the students in the concepts of calculus and linear algebra
- To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real world problems and their applications

Unit 1 Matrices **10**

Rank of a matrix by echelon form, Normal form, Solving system of homogeneous and non-homogeneous linear equations, Eigen values and Eigen vectors and their properties.

Learning Outcomes: At the end of the unit, the student will be able to:

- Find the rank, Eigenvalues and Eigenvectors of a matrix (L1)
- Solve systems of linear equations(L3)

Unit 2 Quadratic forms of matrices **8**

Cayley-Hamilton theorem (without proof), Finding inverse and power of a matrix by Cayley-Hamilton theorem, Diagonalization of a matrix, Quadratic forms and nature of the quadratic forms, Reduction of quadratic form to canonical form by orthogonal transformation.

Learning Outcomes: At the end of the unit, the student will be able to:

- Apply Cayley-Hamilton theorem to find inverse and power of a matrix (L3)
- Identify special properties of a matrix, such as positive definite, etc., and use this information to facilitate the calculation of matrix characteristics(L3)

Unit 3 Mean Value Theorems & Multivariable calculus **10**

Taylor's theorem and Maclaurin's theorem (without proofs) – Simple problems.
Partial derivatives, total derivatives, chain rule, change of variables, Jacobian, maxima and minima of functions of two variables, method of Lagrange multipliers for three variables.

Learning Outcomes: At the end of the unit, the student will be able to:

- Translate the given function as series of Taylor's and Maclaurin's(L2)
- Find partial derivatives numerically and symbolically and use them to analyze and interpret the way a function varies, and utilize Jacobian of a coordinate transformation to deal with the problems in change of variables (L3)
- Acquire the Knowledge of maxima and minima of functions of several variables (L1)

Unit 4 Multiple Integrals **8**

Double integrals, change of order of integration, change of variables (Cartesian to polar), areas enclosed by plane curves, evaluation of triple integrals.

Learning Outcomes: At the end of the unit, the student will be able to:

- Extend the definite integral to double and triple integrals in cartesian and polar coordinates(L2)
- Apply double integration techniques in evaluating areas bounded by region(L3)

Unit 5 Special Functions **8**

Beta and Gamma functions and their properties, relation between beta and gamma functions, evaluation of definite integrals using beta and gamma functions.

Learning Outcomes: At the end of the unit, the student will be able to:

- Understand the properties of beta and gamma functions and its relations(L2)
- Utilize the special functions in evaluating definite integrals(L3)

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,2011.

Reference Books:

1. B. V. Ramana, Higher Engineering Mathematics, Mc Graw Hill Education.
2. George B. Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, 13/e, Pearson Publishers,2013.
3. R.L. Garg Nishu Gupta, Engineering Mathematics Volumes-I &II, Pearson Education
4. H. K. Das, Er. Rajnish Verma, Higher Engineering Mathematics, S. Chand.

Course Outcomes:

At the end of the course, the student will be able to	Blooms Level of Learning
1. Solve systems of linear equations	L3
2. Use the techniques of matrix algebra for engineering applications	L3
3. Apply the functions of several variables in optimization techniques	L4
4. Apply multiple integrals to find area of solids	L3
5. Evaluate definite integrals by using beta and Gamma functions	L2

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
20AC11T.1	3	2	1	2	-	-	-	-	-	-	-	1
20AC11T.2	3	2	1	2	-	-	-	-	-	-	-	1
20AC11T.3	3	2	1	2	-	-	-	-	-	-	-	1
20AC11T.4	3	2	1	2	-	-	-	-	-	-	-	1
20AC11T.5	3	3	2	3	-	-	-	-	-	-	-	1

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Title of the Course Engineering Chemistry
Category BSC
Course Code 20AC14T

Year I Year
Semester I Semester
Branch CE & ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To acquaint the students with soft and hard water types and softening methods.
- To introduce the basic concepts of electrochemical cells
- To impart knowledge on corrosion and its significance.
- To familiarize the students with engineering materials, their properties and applications

Unit 1 Water Technology **9**

Introduction –Hard and Soft water, Estimation of hardness by EDTA Method -Boiler troubles -scale and sludge, priming and foaming, specifications for drinking water, Bureau of Indian Standards(BIS) and World health organization(WHO) standards, Industrial water treatment – zeolite and ion-exchange processes, desalination of brackish water, reverse osmosis (RO) and electro dialysis.

Learning Outcomes: At the end of the unit, the student will be able to:
- list the differences between temporary and permanent hardness of water (L1)
- compare quality of drinking water with BIS and WHO standards. (L4)
- explain the working principles of different Industrial water treatment processes (L4)

Unit 2 Electrochemistry & Corrosion **11**

Electrode potential, determination of single electrode potential –Nernst's equation, Reference electrodes - hydrogen and calomel electrodes – electrochemical series and its applications – primary cell, dry or Leclanche cell – secondary cell, lead acid storage cell, nickel-cadmium cell – lithium batteries (Lithium-MnO_2). Fuel cells, Hydrogen-Oxygen fuel cell.
Corrosion: Definition – theories of corrosion, dry corrosion and electro chemical corrosion – factors affecting corrosion. Corrosion controlling methods: Sacrificial and Impressed current cathodic protection, anodic and cathodic inhibitors

Learning Outcomes: At the end of the unit, the student will be able to:
- apply Nernst equation for calculating electrode and cell potentials (L3)
- demonstrate the corrosion prevention methods and factors affecting corrosion (L3)
- compare different batteries and their applications (L4)

Unit 3 Polymers and Fuel Technology **10**

Polymers: Introduction to polymers, functionality of monomers, Mechanism of chain growth and step growth polymerization. differences between thermoplastic and thermo setting resins, Preparation, properties and uses of PVC and Bakelite
Fuels – Types of fuels, calorific value, determination of calorific value of a fuel using bomb calorimeter, numerical problems based on calorific value. Liquid Fuels - refining of petroleum, fuels for IC engines, knocking and anti-knock agents, Octane and Cetane values. Alternative fuels- propane, power alcohol

Learning Outcomes: At the end of the unit, the student will be able to:
- list major chemical reactions that are used in the synthesis of polymers (L1)
- explain different types of polymers and their applications (L2)
- solve the numerical problems based on Calorific value(L3)
- explain different types of fuels and their applications (L4)

Unit 4 Advanced 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 and Applications

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

Learning Outcomes: At the end of the unit, the student will be able to:

- explain the constituents of Composites (L4)
- illustrate the functions and properties of lubricants (L4)
- enumerate the reactions at setting and hardening of the cement (L1)

Unit 5 Nano materials and Smart Materials 10

Nano Materials: Introduction to Nano materials, chemical synthesis of nano materials by Sol-gel method, Characterization of nano materials by XRD & SEM, Applications of nano materials in wastewater treatment, lubricants, and engines.

Smart Materials: Introduction – Types of smart materials-self healing materials. Shape memory alloys and Uses of smart materials

Learning Outcomes: At the end of the unit, the student will be able to:

- summarize the applications of SEM, in surface characterization (L4)
- outline the preparation of nanomaterials (L1)
- distinguish the principles of XRD and SEM (L4)

Prescribed Textbooks:

1. P.C. Jain and M. Jain, Engineering Chemistry, 17/e, Dhanapat Rai & Sons, 2018.
2. Shashi Chawla, A textbook of Engineering chemistry, 3/e, Dhanapat Rai & Co, 2015.

Reference Books:

1. O.G Palanna, Engineering Chemistry, 2/e, Tata McGraw Hill Education Private Limited, 2017
2. B.S Murthy, P. Shankar, A textbook of NanoScience and NanoTechnology, University Press 2013
3. R. Bouhfid, A.K Qaiss, and M. Jawaid, Polymer Nanocomposite based Smart Materials, Elsevier Woodhead Publishing, 2020.

Course Outcomes:

At the end of the course, the student will be able to	Blooms Level of Learning
1. analyze different types of water samples and their treatment methods	L4
2. apply the principles of corrosion control and differentiate various cells	L3
3. describe different types of polymers and fuels	L4
4. explain the classification, properties and applications of engineering materials	L2
5. analyze the properties and applications of nanomaterials and smart materials	L4

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
20AC14T.1	3	3	2	2	-	-	3	-	-	-	-	1
20AC14T.2	3	2	2	2	-	-	3	-	-	-	-	1
20AC14T.3	2	2	1	1	-	-	2	-	-	-	-	1
20AC14T.4	2	2	1	1	-	-	2	-	-	-	-	1
20AC14T.5	3	3	2	2	-	-	3	-	-	-	-	1

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Title of the Course Communicative English
Category HSMC
Course Code 20AC15T

Year I Year
Semester I Semester
Branch CE, ME, CSE & AI&DS

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

- To Facilitate effective listening skills for better comprehension of academic lectures and English spoken by native speakers
- To focus on appropriate reading strategies for comprehension of various academic texts and authentic materials
- To Help improve speaking skills through participation in activities such as role plays,discussions and structured talks/oral presentations
- To impart effective strategies for good writing and demonstrate the same in summarizing, writing well organized essays
- To provide knowledge of grammatical structures and vocabulary and encourage their appropriate use in speech and writing

Unit 1 **9**

Prescribed Lesson: *On the Conduct of Life* by William Hazlitt
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.
Reading for Writing: Beginnings and endings of paragraphs - introducing the topic, summarizing the main idea and/or providing a transition to the next paragraph.
Grammar and Vocabulary: Parts of Speech, Content words and function words; word forms: verbs, nouns, adjectives and adverbs; nouns: countable and uncountable; singular and plural; basic sentence structures; simple question form - wh-questions; word order in sentences.
Learning Outcomes
At the end of this unit, the student will be able to

- understand social or transactional dialogues spoken by native speakers of English and identify the context, topic, and pieces of specific information (L1)
- ask and answer general questions on familiar topics and introduce oneself/others (L2)
- employ suitable strategies for skimming and scanning to get the general idea of a text and locate specific information (L3)
- recognize paragraph structure and be able to match beginnings/endings/headings with paragraphs (L2)
- form sentences using proper grammatical structures and correct word forms (L4)

Unit 2 **9**

Prescribed Lesson: *The Brook* by Alfred Tennyson;
Listening: Answering a series of questions about main idea and supporting ideas after listening to audio texts.
Speaking: Discussion in pairs/small groups on specific topics followed by short, structured talks.
Reading: Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together.
Writing: Paragraph writing (specific topics) using suitable cohesive devices; mechanics of writing - punctuation, capital letters.

Grammar and Vocabulary: Cohesive devices - linkers, signposts and transition signals; use of articles and zero article; prepositions.

Learning Outcomes

At the end of this unit, the student will be able to

- comprehend short talks on general topics (L1)
- participate in informal discussions and speak clearly on a specific topic using suitable discourse markers (L3)
- understand the use of cohesive devices for better reading comprehension (L1)
- write well-structured paragraphs on specific topics (L4)
- identify basic errors of grammar/ usage and make necessary corrections in short texts (L2)

Unit 3 **9**

Prescribed Lesson: *The Death Trap* by Saki

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, Paragraph Writing, identifying main idea/s and rephrasing what is read; avoiding redundancies and repetitions

Grammar and Vocabulary: Verbs - tenses; subject-verb agreement; direct and indirect speech, reporting verbs for academic purposes.

Learning Outcomes

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

- comprehend short talks and summarize the content with clarity and precision (L1)
- participate in informal discussions and report what is discussed (L3)
- infer meanings of unfamiliar words using contextual clues (L3)
- write summaries based on global comprehension of reading/listening texts (L4)
- use correct tense forms, appropriate structures and a range of reporting verbs in speech and writing(L4)

Unit 4 **9**

Prescribed Lesson: *Muhammad Yunus*

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: Writing structured essays on specific topics using suitable claims and evidence.

Grammar and Vocabulary: Quantifying expressions - adjectives and adverbs; comparing and contrasting; Voice - Active & Passive Voice

Learning Outcomes

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

- infer and predict about content of spoken discourse (L2)
- understand verbal and non-verbal features of communication and hold formal/informal conversations (L1)
- interpret graphic elements used in academic texts (L3)
- produce a coherent paragraph interpreting a figure/graph/chart/table (L4)
- use language appropriate for description and interpretation of graphical elements (L3)

Unit 5 **9**

Prescribed Lesson: *The Dancer with a White Parasol* by Ranjana Deve

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 - without the use of PPT slides.

Reading: Reading for comprehension.

Writing: Letter Writing: Official Letters/Report Writing

Grammar and Vocabulary: Editing short texts –identifying and correcting common errors in grammar and usage (articles, prepositions, tenses, subject verb agreement)

Learning Outcomes

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

- take notes while listening to a talk/lecture and make use of them to answer questions (L4)
- make formal oral presentations using effective strategies (L4)
- comprehend, discuss, and respond to academic texts orally and in writing. (L3)
- produce a well-organized essay with adequate support and detail (L4)
- edit short texts by correcting common errors (L3)

Prescribed Textbook:

1. Language and Life, Orient Black Swan (with CD).

Reference Books

1. English Grammar in Use: A Self Study Reference and Practice Book, Raymond Murphy, Fourth Edition, Cambridge Publications
2. English Grammar and Composition, David Grene, Mc Millan India Ltd
3. Bailey, Stephen. Academic writing: A handbook for international students. Routledge, 2014.
4. Chase, Becky Tarver. Pathways: Listening, Speaking and Critical Thinking. Heinley ELT; 2nd Edition, 2018.
5. Raymond Murphy's English Grammar in Use Fourth Edition (2012) E-book
6. Hewings, Martin. Cambridge Academic English (B2). CUP, 2012.
7. Norman Lewis Word Power Made Easy- The Complete Handbook for Building a Superior Vocabulary (2014)
8. Speed Reading with the Right Brain: Learn to Read Ideas Instead of Just Words by David Butler

Course Outcomes:

At the end of the course, the student will be able to	Blooms Level of Learning
1. Understand the context, topic, and pieces of specific information from social or transactional dialogues spoken by native speakers of English	L3
2. Analyze literary forms, journalistic articles and scientific readings for comprehension and retention	L4
3. Exhibit self-confidence and speak in formal and informal contexts	L3
4. Apply grammatical knowledge in speech and writing and formulate sentences with accuracy	L2
5. Produce coherent and unified paragraphs with adequate support and detail	L4

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
20AC15T/25T-1	-	-	-	-	-	-	-	-	-	3	-	3
20AC15T/25T-2	-	-	-	-	-	-	-	-	-	3	-	3
20AC15T/25T-3	-	-	-	-	-	-	-	-	-	3	-	3
20AC15T/25T-4	-	-	-	-	-	-	-	-	-	3	-	3
20AC15T/25T-5	-	-	-	-	-	-	-	-	-	3	-	3

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

Title of the Course Engineering Graphics
Category ESC
Course Code 20A311T

Year I B. Tech
Semester I Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
1	0	4	3

Course Objectives:

- To enable the students with various concepts like Dimensioning, Conventions and standards related to working drawing in order to become professionally efficient.
- To introduce fundamental concepts of curves used in engineering, projection of points, lines and planes.
- To impart and inculcate proper understanding of the theory of projections.

Unit 1 Introduction & Conic Curves **Theory: 03**
Practice Sessions: 03

Lettering – Geometrical constructions - Curves used in Engineering Practice: Conic Sections– General method only. Special methods: Ellipse – Oblong method, Arcs of circle method, Concentric circles methods - Rectangle method and Tangent method for Parabola - Rectangular Hyperbola.

Learning Outcomes: At the end of the unit, a student will be able to

- Mention the description of a diagram clearly and will be in a position to apply the knowledge of basics learned in Geometrical Constructions wherever applicable (L1)
- Understands the concepts of Conic Sections (L2)

Unit 2 Cycloidal Curves& Involutes **Theory: 02**
Practice Sessions: 02

Cycloid, Epicycloid and Hypocycloid (treatment of simple problems)
Involutes – Square, Pentagon, Hexagon and Circle.

Learning Outcomes: At the end of the unit, a student will be able to

- Understands the concept of Cycloidal Curves and the application of industry standards (L1)
- Understands the concept of Involutes and the application in industry standards (L2)

Unit 3 Orthographic Projections Of Points And Lines **Theory: 03**
Practice Sessions: 03

Orthographic Projections of Points, Lines-Inclined to one reference plane and Inclined to both reference planes, Finding the True lengths - Traces.

Learning Outcomes: At the end of the unit, a student will be able to

- Understand the Orthographic Projections of Points (L2)
- Understand the Orthographic Projections of Lines and are able to improve their visualization skills so that they can apply these skills in developing the new products. (L3)

Unit 4 Projections Of Planes **Theory: 02**
Practice Sessions: 02

Projections of regular Plane surfaces inclined to one reference plane and both reference planes.

Learning Outcomes: At the end of the unit, a student will be able to

- Understand Orthographic Projections of Planes (L2)

- Understand and is capable of analysing how a plane object's shape and size in real working environment is changed while the plane is positioned in seeing in different directions orin different angles (L3)

Unit 5 Auxiliary Planes **Theory: 02**
Practice Sessions: 02

Projection of lines and planes using auxiliary planes.

Learning Outcomes: At the end of the unit, a student will be able to

- Understands the Auxiliary Projections of Lines and Planes (L2)
- Apply the concepts learned through this topic in the situations where actual shape and size is to be identified for sectioned parts (L3)

Prescribed Text Books:

1. Engineering Drawing, N.D. Bhatt, Charotar Publishers
2. Engineering Drawing, K.L. Narayana, P. Kanniah, Scitech Pub

Reference Books:

1. Engineering Drawing and Graphics, Venugopal/ New age.
2. Engineering Drawing, Johle, Tata McGraw-Hill
3. Engineering Drawing, Shah and Rana, 2/e, Pearson Education

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Apply the appropriate annotations to draw the conic sections	L3
2. Apply geometric techniques to construct cycloids, epicycloids and hypocycloids with various parameters and constructs involutes using geometric methods.	L3
3. Apply the principles of orthographic projection for complex engineering problems involving inclined lines to create drawings that represent real-world objects accurately.	L3
4. Apply the principles of orthographic projection for solving engineering problems of planes.	L3
5. Apply the principles of orthographic projection for solving engineering problems of solids.	L3

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A311T.1	3	2	1	1	-	-	-	-	-	-	-	-	2	2
20A311T.2	3	2	1	1	-	-	-	-	-	-	-	-	2	2
20A311T.3	3	2	1	1	-	-	-	-	-	-	-	-	2	2
20A311T.4	3	2	1	-	-	-	-	-	-	-	-	-	2	2
20A311T.5	3	2	1	-	-	-	-	-	-	-	-	-	2	2

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

Title of the Course Problem Solving through C programming
Category ESC
Course Code 20A511T

Year I B. Tech
Semester I Semester
Branch CE, EEE, ME, ECE, CSE & AI&DS

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- Understanding the steps in problem solving and formulation of algorithms to problems.
- Develop programming skills as a means of implementing an algorithmic solution with appropriate control and data structures.
- Develop intuition to enable students to come up with creative approaches to problems.
- Develop programs using pointers, structures and unions
- Manipulation of text data using files

Unit 1 Problem Solving and Introduction to C **9**

Steps to solve problems, algorithm, Pseudo code, Flowchart with examples, Program Development Environments. Introduction to programming: Programming languages and generations.
Introduction to C: Introduction, structure of C program, keywords, identifiers, Variables, data types, constants, I/O statements, operators, precedence and associatively.
Learning Outcomes: At the end of the unit, the student will be able to:
- Identify situations where computational methods and computers would be useful. (L2)
- Approach the programming tasks using techniques learned and write pseudo-code.(L2)
- Choose the right data representation formats based on the requirements of the problem. (L3)
- Write the program on a computer, edit, compile, debug, correct, recompile and run it.(L4)

Unit 2 Introduction to decision control statements and Arrays **9**

Selective, looping and nested statements, jumping statements.
Arrays: Introduction, declaration of arrays, accessing and storage of array elements, searching (linear and binary search algorithms) and sorting (selection and bubble) algorithms, multidimensional arrays, matrix operations.
Learning Outcomes: At the end of the unit, the student will be able to
- Use the comparisons and limitations of the various programming constructs and choose the right one for the task in hand.(L3)
- Identify tasks in arrays with different techniques that are applicable and apply them to write programs. (L2)
- Design and implement operations on both single and Multidimensional arrays. (L4)

Unit 3 Strings and Functions **9**

Strings: Declaration and Initialization, String Input / Output functions, String manipulation functions.
Functions: Types of functions, recursion, scope of variables and storage classes.
Preprocessor Directives: Types of preprocessor directives, examples.
Learning Outcomes: At the end of the unit, the student will be able to
- Implement and test the programs on strings using string manipulation functions. (L5)
- Analyze programming problems to choose when regular loops should be used and when recursion will produce a better program (L4)

Unit 4 Pointers **9**

Pointers: Understanding computer's memory, introduction to pointers, declaration pointer variables, pointer arithmetic, pointers and strings, array of pointers, function pointers, dynamic memory allocation, advantages and drawbacks of pointers.

Learning Outcomes: At the end of the unit, the student will be able to:

- Identify tasks in which the dynamic memory allocation techniques learned are applicable and apply them to write programs, and hence use computers effectively to solve the task. (L2)
- Design and develop Computer programs, analyzes, and interprets the concept of pointers and their usage. (L6)

Unit 5 Structures and Files **9**

Structures: Structure definition, initialization and accessing the members of a structure, nested structures, array of structures, structures and functions, structures and pointers, self-referential structures, unions and enumerated data types.

Files: Introduction to files, file operations, reading and writing data on files, error handling during file operations.

Learning Outcomes: At the end of the unit, the student will be able to:

- Define derived data types and use them in simple data processing applications. (L2)
- Develop and test C programs for simple applications using files. (L5)

Prescribed Text Books:

1. C Programming and Data Structures. B.A. Forouzan, R. F.Gilberg,Cengage learning, Indian edition.
2. C and Data Structures, E.Balaguruswamy, Tata McGraw Hill.
3. Programming in C and Data Structures, J.R.Hanly, Ashok N. Kamthane and A. Ananda Rao, Pearson Education.

Reference Books:

1. LET US C, Yeswanth Kanitkar, Ninth Edition, BPB Publication
2. Byron Gottfried, Schaum's" Outline of Programming with C", McGraw-Hill.
3. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India.
4. A K Sharma "Computer Fundamentals and Programming", 2nd Edition, University Press, 2018.
5. PradeepDey and Manas Ghosh, "Programming in C", Oxford Press, 2nd Edition, 2017
6. ReemaTharaja "Introduction to C Programming", Second Edition, OXFORD Press, 2015

Course Outcomes:

At the end of the course, the student will be able to	Blooms Level of Learning
1. Formulate solutions to problems and represent those using algorithms/Flowcharts.	L3
2. Choose proper control statements and use arrays for solving problems.	L3
3. Decompose a problem into modules and use functions to implement the modules.	L4
4. Apply and use allocation of memory for pointers and solve the problems related to manipulation of text data using files and structures.	L3
5. Develop the solutions for problems using C programming Language.	L6

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A511T.1	1	2	2	3	-	1	-	-	-	-	-	-	-	-
20A511T.2	3	3	3	3	3	-	-	-	1	-	-	-	-	-
20A511T.3	3	2	1	2	1	-	-	-	1	-	-	2	-	-
20A511T.4	2	3	2	2	3	-	-	-	1	-	1	2	-	-
20A511T.5	3	2	2	2	2	-	-	-	1	-	-	2	-	-

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

Title of the Course Engineering Chemistry lab
Category BSC
Course Code 20AC14L

Year I Year
Semester I Semester
Branch CE & ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	3	1.5

Course Objectives:

- To familiarize the students with the basic concepts of chemistry
- To impart training for handling of different instruments.
- To familiarize the students with digital and instrumental methods of analysis
- To expose the students in practical aspects of the theoretical concepts.

List of experiments:

1. Determination of Hardness of a ground water sample by Complexometry.
2. Estimation of active chlorine content in Bleaching powder.
3. Determination of strength of an acid by pH metric method.
4. Determination of Fe (II) in Mohr's salt by potentiometric method.
5. Estimation of mixture of acids by conductometric titration
6. Estimation of Iron in Cement by Colorimetry
7. Preparation of Phenol-formaldehyde resin
8. Determination of strength of solutions by Conductometry
9. Determination of viscosity of lubricating oil by Red Viscometer 1 or 2
10. Estimation of Ferrous iron by Dichrometry.
11. Determination of copper in by Iodometry.
12. Determination of calorific value of a fuel by bomb calorimeter

Prescribed Text Books:

1. J. Mendham, R.C Denney, J.D Barnes, M. Thomas, B. Sivasankar Vogel's Quantitative Chemical Analysis 6/e, Pearson publishers, 2009.
2. N.K Bhasin and Sudha Rani Laboratory Manual on Engineering Chemistry 3/e, Dhanpat Rai Publishing Company 2009.

Course Outcomes:

At the end of the course, the student will be able to	Blooms Level of Learning
1. Analyze samples using ph meter, conductivity meter, viscometer and potentiometers	L4
2. Estimate the concentration of Cr, Fe & Cu and other metals in various compounds	L5
3. Analyze the quality of ground water samples	L4
4. Determine calorific value of different fuel samples	L5
5. Synthesize polymers and nano-materials	L6

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
20AC14L.1	3	3	-	2	1	-	2		1	-	-	3
20AC14L.2	3	3	-	3	2	-	2		1	-	-	3
20AC14L.3	3	3	-	2	1	-	2		1	-	-	3
20AC14L.4	3	3	-	3	2	-	2		1	-	-	3
20AC14L.5	3	3	-	3	3	-	2		1	-	-	3

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

Title of the Course Communicative English Lab
Category HSMC
Course Code 20AC15L

Year I B. Tech.
Semester I Semester
Branch CE, ME, CSE & AI&DS

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	3	1.5

Course Objectives:
1. To learn better English pronunciation
2. To use language effectively in everyday conversations
3. To make formal oral presentations using effective strategies in professional life
4. To be exposed to a variety of self-instructional, learner friendly modes of language learning

Detailed Syllabus:

Pronunciation: **6**
Introduction to English speech sounds
Learning Outcome:
At the end of the module, the learners will be able to
- understand different accents spoken by native speakers of English and speak in intelligible way

Listening Comprehension: Identifying the topic, the context and specific pieces of information by listening to short audio texts and answering a series of questions. Answering a series of questions about main idea and supporting ideas after listening to audio texts. Listening for global comprehension and summarizing what is listened to.
Learning Outcome:
At the end of the module, the learners will be able to
- Adopt better strategies to listen attentively and comprehend attentively

Speaking **24**
Situational Dialogues (Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions - Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others.)

Oral Presentations: Formal oral presentations on topics from academic contexts - Formal presentations using PPT slides with graphic elements, deliver an enthusiastic and well-practiced presentation

Describing people and situations (learn new adjectives, practice describing themselves and others, describe objects using proper adjectives, use details in pictures to make predictions orally, describing situations, Integrate and evaluate information presented in diverse media visually and orally
Learning Outcomes:
At the end of the module, the learners will be able to
- speak confidently in formal and informal contexts
- comprehend and produce short talks on general topics
- use specific vocabulary to describe different persons, places and objects

Reading **6**
Information Transfer (Studying the use of graphic elements in texts to convey information, reveal trends/ patterns/ relationships, communicate processes or display complicated data.

Learning Outcome:
At the end of the unit, the student will be able to

- Analyze data given in an infographic and write/speak about it

Minimum Requirements:

1. Computer aided Language Lab for 60 students with 60 systems, one master console, LAN facility and English language software for self- study by learners.
2. Communication Skills Lab with movable chairs and audio-visual aids with a P.A System, a T. V. an LCD projector, a digital stereo –audio & video system and camcorder etc.

Prescribed Textbook: Lab Manual developed by Faculty Members of AITS Rajampet
Suggested Software:

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

Course Outcomes:

Student will be able to	Blooms Level of Learning
1. Analyze their pronunciation of English sounds, and their accent	L4
2. Use effective listening skills for better comprehension of English, spoken by native speakers	L3
3. Illustrate themselves in social and professional context effectively	L3
4. Apply their public speaking skills and make technical presentations confidently	L3
5. Describe people and situations using adjectives effectively and assess data from graphs/pie charts/tables	L2

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
20AC15L/25L-1	-	-	-	-	-	-	-	-	3	3	-	3
20AC15L/25L-2	-	-	-	-	-	-	-	-	3	3	-	3
20AC15L/25L-3	-	-	-	-	-	-	-	-	3	3	-	3
20AC15L/25L-4	-	-	-	-	-	-	-	-	3	3	-	3
20AC15L/25L-5	-	-	-	-	-	-	-	-	3	3	-	3

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

Title of the Course Problem solving through C Programming Lab
Category ESC
Course Code 20A511L

Year I B. Tech
Semester I Semester
Branch CE, EEE, ME, ECE, CSE & AI&DS

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	3	1.5

Course Objectives:
- Setting up programming environment.
- Develop Programming skills to solve problems.
- Use of appropriate C programming constructs to implement algorithms.
- Identification and rectification of coding errors in program
- Develop applications using a modular programming and Manage data using files.

Minimum number of FOUR programs from each exercise is to be done students

Data Types, constants, Input and Output and expressions

Exercise :(week-1): Data types, Variables, Constants and Input and Output.
Exercise2 :(week-2): Operators, Expressions and Type Conversions.
Learning Outcomes: At the end of the unit, the student will be able to:
- Identify situations where computational methods and computers would be useful. (L2)
- Approach the programming tasks using techniques learned and write pseudo-code. (L2)
- Write the program on a computer, edit, compile, debug, correct, recompile and run it. (L4)

Decision control statements and Arrays

Exercise3 :(week-3): Conditional Statements [two way and multipath].
Exercise4:(week-4):Loop Control Statements.[for, while and do-While]
Exercise5 :(week-5): Unconditioned JUMP Statements-break, continue, go to.
Exercise6 :(week-6): Declaring Arrays, Referencing Arrays, Array Subscripts. Using for loop for sequential Access.
Exercise7:(week-7):Multidimensional Arrays
Learning Outcomes: At the end of the unit, the student will be able to:
- Choose the right data representation formats based on the requirements of the problem. (L3)
- Use the comparisons and limitations of the various programming constructs and choose the right one for the task in hand. (L3)
- Identify tasks in arrays with different techniques that are applicable and apply them to write programs. (L2)
- Design and implement operations on both single and Multidimensional arrays. (L6)

Strings and Functions

Exercise8 :(week-8): String Basics, String Library Functions and Array of Strings.
Exercise9 :(week-9): Simple user defined functions, Parameter passing methods – pass by value, pass by reference.
Exercise10:(week-10):Storageclasses-Auto,Register,StaticandExtern
Exercise11 :(week-11): Recursive Functions, Preprocess or commands.
Exercise12 :(week-12): Array Elements as Function Arguments.
Learning Outcomes: At the end of the unit, the student will be able to:

- Implement and test the programs on strings using string manipulation functions. (L5)
- Analyze programming problems to choose when regular loops should be used and when recursion will produce a better program (L4)

Pointers

Exercise13:(week-13): Pointers, Dynamic memory allocation and error handling

Learning Outcomes: At the end of the unit, the student will be able to:

- Design and develop Computer programs, analyzes, and interprets the concept of pointers and their usage. (L6)
- Identify tasks in which the dynamic memory allocation techniques learned are applicable and apply them to write programs, and hence use computers effectively to solve the task. (L2)

Structures and Files

Exercise14:(week-14):Structures

Exercise15:(week-15): File handling

Learning Outcomes: At the end of the unit, the student will be able to:

- Define structure data types and use them in simple data processing applications. (L2)
- Develop and test C programs for simple applications using files. (L6)

Prescribed Text Books:

1. C Programming and Data Structures. B.A. Forouzan, R. F.Gilberg,Cengage learning, Indian edition.
2. C and Data Structures, E.Balaguruswamy, Tata McGraw Hill.
3. Programming in C and Data Structures, J.R.Hanly, Ashok N. Kamthane and A. Ananda Rao, Pearson Education.

Reference Books:

1. Let Us C, Yeswanth Kanitkar, Ninth Edition, BPB Publication
2. A K Sharma "Computer Fundamentals and Programming", 2nd Edition, University Press, 2018.
3. Pradeep Dey and Manas Ghosh, "Programming in C", Oxford Press, 2nd Edition, 2017
4. Reema Tharaja "Introduction to C Programming", Second Edition, OXFORD Press, 2015
5. https://www.cprogramming.com/
6. https://www.mycplus.com/tutorials/c-programming-tutorials

Course Outcomes:

At the end of the course, the student will be able to	Blooms Level of Learning
1. Identify and setup program development environment	L2
2. Implement the algorithms using C programming language constructs	L3
3. Identify and rectify the syntax errors and debug program for semantic errors	L3
4. Solve problems in a modular approach using functions	L4
5. Implement file operations with simple text data	L4

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A511L.1	3	2	-	2	2	-	-	-	2	2	1	-	-	-
20A511L.2	2	2	-	-	-	-	-	-	1	-	-	-	-	-
20A511L.3	3	3	3	3	-	-	-	-	1	-	-	3	-	-
20A511L.4	3	3	3	3	-	-	-	-	-	-	-	3	-	-
20A511L.5	3	3	3	3	-	-	-	-	-	-	-	3	-	-

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

Title of the Course Environmental Science
Category MC
Course Code 20AC16T

Year I B. Tech
Semester I Semester
Branch CE, ME, CSE & AI&DS

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	0

Course Objectives:
- To make the student to get awareness on environment and understand the importance of protecting natural resources.
- To enable the student to know the importance of ecosystems and biodiversity for future generations.
- To make the student to know pollution problems due to the day-to-day activities of human life.
- To enable the student to acquire skills for identifying and solving the social issues related to environment.
- To enable the student to understand the impact of human population on the environment.

Unit 1 Multidisciplinary Nature of Environmental Studies 10

Definition, Scope and Importance – Need for Public Awareness. NATURAL RESOURCES: Renewable and non-renewable resources – Forest resources: Uses, deforestation– Water resources: Uses, floods, drought – Mineral resources: Uses, environmental effects of extracting mineral resources – Food resources: Impacts of overgrazing, problems with traditional agriculture, effects of modern agriculture – Land Resources: Land degradation, soil erosion - Energy resources: Renewable and non-renewable energy resources.

Learning Outcomes: At the end of the unit, the student will be able to:
- Understand the importance of public awareness (L1).
- Identify various natural resources (L2).

Unit 2 Ecosystems, Biodiversity and its Conservation 10

Ecosystems: Producers, consumers and decomposers – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem: Forest ecosystem, lake ecosystem.

Biodiversity and Its Conservation: Definition – Value of biodiversity - Hot-spots of biodiversity – Threats to biodiversity – Conservation of biodiversity.

Learning Outcomes: At the end of the unit, the student will be able to:
- Explain the concept of ecosystem (L2).
- Recognize the importance of biodiversity (L2).

Unit 3 Environmental Pollution 8

Definition, Causes, effects and control measures of: Air Pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards.

Learning Outcomes: At the end of the unit, the student will be able to:
- Illustrate the different types of pollution (L2).
- Describe various sources, effects and control measures of pollution (L2).

Unit 4 Social Issues and the Environment 10

Rain water harvesting, Environmental ethics: Issues and possible solutions – global warming, acid rain, ozone layer depletion – Environment Protection Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act.

Learning Outcomes: At the end of the unit, the student will be able to:

- Interpret social issues related to environment (L3).
- Relate importance of environmental acts (L4).

Unit 5 Human Population and the Environment 7

Population explosion – Family Welfare Programmes – Environment and human health – Value Education – HIV/AIDS – Role of information Technology in Environment and human health, Field work – Visit to a local area to document environmental assets.

Learning Outcomes: At the end of the unit, the student will be able to:

- Understand the effects of population explosion (L1).
- Identify the natural assets and their relationship (L2).

Prescribed Textbooks:

1. Perspectives in environmental Studies, Anubha Kaushik and C P Kaushik, New Age International Publishers, New Delhi, 2018.
2. A Textbook of Environmental Studies, Shashi Chawla, McGraw Hill Education, New Delhi, 2017.

Reference Books:

1. Environmental Studies by Benny Joseph, McGraw Hill Education, New Delhi, 2017.
2. A textbook of environmental studies, A Dhinakaran and B Sankaran, Himalaya Publishing House, Mumbai, 2017.
3. Fundamentals of environmental studies, Mahua Basu and S Xavier, Cambridge University Press, New Delhi, 2017.
4. Textbook of Environmental Studies for undergraduate courses, ErachBharucha for University Grant Commission, University press, New Delhi, 2013.
5. A textbook of environmental studies, Vijay kumarTiwari, Himalaya Publishing House, Mumbai, 2017.

Course Outcomes:

At the end of the course, the student will be able to	Blooms Level of Learning
1. explain how natural resources should be utilized with a focus on sustainability	L2
2. describe the need to protect ecosystems and biodiversity for future generations.	L2
3. comprehend major pollution problems related to ecosystems	L2
4. apply quantitative reasoning skills in the proper utilization of goods and services.	L3
5. explain the interconnectedness of human dependence on the earth's ecosystems.	L2

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
20AC16T.1	2	2	-	-	-	-	3	-	-	-	-	2
20AC16T.2	2	2	-	-	-	-	3	-	-	-	-	2
20AC16T.3	2	2	-	-	-	-	3	-	-	-	-	2
20AC16T.4	3	2	-	-	-	-	3	-	-	-	-	3
20AC16T.5	2	2	-	-	-	-	3	-	-	-	-	2

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

Title of the Course Differential Equations and Vector Calculus
Category BSC
Course Code 20AC21T

Year I B. Tech
Semester II Semester
Branch CE, EEE, ME, ECE, CSE & AI&DS

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To enlighten the learners in the concept of differential equations and multivariable calculus.
- 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.

Unit 1 Linear differential equations of higher order with constant Coefficients 10

Basic concepts - general solution-operator D-rules for finding complimentary function-inverse operator-rules for finding particularintegral for RHS term of the type e^{ax}, $\sin ax / \cos ax$, polynomials in x, $e^{ax}\sin ax / e^{ax}\cos ax / e^{ax}x^n, x\sin ax / x\cos ax$ -method of variation of parameters.

Learning Outcomes: At the end of the unit, the student will be able to
- identify the essential characteristics of linear differential equations with constant coefficients(L3)
- solve the linear differential equations with constant coefficients by appropriate method (L3)

Unit 2 Equations reducible to Linear Differential Equations with constant coefficients 8

Cauchy's and Legendre's linear equations, simultaneous linear equations with constant coefficients
Applications**:** Electrical Circuits – L-C and L-C-R Circuit problems.

Learning Outcomes: At the end of the unit, the student will be able to
- classify and interpret the solutions of linear differential equations(L4)
- generalize and solve the higher order differential equation by analyzing physical situations(L3)

Unit 3 Partial Differential Equations 8

Formation of PDEs by eliminating arbitrary constants and arbitrary functions, solutions of first order linear and non-linear PDEs (Charpit's method). Introduction to method of separation of variables for second order linear Partial Differential Equations.

Learning Outcomes: At the end of the unit, the student will be able to
- apply the techniques to find solutions of standard PDEs (L3)
- solve the boundary value problems (L3)

Unit 4 Vector Differentiation 8

Scalar and vector point functions, vector operator Del, Gradient, Divergence and Curl operators, vector identities.

Learning Outcomes: At the end of the unit, the student will be able to
- apply del to scalar and vector point functions(L3)
- illustrate the physical interpretation of Gradient, Divergence and Curl(L2)

Unit 5 Vector integration 10

Line integral-circulation-work done, surface integral, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof) and applications of these theorems.

Learning Outcomes: At the end of the unit, the student will be able to
- find the work done in moving a particle along the path over a force field(L1)

- apply Green's, Stokes and Divergence theorem in evaluation of double and triple integrals(L3)

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, 2011.

Reference Books:

1. B. V. Ramana, Higher Engineering Mathematics, Mc Graw Hill Education.
2. George B. Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, 13/e, Pearson Publishers,2013.
3. R.L. Garg NishuGupta, Engineering Mathematics Volumes-I &II, PearsonEducation
4. H. K. Das, Er. Rajnish Verma, Higher Engineering Mathematics, S.Chand.

Course Outcomes:

At the end of the course, the student will be able to	Blooms Level of Learning
1. Solve the differential equations in engineering	L3
2. Apply the knowledge of the higher order differential equations in electrical circuit problems	L3
3. Solve the standard Partial Differential Equations	L3
4. Illustrate differential operators such as gradient, curl and divergence	L3
5. Apply vector integral theorems in evaluating double and triple integrals	L3

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
20AC21T.1	3	2	1	2	-	-	-	-	-	-	-	1
20AC21T.2	3	2	1	2	-	-	-	-	-	-	-	1
20AC21T.3	3	2	1	2	-	-	-	-	-	-	-	1
20AC21T.4	3	2	1	2	-	-	-	-	-	-	-	1
20AC21T.5	3	2	1	2	-	-	-	-	-	-	-	1

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

Title of the Course Engineering Physics
Category BSC
Course Code 20AC24T

Year I B. Tech.
Semester II Semester
Branch CE & ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To impart knowledge in basic concepts of mechanics, acoustics, and ultrasonics with their engineering applications
- To explain the significant concepts of dielectrics and magnetic materials in the field of engineering and their potential applications.
- To impart knowledge in basic concepts of LASERs and optical fibers along with its engineering applications.

Unit 1 Mechanics **9**

Gradient of scalar, Divergence and Curl of vector field and their physical significance-rotational frames-conservative forces- F = - grad V, torque and angular momentum - Newton's laws in inertial and non-inertial frames of reference-rotating frame of reference with constant angular velocity-qualitative explanation of Foucault's pendulum-rigid body-angular velocity vector-centre of mass- gravitation law and Kepler's laws(qualitative).

Learning Outcomes: At the end of the unit, the student will be able to:
- Identify forces and moments in mechanical systems using scalar and vector techniques. (L3)
- Interpret the equation of motion of a rigid rotating body (torque on a rigid body). (L3)
- Extend Newton's second law for inertial and non-inertial frame of reference. (L2)

Unit 2 Acoustics and Ultrasonic's **9**

Acoustics: Introduction- reverberation-reverberation time-Sabine's formula- derivation using growth and decay method – Absorption coefficient and its determination –factors affecting acoustics of buildings and their remedies.

Ultrasonic's: Introduction- Properties- Production of ultrasonic's by magnetostriction and piezoelectric methods - acoustic grating -Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C – scan displays, Medical applications – Sonogram.

Learning Outcomes: At the end of the unit, the student will be able to:
- Explain how sound is propagated in buildings. (L2)
- Analyze acoustic properties of typically used materials in buildings. (L4)
- Identify the use of ultrasonic's in different fields. (L3)

Unit 3 Dielectric and Magnetic materials **10**

Introduction-Dielectric Polarization-Dielectric polarizability- Susceptibility and Dielectric constant- Types of polarizations: Electronic and Ionic (quantitative), Orientation polarizations (qualitative) -Frequency dependence of polarization-Lorentz (internal) field-Claussius -Mosotti equation-Applications of Dielectrics.

Introduction- Magnetic dipole moment-Magnetization-Magnetic susceptibility and permeability- Origin of permanent magnetic moment -Classification of Magnetic materials-Weiss domain theory of ferromagnetism (qualitative)-Hysteresis-soft and hard magnetic materials-Magnetic device applications.

Learning Outcomes: At the end of the unit, the student will be able to:
- Explain the concept of dielectric constant and polarization in dielectric materials. (L2)
- Classify the magnetic materials based on susceptibility and their temperature dependence. (L2)
- Apply the concept of magnetism and magnetic devices. (L3)

Unit 4 LASERs and Fiber Optics 10

Introduction-characteristics of lasers-spontaneous and stimulated emission of radiation-Einstein's coefficients-population inversion-pumping mechanism-Ruby laser- He-Ne laser-semiconductor laser-applications of lasers.
Introduction to Optical Fibers-Total Internal Reflection-Critical angle of propagation- Acceptance angle -Numerical Aperture-Classification of fibers based on Refractive index profile& modes (step index and Graded index optical fibers)-attenuation and optical fiber losses-Block diagram of fiber optic communication- Medical Applications.

Learning Outcomes: At the end of the unit, the student will be able to:

- Understand the basic concepts of laser light sources. (L2)
- Identify the Engineering applications of lasers. (L2)
- Classify optical fibers based on refractive index profile and mode of propagation and identify the applications of optical fibers in medical, communication and other fields. (L2)

Unit 5 Sensors 8

Sensors:(qualitative description only): Different types of sensors and applications; Strain and Pressure sensors- Piezoelectric, magneto strictive sensors, Fibre optic methods of pressure sensing; Temperature sensors - bimetallic strip, pyroelectric detectors, Hall-effect sensor, smoke, and fire detectors.

Learning Outcomes: At the end of the unit, the student will be able to:

- Identify different types of sensors and applications. (L3)
- Explain physics behind the working principles of sensors. (L2)
- Select sensors for different type of applications. (L3)

Prescribed Textbooks:

1. D.Kleppner and Robert Kolenkow , "An introduction to Mechanics"-II -Cambridge University Press,2015
2. M.N.Avadhanulu & P.G.Kshirsagar, "A textbook of Engineering Physics"- S. Chand Publications, 2017
3. Ian R Sinclair, Sensors and Transducers, 3rd ed,Elsevier (Newnes), 2001

Reference Books:

1. K.Thyagarajan. "Engineering Physics"-Mc Graw Hill Publishing company Ltd,2015.
2. M K Varma "Introduction to Mechanics"-Universities Press-2015.
3. D.K. Bhattacharya and A. Bhaskaran, "Engineering Physics"- Oxford Publications-2015

Course Outcomes:

At the end of the course, the student will be able to	Blooms Level of Learning
1. apply scalar and vector techniques	L3
2. apply the principles of acoustics for noise cancellation and ultrasonics in engineering	L3
3. describe polarization of dielectrics and magnetic materials	L2
4. apply lasers and optical fibre concepts in engineering applications	L3
5. explain various types of sensors used in engineering	L2

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
20AC24T. 1	3	2	1	2	-	-	-	-	-	-	-	1
20AC24T. 2	3	2	1	2	-	-	-	-	-	-	-	1
20AC24T.3	2	2	1	1	-	-	-	-	-	-	-	1
20AC24T. 4	3	2	1	2	-	-	-	-	-	-	-	1
20AC24T. 5	2	2	1	1	-	-	-	-	-	-	-	1

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

Title of the Course Engineering Materials
Category ESC
Course Code 20A321T

Year I B. Tech
Semester II Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

- To understand the basic structure, properties of metals, mechanism of crystallization and imperfections in crystals.
- To study the importance of binary phase diagrams.
- To acquire knowledge on properties and structure of ferrous and nonferrous alloys and to select suitable materials for various engineering applications.
- To learn various methods of heat treatment and surface coating processes.
- To gain knowledge on materials like Ceramics and Composites

Unit 1 Structure of Metals & Constitution of Alloys 8

Structure Of Metals: Bonds in Solids – Metallic bond with examples, Crystal structures, crystallization of metals, imperfections, grain and grain boundaries, effect of grain boundaries on the properties of metal / alloys – determination of grain size.

Constitution Of Alloys: Necessity of alloying, types of solid solutions, Hume Rotherys rules, intermediate alloy phases, and electron compounds with examples.

Learning Outcomes: At the end of the unit, the student will be able to:

- Recall the definitions ad terminology of crystallography (L1)
- Understand the effect of grain size and grain boundaries on the properties of metals and alloys (L2)
- Differentiate between metals and alloys (L4)

Unit 2 Equilibrium Diagrams 8

Experimental methods of construction of equilibrium diagrams, Isomorphous alloy systems, equilibrium cooling and heating of alloys, Phase rule, Lever rule, eutectic systems with examples, peritectic reaction, eutectoid, peritectoid reactions, phase rule, relationship between equilibrium diagrams and properties of alloys. Study of binary phase diagram of Fe-Fe3C.

Learning Outcomes: At the end of the unit, the student will be able to:

- Make use of the principles of construction of binary phase diagrams (L1)
- Know the concepts of Lever and phase rule. (L1)
- Identify various Invariant reactions in binary phase diagrams (L2)

Unit 3 Ferrous & Non-Ferrous Alloys 8

Ferrous - Cast Irons: Structure, composition and properties of White Cast iron, Malleable Cast iron, grey cast iron, Spheroidal graphite cast iron, Alloy cast irons with applications.

Steels - Classification of steels, structure and properties of plain carbon steels, Low alloy steels, Stainless steels, Hadfield manganese steels, tool steels with applications.

Non-Ferrous Metals And Alloys: Structure and properties of copper and its alloys, Aluminium and its alloys, Titanium and its alloys, with applications.

Learning Outcomes: At the end of the unit, the student will be able to:

- Classify various types of cast irons and steels , their properties and applications (L2)
- Understand the importance of non ferrous metals and their alloys in engineering applications (L2)
- Compare cast Irons, steels and non ferrous alloys , their limitations in applications (L4)

Unit 4 Heat Treatment of Alloys & Surface Engineering 7

Heat Treatment of Alloys: Effect of alloying elements on Iron – Iron carbon system, Annealing, normalizing, Hardening, TTT diagrams, tempering, Hardenability, surface - hardening methods, Age hardening.

Surface Engineering: Surface treatment processes and their characteristics and applications, mechanical coatings, Diffusion coating.

Learning Outcomes: At the end of the unit, the student will be able to:

- Know the influence of heat treatment in modification of properties of steels. (L1)
- Develop a heat treatment cycle based on properties required. (L4)
- Learn the importance of surface treatment processes. (L2)

Unit 5 Ceramic Materials & Composite Materials 7

Ceramic Materials: Crystalline ceramics, glasses, cermets.

Composite Materials: Classification of composites, various methods of component manufacture of composites, particle – reinforced materials, fiber reinforced materials, metal ceramic mixtures, metal – matrix composites and Carbon – Carbon composites.

Learning Outcomes: At the end of the unit, the student will be able to:

- Understand the properties of ceramics and their applications. (L2)
- Summarize the properties of composites and their use (L3)
- Choose composites for various applications (L2)

Prescribed Text Books:

1. Kodgire, Material Science and Metallurgy, 42nd edition Everest Publishing House 2017.
2. Donald R. Askeland, Essential of Materials Science and Engineering. Thomson Publications 2014

Reference Books:

1.Sidney H. Avener, Introduction to Physical Metallurgy, TMH
2. William and collister, Materials Science and Engineering, wiley pub. 2014
3. V. Raghavan, Material science and engineering, PH Pub. 2015
4. R.K.Rajput, Engineering materials and metallurgy. S.Chand & Co. 2006
5. O.P. Khanna, Material Science and Metallurgy. Dhanpatrai Pub. 2014

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Summarize the crystallization of metals and factors affecting the solid solubility.	L2
2. Analyze the phase diagrams of binary systems and iron-carbide diagram to identify the material composition depending on the design requirements.	L4
3. Summarize the structure and properties of various cast irons, steels and non-ferrous alloys.	L2
4. Apply the various heat treatment processes, surface hardening methods & coatings depending on material requirements.	L3
5. Summarize the concept of ceramics and composites	L 2

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A321T.1	2	2	1	1	-	-	-	-	-	-	-	-	-	1
20A321T.2	3	3	2	2	-	-	-	-	-	-	-	-	-	1
20A321T.3	2	2	1	1	-	-	-	-	-	-	-	1	-	1
20A321T.4	3	2	1	2	-	1	1	-	-	-	-	1	-	1
20A321T.5	2	2	1	1	-	-	-	-	-	-	-	1	-	1

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

Title of the Course Engineering Graphics & Design
Category ESC
Course Code 20A322T

Year I B. Tech
Semester II Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
1	0	4	3

Course Objectives:
- To impart and inculcate proper understanding of the theory of projections of solids and simple machine components.
- To visualize projections of solids with sectioning, isometric views and conversion of views.
- To prepare the student for future engineering positions.

Unit 1 Projections of Solids **Theory: 03**
Practice Sessions: 03

Projections of Regular Solids – Cylinder, Cone, Prism and Pyramid - inclined to one reference plane & both reference planes – Auxiliary Views.

Learning Outcomes: At the end of the unit, the student will be able to:
- Understand the Orthographic Projections of Solids. (L2)
- Apply the concepts learned in industrial applications. (L3)

Unit 2 Sections Of Solids **Theory: 02**
Practice Sessions: 02

Section Planes and Sectional views of Right Regular Solids–Prism, Cylinder, Pyramid and Cone. True shapes of the sections.

Learning Outcomes: At the end of the unit, the student will be able to:
- Understand the concept of Sections of Solids. (L2)
- Apply sectional views for engineering components. (L3)

Unit 3 Development of Surfaces & Interpenetration of Right Regular Solids **Theory: 03**
Practice Sessions: 03

Development of Surfaces of Right Regular Solids – Prisms, Cylinder, Pyramid, Cone and their Sectioned parts. Projections of curves of Intersection of Cylinder Vs Cylinder – Cylinder Vs square prism – Cylinder Vs Cone and Square prism Vs Square prism (Axis bisecting problems only).

Learning Outcomes: At the end of the unit, the student will be able to:
- Understand the Development of surfaces and Intersections of Solids (L2)
- Develop a sheet which meets the specifications of an object and can analyze the image of an intersected solids (L3)

Unit 4 Isometric Projections / Views **Theory: 02**
Practice Sessions: 02

Principles of Isometric Projection – Isometric Scale – Isometric Views– Conventions – Isometric Views of Lines, Plane Figures, Simple and Compound Solids.

Learning Outcomes: At the end of the unit, the student will be able to
- Understand the Isometric Views and Isometric Projections (L2)
- Employ freehand 3D pictorial sketching to aid in the visualization process and can efficiently communicate ideas graphically. (L3)

Unit 5 Conversion of Views **Theory: 02**
Practice Sessions: 02

Conversion of Isometric views to Orthographic Views and Conversion of Orthographic views to Isometric views.

Learning Outcomes: At the end of the unit, the student will be able to:

- Understands the conversion of views. (L2)
- Analyze a drawing and can efficiently communicate ideas graphically (L4)

Prescribed Text Books:

1. Engineering Drawing, N.D. Bhatt, Charotar Publishers
2. Engineering Drawing, K.L. Narayana, P. Kanniah, Scitech Pub

Reference Books:

1. Engineering Drawing and Graphics, Venugopal/ New age
2. Engineering Drawing, Johle, Tata McGraw-Hill
3. Engineering Drawing, Shah and Rana, 2/e, Pearson Education

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Apply knowledge to draw sectional views and true shapes of right regular solids and to interpret sectional views accurately	L3
2. Apply knowledge of surface development to solve problems related to various parts of right regular solids.	L3
3. Apply knowledge of projection techniques to solve problems related to visualizing and representing intersection curves of different solids.	L3
4. Apply knowledge of isometric projection principles to solve problems related to representing complex objects in isometric views.	L3
5. Apply the conversion techniques to solve problems related to orthographic projections and isometric projection views.	L3

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A322T.1	3	2	1	1	-	-	-	-	-	-	-	-	2	2
20A322T.2	3	2	1	1	-	-	-	-	-	-	-	-	2	2
20A322T.3	3	2	1	-	-	-	-	-	-	-	-	-	2	2
20A322T.4	3	2	1	-	-	-	-	-	-	-	-	-	2	2
20A322T.5	3	2	1	-	-	-	-	-	-	-	-	-	2	2

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

Title of the Course Engineering Mechanics
Category ESC
Course Code 20A323T

Year I B. Tech
Semester II Semester
Branch CE & ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To explain the effect of force and moment in the different engineering applications.
- To familiarize frictional forces in mechanical applications.
- To teach centre of gravity and moment of inertia of solids and surfaces.
- To understand the analysis of rigid bodies under dynamic conditions.

Unit 1 Introduction to Engineering Mechanics 08

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 systems.

Learning Outcomes: At the end of the unit, the student will be able to
- Resolve the forces in mechanical systems (L2)
- Identify the moments and forces (L3)
- Draw free body diagram (L3)
- Demonstrate equilibrium of ideal system. (L2)

Unit 2 Analysis of Structures and Friction 09

Introduction to plane trusses, analysis of plane trusses by method of joints and method of sections.
Friction: Laws of friction, types of friction, equilibrium of force systems involving frictional forces, wedge friction. Free body diagrams involving frictional forces.

Learning Outcomes: At the end of the unit, the student will be able to:
- Identify different types of trusses. (L2)
- Analyze the plane trusses by method of joints and the method of sections. (L4)

Unit 3 Properties of Surfaces and Moment of Inertia 09

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.

Learning Outcomes: At the end of the unit, the student will be able to:
- Identify the centre of gravity of composite sections. (L3)
- Determine the centre of gravity of common solids. (L3)
- Determine moment of inertia for composite volumes. (L3)

Unit 4 Kinematics 08

Equations of motion for rigid bodies, constant and variable acceleration, rectilinear and curvilinear motion, motion under gravity -projectile motion, use of rectangular coordinates, tangential and normal coordinates, radius of curvature, rotation of a rigid body about a fixed axis, introduction to plane motion.

Learning Outcomes: At the end of the unit, the student will be able to:

- Write equations of motion for rigid bodies. (L3)
- Find velocity and acceleration in rectilinear and curvilinear motions (L4)
- Trace the path of projectile. (L3)

Unit 5 Kinetics and Ideal Systems 08

Kinetics: Principles of dynamics - Newton's Laws of motion, D'Alembert's principle in rectilinear translation, principle of work and energy.

Ideal Systems: Principle of conservation of energy, concept of power, conservation of linear and angular momentum, principle of momentum and impulse, impact - types of impact.

Learning Outcomes : At the end of the unit, the student will be able to:

- Apply D'Alembert's principle in rectilinear translation. (L3)
- Estimate the work done by a force and work done by a couple. (L3)
- Relate principle of work and energy in dynamic systems. (L3)
- Make use of principle of momentum and impulse to dynamic bodies. (L4)

Prescribed Text Books:

1. A Nelson, Engineering Mechanics: Statics and Dynamics, McGraw Hill publications.
2. J.L.Meriam , L.G.Kraige , J.N.Bolton ,Engineering Mechanics-statics, Engineering Mechanics-Dynamics.
3. S SBhavikatti, Engineering Mechanics, New Age International.
4. RK Bansal , Engineering Mechanics, Laxmi Publications.

Reference Books:

1. Basudeb Bhattacharya., Engineering Mechanics, 2/e, Oxford University Press (India), 2015.
2. Irving Shames, G K M Rao, Engineering Mechanics: Statics and Dynam-ics, 4/e, Pearson, 2009
3. K L Kumar, Veenu Kumar, Engineering Mechanics, 4/e, Tata McGraw Hill, 2010.

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Calculate the resultant forces and couple in mechanical systems.	L3
2. Analyze the frictional forces under equilibrium conditions and forces in members of a truss.	L4
3. Evaluate the centroid, centre of gravity and moment of inertia for various geometric shapes.	L5
4. Evaluate the different types of motions of a body without considering forces.	L5
5. Calculate the displacement, velocity and acceleration in dynamic systems.	L3

Final CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A323T.1	3	3	2	3	-	-	-	1	-	-	-	-	2	2
20A323T.2	3	3	3	3	-	-	-	-	-	-	-	-	2	2
20A323T.3	3	3	3	3	-	-	-	1	-	-	-	-	2	2
20A323T.4	3	3	3	3	-	-	-	1	-	-	-	-	2	2
20A323T.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 Engineering Physics Lab
Category BSC
Course Code 20AC24L

Year I B. Tech.
Semester II Semester
Branch CE & ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	3	1.5

Course Objectives:
- To understand the role of Optical fiber parameters in engineering applications.
- To recognize the significance of laser and ultrasonics by studying its characteristics and its applicationin finding the particle size.
- To illustrate the semiconductor, magnetic and dielectric materials applications.
- To identify the various sensor applications.

List of Experiments
1. Determination of wavelength of LASER light using diffraction grating
2. Determination of particle size using LASER.
3. Determination of spring constant of springs using Coupled Oscillator
4. Determination of Hall voltage and Hall coefficient of a given semiconductor usingHalleffect.
5. Determination of Dielectric constant of dielectric material using charging and dischargingofcapacitor.
6. Determination of Magnetic field along the axis of a circular coil carrying current.
7. Determination of Rigidity modulus of material of a wire-dynamic method (Torsional pendulum)
8. Determination of hysteresis loss by tracing B-H Curve of ferromagnetic material.
9. Determination of the numerical aperture of a given optical fiber and hence to find itsacceptance Angle
10. Measurement of magnetic susceptibility by Gouy's method
11. Determination of ultrasonic velocity in liquid (Acoustic grating)
12. Determination of pressure variation using Strain Guage sensor.
13. Determination of temperature change using Strain Guage sensor.
14. Determination of pressure variations using optical fiber sensors.
15. Determination of temperature changes using optical fiber sensors

References:
1. S. Balasubramanian, M.N. Srinivasan "A Text book of Practical Physics"- S Chand Publishers, 2017

Course Outcomes:

At the end of the course, student will be able to	Blooms Level of Learning
1. estimate the basic parameters of solid materials.	L5
2. estimate the basic characteristics of LASERS and size of the particles	L5
3. evaluate the physical parameters of optical fiber and sensors	L5
4. evaluate the quantities of semiconductors, magnetic and dielectric materials.	L5

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20AC24L.1	3	3	1	1	2	-	-	-	-	-	-	3	-	-
20AC24L.2	3	3	1	1	2	-	-	-	-	-	-	3	-	-
20AC24L.3	3	3	1	1	2	-	-	-	-	-	-	3	-	-
20AC24L.4	3	3	1	1	2	-	-	-	-	-	-	3	-	-

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

Title of the Course Engineering Materials Lab
Category ESC
Course Code 20A321L

Year I B. Tech
Semester II Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	3	1.5

Course Objectives:
- To gain the knowledge of microstructures of different ferrous and non ferrous alloys
- To gain the knowledge of calculating hardness number of heat treated steels
- To gain the knowledge of conducting experiment on jominy & quench apparatus for hardenability

List of Experiments: **8**
1. Study of Microstructures of Pure Metals – Copper & Aluminium.
2. Study of Microstructures of Non – Ferrous Alloy – Brass.
3. Study of Microstructures of Other Alloys – Stainless Steel, Case Carburized Steel & Bearing Metal.
4. Study of Microstructures of Cast Irons – Gray, Malleable & White Cast Irons.
5. Study of Microstructures of Low Carbon Steel & Medium Carbon Steel.
6. Study of Microstructures of Heat Treated Steels.
7. Finding out the Hardness of Treated and Untreated Steels.
8. Finding out the Hardability of Steels by using Jominy End Quench Test Apparatus.

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Explain and draw the microstructure of ferrous and nonferrous alloys.	L3
2. Explain and draw the microstructure of heat treated steels	L3
3. Calculate the hardness of treated and untreated steels.	L3
4. Analyse and Conduct experiment for hardenability.	L5

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A321L.1	3	2	1	1	-	-	-	1	1	-	-	-	2	1
20A321L.2	3	2	1	1	-	-	-	1	1	-	-	-	2	1
20A321L.3	3	2	1	1	-	-	-	1	1	-	-	-	2	1
20A321L.4	3	3	2	3	-	-	-	1	1	-	-	-	2	1

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

Title of the Course Engineering & IT Workshop
Category ESC
Course Code

Year I B. Tech
Semester II Semester
Branch CE, ME & ECE

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	3	1.5

Course Objectives:

- To read and interpret job drawing, plan various operations and make assembly.
- To identify and select the hand tools and instruments used in various trades.
- To gain practical skills by performing the experiments in different trades of workshop.
- Demonstrate the parts of a personal computer system
- Demonstrate the Installation the operating system and other software required in a personal computer system
- Introduce connecting the PC on to the internet from home and workplace and effectively usage of the internet, Usage of web browsers, email, news groups and discussion forums
- Introduce the usage of Productivity tools in crafting professional word documents, excel spreadsheets and power point presentations
- To utilize MS Office tools

Engineering Workshop:

Trade 1 Carpentry Shop 02

Two joints (exercises) from : Mortise and tenon T joint, Dove tail joint, Bridle T joint, middle lap T joint, Half Lap joint, cross lap joint, Corner Dovetail joint or Bridle Joint from soft wood stock.

Learning Outcomes: At the end of the unit, the student will be able to apply wood working skills in real world applications. (L3)

Trade 2 Sheet metal shop 02

Two jobs (exercises) from: Tapered Tray, cylinder, conical funnel from out of 22 or 20 guage G.I. sheet

Learning Outcomes: At the end of the unit, the student will be able to build different parts with metal sheets used in various appliances (L3)

Trade 3 Fitting shop 02

Two jobs (exercises) from: square Fit, V-Fit, Semi-circular fit, dove tail fit from M.S. stock

Learning Outcomes: At the end of the unit, the student will be able to apply fitting operations in various assemblies. (L3)

Trade 4 House-wiring 02

Two jobs (exercises) from: Parallel and Series, Two way switch, Tube –Light connection, Stair case connection.

Learning Outcomes: At the end of the unit, the student will be able to apply basic electrical engineering knowledge for house wiring practice. (L3)

Trade 5 Demonstration 01

Any one trade of Plumbing • Machine Shop • Metal Cutting • Soldering and Brazing

Learning Outcomes: At the end of the unit, the student will be able to get the basic awareness of any of trade demonstrated. (L3)

Prescribed Text Books:

1. Kannaiah P. and Narayana K.L., Workshop Manual, 3rd Edn, Scitech publishers.

2. John K.C., Mechanical Workshop Practice. 2nd Edn. PHI 2010.

Reference Books:

1. Jeyapoovan T.and Pranitha S., Engineering Practices Lab Manual, 3rd Edn. Vikas Pub.2008.

IT Workshop:

Task 1 **01**

Learn about Computer: Identify the internal parts of a computer, and its peripherals. Represent the same in the form of diagrams including Block diagram of a computer. Write specifications for each part of a computer including peripherals and specification of Desktop computer. Submit it in the form of a report

Learning Outcomes: At the end of the unit, the student will be able to:

- Identify the parts of a computer (L2)
- Know the usage of internal parts of a computer (L2)

Task 2 **01**

Install Operating System: Student should install Linux on the computer. Students should record the entire installation process.

Learning Outcomes: At the end of the unit, the student will be able to:

- Install another operating systems (L1)
- Know how to install software's (L2)

Task 3 **01**

Browsing Internet: Student should access the Internet for Browsing. Students should search the Internet for required information. Students should be able to create e-mail account and send email. They should get acquaintance with applications like Face book, Skype etc. If Intranet mailing facility is available in the organization, then students should share the information using it. If the operating system supports sending messages to multiple users (LINUX supports it) in the same network, then it should be done by the student. Students are expected to submit the information about different browsers available, their features, and search process using different natural languages, and creating e-mail account.

Learning Outcomes: At the end of the unit, the student will be able to:

- Create e-mail account and send email (L2)
- Browse internet for required information (L2)

Task 4 **01**

Word Processor: Students should be able to create documents using the word processor tool. Some of the tasks that are to be performed are inserting and deleting the characters, words and lines, Alignment of the lines, Inserting header and Footer, changing the font, changing the colour, including images and tables in the word file, making page setup, copy and paste block of text, images, tables, linking the images which are present in other directory, formatting paragraphs, spell checking, etc. Students should be able to prepare project cover pages, content sheet and chapter pages at the end of the task using the features studied. Students should submit a user manual of the word processor considered. .

Learning Outcomes: At the end of the unit, the student will be able to:

- Prepare project documents, user manuals (L3)
- Get the knowledge on word processor tool (L1)

Task 5 **01**

Spreadsheet: Students should be able to create, open, save the application documents and format them as per the requirement. Some of the tasks that may be practiced are Managing the worksheet environment, creating cell data, inserting and deleting cell data, format cells, adjust the cell size, applying formulas and functions, preparing charts, sorting cells. Students should submit a user manual of the Spreadsheet application considered.

Learning Outcomes: At the end of the unit, the student will be able to:

- Create , open and save spread sheets (L3)
- Apply formulas for different tasks (L4)

Task 6 **01**

Presentations: creating, opening, saving and running the presentations, selecting the style for slides, formatting

the slides with different fonts, colours, creating charts and tables, inserting and deleting text, graphics and animations, bulleting and numbering, hyper linking, running the slide show, setting the timing for slide show. Students should submit a user manual of the Presentation tool considered.

Learning Outcomes: At the end of the unit, the student will be able to:

- Create , open and save slides (L4)
- Create their own presentations for seminars (L4)

Prescribed Text Books:

1. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education.
2. Upgrading and Repairing PC's, 22nd Edition, Scott Muller QUE, Pearson Education.
3. Comdex Information Technology Course Kit, Vikas Gupta, WILEY Dream tech.
4. MOS 2010 Study Guide for Microsoft Word, Excel, PowerPoint, and Outlook Exams, 1st Edition, Joan Lambert, Joyce Cox, Microsoft Press

Reference Books:

1. IT Essentials PC Hardware and Software Companion Guide, CICSO Networking Academy
2. Network Your Computer & Devices Step by Step 1st Edition, Ciprian Rusen, Microsoft Press
3. Troubleshooting, Maintaining & Repairing PCs, 5th Edition, Bigelow, TMH
4. Introduction to computers, Peter Norton, 6/e, Mc Graw Hill

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Apply wood working skills to prepare different joints for real world applications.	L3
2. Development of sheet metal jobs with GI sheet.	L6
3. Apply techniques to perform basic operations with hand tools to model various proto types with mild steel for different assemblies.	L3
4. Apply basic electrical engineering knowledge for house wiring practice	L3
5. Identify various operations and its applications from the demonstration	L3
6. Recognize the peripherals of a computer, perform assembling and disassembling of various components of a computer.	L3
7. Describe and perform installation and un-installation of Windows and Linux operating systems and also perform troubleshooting of various hardware and software components	L3
8. Use Web browsers to access Internet, Search Engines.	L3
9. Use word processor; spread sheet, presentation and data storage tools	L3

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A326L.1	**3**	**1**	**1**	**-**	**-**	**1**	**-**	**-**	**2**	**2**	**-**	**2**	**1**	**2**
20A326L.2	**3**	**3**	**1**	**-**	**-**	**1**	**-**	**-**	**2**	**2**	**-**	**2**	**1**	**2**
20A326L.3	**3**	**1**	**1**	**-**	**-**	**1**	**-**	**-**	**2**	**2**	**-**	**2**	**1**	**2**
20A326L.4	**3**	**1**	**1**	**-**	**-**	**1**	**-**	**-**	**2**	**2**	**-**	**2**	**1**	**2**
20A326L.5	3	-	1	-	1	-	-	-	-	-	-	1	-	-
20A326L.6	3	3	1	-	3	-	-	-	-	-	-	3	-	-
20A326L.7	3	3	1	-	3	-	-	-	-	-	-	3	-	-
20A326L.8	3	3	1	-	3	-	-	-	-	-	-	3	-	-
20A326L.9	3	3	1	-	3	-	-	-	-	-	-	3	-	-

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

Title of the Course Partial Differential Equations and Numerical Methods
Category BSC
Course Code 20AC31T

Year II Year
Semester I Semester
Branch CE & ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To introduce numerical methods for solving algebraic and transcendental equations.
- To notify the numerical methods in interpolation
- To explain various numerical methods for evaluating definite integrals.
- To introduce the numerical solutions of ordinary differential equations.
- To describe the applications of Partial differential equations

Unit 1 **Solutions of algebraic and transcendental equations** **10**

Bisection method - Regula-Falsi method - The Iteration Method-Newton-Raphson method.

Learning Outcomes: At the end of the unit, the student will be able to:
- acquire the Knowledge of algebraic and transcendental equations (L1)
- find approximate roots of an equation by using bisection, regula-falsi and Newton's methods (L3)

Unit 2 **Interpolation** **10**

Finite differences - forward differences and backward differences - Newton's forward interpolation formula - Newton's backward interpolation formula - Lagrange's interpolation formula.

Learning Outcomes: At the end of the unit, the student will be able to:
- Explain various discrete operators (L2)
- Apply Newton forward and Backward formula for equal intervals (L3)
- Apply Lagrange's interpolation formula for unequal intervals (L3)

Unit 3 **Numerical Differentiation and Numerical integration** **8**

Numerical Differentiation, Numerical integration - Trapezoidal rule - Simpson's 1/3rd and Simpson's 3/8 rules.

Learning Outcomes: At the end of the unit, the student will be able to:
- Find differentiation of a function by using different numerical methods (L3)
- Determine the integration of a function by using numerical integration (L3)

Unit 4 **Numerical solutions of ordinary differential equations of first order** **10**

Picard's method -Taylor's series- Euler's method - Modified Euler's method - Runge-Kutta method of fourth order.

Learning Outcomes: At the end of the unit, the student will be able to:
- Solve ordinary differential equations by using different numerical schemes (L3)
- Apply the knowledge of numerical methods to solve Engineering problems (L3)

Unit 5 **Applications of Partial Differential Equations** **10**

Solution of 1D-wave - 1D-heat and 2D-Laplace equations in cartesian coordinates by the Method of separation of variables.

Learning Outcomes: At the end of the unit, the student will be able to:
- Find the solution of partial differential equations bearing applications (L3)
- Solve the boundary value problems related to one dimensional wave equation and heat equations. (L3)

Prescribed Textbooks:

1. R.K. Jain, S.R.K. Iyengar, Advanced Engineering Mathematics, 5/e, Narosa Publishers, 2016.
2. E. Kreyszig, Advanced Engineering Mathematics, 9/e, John Wiley & Sons, 2006.
3. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.

Reference Books:

1. T. Veerarajan, Engineering Mathematics, Tata McGraw-Hill, New Delhi, 2008.
2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
3. P. Kandasamy, K. Thilagavathi, K. Gunavathi, Numerical Methods, S. Chand & Company, 2/e, Reprint 2012.

Course outcomes:

Upon successful completion of this course the student should be able to	Blooms Level of Learning
1. solve algebraic and transcendental equations using numerical methods	L3
2. apply interpolation technique in engineering	L3
3. evaluate differentiation and integration	L5
4. solve the ordinary differential equations using numerical methods	L3
5. solve the boundary value problems in heat and wave equations	L3

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
20AC31T.1	3	2	1	2	-	-	-	-	-	-	-	1
20AC31T.2	3	2	1	2	-	-	-	-	-	-	-	1
20AC31T.3	3	3	1	3	-	-	-	-	-	-	-	1
20AC31T.4	3	2	1	2	-	-	-	-	-	-	-	1
20AC31T.5	3	2	1	2	-	-	-	-	-	-	-	1

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

Title of the Course	Basic Electrical and Electronics Engineering
Category	ESC
Course Code	20A235T

Year	II Year
Semester	I Semester
Branch	ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

- To discuss the basic knowledge about fundamental laws and electric circuits.
- To describe the working of various DC Machines.
- To describe the working of various AC Machines.
- To describe the operation of electronic devices.
- To discuss the various electrical installations and measuring instruments

Unit 1 Fundamental Laws and Electrical Circuits **9**

Basic definitions - Voltage, current, power, energy, charge, flux, static and dynamic emf, Faraday's laws of electromagnetic induction, Fleming's right-hand rule, Fleming's left-hand rule, Lenz's law, Cork screw rule, Right hand thumb rule, Right hand palm rule, types of elements, ohms law, resistive, inductive, capacitive networks, Series-parallel circuits and Kirchhoff's laws.

Learning Outcomes: At the end of the unit, the student will be able to

- Describe the fundamental laws of Electrical Engineering. (L2)
- Describe the Kirchhoff's laws (L2)

Unit 2 DC Machines **9**

DC Generator: Constructional Details of DC machine, Principle of operation, emf equation, types of generators, applications.

DC Motor: principle of operation, torque equation, types, losses and efficiency, applications, Brake test, Swinburne's test and Speed control methods.

Learning Outcomes: At the end of the unit, the student will be able to

- Describe construction and operation of DC machines (L2)
- Analyze the performance of DC machines (L4)
- Discuss the speed control methods of DC motor (L2)

Unit 3 AC Machines **9**

1-Φ Transformer: Principle of operation, emf equation, losses, efficiency and regulation calculations using OC and SC tests. Introduction to 3-Φ system, 3-Φ Alternator: Principle of operation of alternators-Regulation by synchronous impedance method. 3-Φ Induction Motor: Principle of operation of induction motor, Brake Test on 3-Φinduction motor.

Learning Outcomes: At the end of the unit, the student will be able to

- Describe construction and operation of various AC machines (L2)
- Analyze the performance of various AC machines (L4)

Unit 4 Diode and Transistor **9**

Diode: PN junction diode, symbol, v-i characteristics, applications, half wave, full wave and bridge rectifiers. Transistor: PNP and NPN transistor, characteristics of CE configuration.

Learning Outcomes: At the end of the unit, the student will be able to:

- Sketch operating characteristics of PN junction diode (L3)
- List out the applications of PN junction diode (L1)
- Describe the operation of various types of BJTs (L2)
- Sketch operating characteristics of CE configuration of BJTs (L3)

Unit 5 Measuring Instruments and Electrical Installations 9

Introduction, Electrical and Electronic Instruments, Classification of Instruments, Multimeter, Function generator, CRO: Block diagram of CRO, Principle of CRT (Cathode Ray Tube), applications of CRO, voltage, current and frequency measurements using CRO.

Switch Fuse Unit (SFU), MCB, types of wires and cables, earthing, elementary calculations for energy consumption.

Learning Outcomes: At the end of the unit, the student will be able to:

- Describe the construction and operation of measuring instruments. (L2)
- Describe the various electrical installations (L2)

Prescribed Text Books:

1. V.K. Mehta, Principles of Electrical and Electronics Engineering. S. Chand & Co 2015.
2. T.Thyagarajan, Fundamentals of Electrical and Electronics Engineering. SciTech publications, 2011, 5th Ed
3. D. C. Kulshreshta, "Basic Electrical Engineering", McGraw Hill, 2017.
4. P.S.Dhogal "Basic Electrical Engineering with Numerical Problems" McGraw Hill, 2006.
5. A.Sudhakar and Shyammohan, S Palli, "Circuits and Networks" McGraw Hill, 2018.

Reference Books:

1. M.S Naidu and S.Kamakshaiah, Introduction to Electrical Engineering. TMH Publications. 2017
2. D.P Kothari and I.J Nagrath, Basic Electrical Engineering, TMH, 4thEd.2019
3. Millman and Halkias, Satya Prabhajit, Electronic devices and circuits, 4th Edition, TMH, 2015
4. Salivahanan, N,Suresh Kumar, "Electronic Devices and Circuits" 4th Edition, McGraw Hill, 2016.

Course Outcomes:

At the end of the course, the student will be able to	Blooms Level of Learning
1. Describe the basic laws and apply to electrical circuits	L3
2. Describe the working of various DC Machines and analyze their performance.	L4
3. Describe the working of various AC Machines and analyze their performance.	L4
4. Describe the working of various electronic devices and sketch their characteristics.	L3
5. Describe the operation of various electrical installations and measuring instruments	L2

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
20A235T.1	2	2	-	2	-	-	-	-	-	-	-	-	-	-
20A235T.2	2	3	2	2	-	-	-	-	-	-	-	-	-	-
20A235T.3	2	3	2	2	-	-	-	-	-	-	-	-	-	-
20A235T.4	2	2	-	3	-	-	-	-	-	-	-	-	-	-
20A235T.5	2	2	1	3	-	-	-	-	-	-	-	-	-	-

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

Title of the Course Mechanics of Solids
Category PCC
Course Code 20A331T

Year II B. Tech
Semester I Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To understand the nature of stresses induced in material under different loads.
- To plot the variation of shear force and bending moments over the beams under different types of loads.
- To understand the behavior of beams subjected to bending and shear loads.
- To calculate the deflection of beams under complex loading.
- To analyze the cylindrical and spherical shells under circumferential and radial loading conditions.

Unit 1 Simple Stresses & Strains 9

Elasticity– 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 – Elastic moduli & the relationship – Bars of varying section–composite bars (simple problems)–Thermal stresses (simple problems).Strain energy–Resilience, principal stresses and strains - mohrs circle (Elementary treatment only) .

Learning Outcomes: At the end of the unit, the student will be able to:
- Define the simple stresses and strains when members are subjected to axial loads.(L1)
- Identify the temperature stresses and strains when members are subjected to axial loads (L2 , L3 & L4)

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, UDL, uniformly varying loads and combination – Point of contra flexure –Relation between S.F.,B.M and rate of loading at a section of a beam.

Learning Outcomes: At the end of the unit, the student will be able to:
- Sketch the shear force and bending moment diagrams for the beam subjected to different loading conditions (L3).

Unit 3 Bending Stresses & Shear Stresses 8

Flexural Stresses: Theory of simple bending – Assumptions – Derivation of bending equation: M/ I = f/y = E/R Neutral axis–Determination of bending stresses–section modulus of rectangular and circular sections (Solid and Hollow),I,T, Angle and Channel sections.

Shear Stresses: Derivation of formula – Shear stress distribution across various beam sections like rectangular, circular, triangular, I,T and angle sections.

Learning Outcomes: At the end of the unit, the student will be able to:
- Identify the stresses induced in different cross – sectional members subjected to bending moment (L2, L3).
- Identify the stresses induced in different cross – sectional members subjected to shear loads (L2, L3).

Unit 4 Deflection of Beams 9

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, U.D.L, uniformly varying load.

Learning Outcomes: At the end of the unit, the student will be able to:
- Identify the deflections in beams subjected to different loading conditions (L2 & L4)

Unit 5 Thin Cylinders **7**

Thin Cylinders: Thin seam less cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and volumetric strains – changes in diameter, and volume of thin cylinders – Thin spherical shells.

Learning Outcomes: At the end of the unit, the student will be able to:

- Identify the stresses in thin cylindrical shells (L2 & L4).

Prescribed Text Books:

1. Strength of materials by S S Bhavikatti
2. Strength of materials by R S Khurmi& N. Khurmi, S. Chand Publishing
3. Strength Of Materials by S. Ramamrutham

Reference Books:

1. S.B. Junnarkar , Mechanics of Structures Vol-III, Charotar publishing house.
2. S.Timoshenko, Strength of Materials, D Van Nostrand Company.
3. Strength of Materials by Dr. Sadhu Singh, ISBN: 978-81-7409-048-5,11th edition..
4. Strength Of Materials by SS Rattan, Tata Mcgraw Hill Education Private Limited; 2nd edition (July 11, 2011)

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Solve for simple stresses and strains when members are subjected to load	L3
2. Analyze Shear Force and Bending Moment in the beam subjected to different loading conditions.	L4
3. Evaluate shear stresses and bending stresses in a beam subjected to different loading conditions.	L5
4. Analyze the deflections in beam subjected to different loading conditions.	L4
5. Analyze thin cylindrical and spherical shell.	L4

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A331T.1	3	3	2	3	-	-	-	-	-	-	-	-	2	2
20A331T.2	3	3	3	3	-	-	-	-	-	-	-	-	2	2
20A331T.3	3	3	3	3	-	-	-	-	-	-	-	-	2	2
20A331T.4	3	3	3	3	-	-	-	-	-	-	-	-	2	2
20A331T.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 Manufacturing Processes
Category PCC
Course Code 20A332T

Year II B. Tech
Semester I Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

- To identify the basic steps involved in manufacturing processes of casting, pattern preparation and designing of Gating system.
- To illustrate the concepts of various joining and cutting processes.
- To demonstrate the concept of metal forming processes, mechanism and their working principle, tools and dies, its types and applications.
- To identify the concepts of basic extrusion and forging processes and its applications
- To demonstrate the basic knowledge on plastics, 3D Printing, classification, processing of plastics, its applications and process of steel making and metallurgy.

Unit 1 Casting Processes **8**

Steps involved in making casting– Types of patterns–Pattern Materials—Pattern allowances and their Construction –Principles of Gating, Gating ratio and design of Gating systems- defects in casting. Solidification of casting–Concept–Solidification of pure metal and alloys, short & long freezing range alloys, Solidification time calculations – Types of Risers, function and design, casting design considerations, Special casting processes: Centrifugal- Die –Investment- stir casting.

Learning Outcomes: At the end of the unit, the student will be able to:

- Understand the steps involved in metal casting, pattern making. (L2)
- Apply the knowledge of designing gating systems, risers. (L3)
- Identify the various casting defects. (L2)

Unit 2 Joining Processes **8**

Classification of welding process, types of welds, forward, backward welding and welded joints. Gas welding, ARC welding, Forge welding, resistance welding, Thermit welding and Plasma (Air and water) welding. Inert Gas welding, TIG & MIG welding – Friction stir Welding. Soldering & Brazing. Heat affected zones in welding; welding defects – causes and remedies – destructive and non destructive testing of welds. Cutting of metals: Oxy–Acetylene Gas cutting, Cutting of ferrous, non-ferrous metals.

Learning Outcomes: At the end of the unit, the student will be able to:

- Classify the working of various welding processes. (L2)
- Summarize the applications, advantages of various welding processes. (L3)
- Identify the defects in welding. (L2)

Unit 3 Metal Forming Processes **8**

Hot working and cold working of metals –strain hardening, recovery, re-crystallization and grain growth, Comparison and properties of Cold and Hot worked parts, rolling fundamentals–theory of rolling, types of Rolling mills and products – defects in rolled products. Press working process: Stamping, forming and other cold working processes: Blanking and piercing– Bending and forming– Drawing and its types – wire drawing and Tube drawing– coining–Hot and cold spinning

Learning Outcomes: At the end of the unit, the student will be able to:

- Compare cold working and hot working processes. (L4)
- Evaluate the forces and power in rolling and extrusion processes. (L5)
- Summarize the various operations in drawing, blanking and bending processes. (L3)

Unit 4 Extrusion and Forging Processes 6

Basic extrusion and its characteristics – Hot and cold extrusion – Forward and backward extrusion - Impact extrusion – Hydrostatic extrusion. Forging processes: Principles of forging–Tools and dies–Types of Forging – Smith forging –Drop Forging–Roll forging–Forging hammers: Rotary forging – forging defects – Rotary swaging.

Learning Outcomes: At the end of the unit, the student will be able to:

- Summarize the working of various extrusion processes. (L3)
- Identify the principles of forging, tools and dies. (L2)
- Identify the defects in forging. (L2)

Unit 5 Plastics & Metallurgy 6

Plastics: Classification – Properties – Plastics as engineering materials – Method of processing plastics – Injection moulding –Blow moulding -extrusion compression and transfer moulding.

Metallurgy: Steel Making - Introduction, Methods of steelmaking – crucible process, Bessemer converter process, Open Hearth Process, Introduction to Powder Metallurgy - Principle, manufacture of powders, steps involved.

Learning Outcomes: At the end of the unit, the student will be able to:

- Learn the methods of manufacturing plastics parts and various moulding methods. (L1)
- Understand the process of 3D printing. (L2)
- Explain the steps in manufacturing of powder metallurgy parts. (L2)

Prescribed Text Books:

1. P.N. Rao, Manufacturing Technology.TMH, 2017, ISBN 978-1259062575.
2. Kalpak Jain, Manufacturing Technology. Pearson education, 2015, ISBN 9332587906.
3. Lindberg, PE, Process and materials of manufacturing, Allyn and Bacon, 1977. ISBN 978-9332556973.

Reference Books:

1. R.K.Jain, Production Technology, Khanna Publisher, 2004
2. Rosenthal, Principles of Metal Castings, TMH, 1976
3. Parmar, Welding Process, Khanna Publishers, 2010.
4. R.K.Rajput, Manufacturing Technology. Laxmi Publications, 2007.
5. K.L. Narayana, Production Technology, I. K. International Pub, 2010
6. Hazrachoudary, Elements of workshop technology volume–1, Indian Book distributing company, Calcutta, 2010.

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Comprehend the complete casting process, including pattern making, gating design, solidification principles, and defect analysis, with a focus on gating ratio, riser types, and special casting techniques.	L2
2. Describe the diverse welding processes, joint types, cutting methods, and inspection techniques, including soldering and brazing.	L2
3. Explain the forces in rolling and power requirements of metal forming processes, comprising rolling methods and various cold working techniques.	L2
4. Summarize extrusion and forging techniques, hot and cold extrusion methods, and various forging processes.	L2
5. Explain plastics as engineering materials, their classification, properties, processing methods as well as introduction concepts of 3D printing.	L2

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A332T.1	2	2	1	1	-	-	-	-	-	-	-	-	2	1
20A332T.2	2	2	1	1	-	-	-	-	-	-	-	-	2	1
20A332T.3	2	2	1	1	-	-	-	-	-	-	-	-	2	1
20A332T.4	2	1	1	-	-	-	-	-	-	-	-	-	2	1
20A332T.5	2	-	-	-	-	-	-	-	-	-	-	-	2	1

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

Title of the Course Basic Thermodynamics
Category PCC
Course Code 20A333T

Year II B. Tech
Semester I Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives: This course will
- Impart the awareness on laws of thermodynamics.
- Enable the students to understand second law of thermodynamics and its applications to various systems.
- Familiarize steam properties to understand working of steam power plants.
- Acquire knowledge on equations of state and determine the properties of gas mixtures.
- Understand the inter-relationship between various air standard cycles used in gas power cycles.

Unit 1 Basic Concepts & First Law Of Thermodynamics 11

System, Control Volume, Surrounding, Boundaries, 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, Point and Path function.

Zeroth Law of Thermodynamics –Ideal Gas Scale – PMM I - Joule's Experiments – First law of Thermodynamics – Corollaries – First law applied to a Process – applied to a flow system – Steady Flow Energy Equation.

Learning Outcomes: At the end of this Unit, the student will be able to
- Classify various thermodynamic systems, properties and their importance in solving engineering problems. (L3)
- Apply energy balance to the system involving heat and work interactions. (L3)

Unit 2 Second Law Of Thermodynamics 10

Limitations of the First Law – Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance, Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements and their Equivalence / Corollaries, PMM of Second kind, 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.

Learning Outcomes: At the end of the unit, the student will be able to:
- Solve the problems related to the performance measurement of thermal interacting devices. (L3)
- Determine entropy changes in a wide range of processes and determine the reversibility or irreversibility of a process. (L3)

Unit 3 Pure Substances 8

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, Constructional use of Property tables. Mollier charts – Various Thermodynamic processes and energy Transfer – Steam Calorimetry.

Learning Outcomes: At the end of the unit, the student will be able to:
- Apply properties of steam to design steam systems. (L3)
- Determine properties of pure substances. (L3)

Unit 4 Perfect Gas Laws & Mixture Of Perfect Gases 13

Equation of State, specific and Universal Gas constants – various Non-flow processes, properties, end states, Heat and Work Transfer, changes in Internal Energy – Throttling and Free Expansion Processes – Flow

processes – Deviations from perfect Gas Model – Vander Waals Equation of State – Compressibility charts – variable specific Heats – Gas Tables.
Mole Fraction, Mass fraction Gravimetric and volumetric Analysis – Dalton's Law of partial pressure, Avogadro's Laws of additive volumes – Mole fraction, Volume fraction and partial pressure, Equivalent Gas constant and Molecular Internal Energy, Enthalpy, specific heats and Entropy of Mixture of perfect Gases and Vapour.
Learning Outcomes: At the end of the unit, the student will be able to:

- Utilize the equations of state and compressibility charts in solving thermodynamic problems. (L3)
- Determine the properties of ideal gas mixtures. (L3)

Unit 5 Air Standard Cycles 6

Otto, Diesel and Dual cycles, P-V and T -S diagrams - Description and Efficiencies- Mean effective pressures. Comparison of Otto, Diesel and Dual cycles.
Learning Outcomes: At the end of the unit, the student will be able to:

- Identify the cycles followed for each type of engine. (L2)
- Determine the performance of different air standard cycles. (L3)

Prescribed Text Books:

1. Engineering Thermodynamics. PK Nag, TMH, 5TH Ed.2013 ISBN: 1259062562 / 9781259062568.
2. Basic Engineering Thermodynamics. A. Venkatesh, Universities Press; First edition (2007). ISBN: 9788173715877.
3. Thermodynamics – An Engineering Approach. Yunus Cengel& Boles, TMH. Mcgraw Higher Ed Edition: 8, 2015. ISBN 13: 9781259822674.

Reference Books:

1. Fundamentals of Thermodynamics. Sonntag, Borgnakke and Van wylen, John Wiley & sons (ASIA) Pt Ltd. Publisher: Wiley; 8 edition (December 26, 2012). ISBN-13 : 978-1118131992.
2. Thermodynamics. Mc Graw Hill J. P. Holman, McGraw-Hill College; 4th edition (January 1, 1988). ISBN-13 : 978-0070296336.
3. An introduction to Thermodynamics. YVC Rao, Universities Press, 3rd edition 2004. ISBN: 9788173714610.
4. Engineering Thermodynamics, Jones & Dugan, PHI INDIA (2011). ISBN-13 : 978-8120313750.

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Apply the first law of thermodynamics for various energy systems.	L3
2. Analyze the performance of thermal engineering devices by using Second law of Thermodynamics.	L4
3. Solve the properties of pure substances by using steam tables.	L3
4. Calculate the P-V-T properties of gases and mixtures.	L3
5. Analyze the Air standard cycles by using the thermodynamic principles.	L4

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A333T.1	3	2	1	1	-	-	-	-	-	1	-	1	1	2
20A333T.2	3	3	1	1	-	-	-	-	-	1	-	1	2	2
20A333T.3	3	2	1	1	-	-	-	-	-	1	-	1	1	2
20A333T.4	3	2	1	1	-	-	-	-	-	1	-	1	1	2
20A333T.5	3	3	1	1	-	-	-	-	-	1	-	1	3	3

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

Title of the Course Basic Electrical and Electronics Engineering lab
Category ESC
Course Code 20A235L

Year II B. Tech
Semester I Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	3	1.5

Course Objectives:

- To impart knowledge and practical exposure on various elements of electrical circuits, operational aspects of various electrical machines and electronic circuits.

List of experiments:

1. Pre-determination of efficiency of DC shunt Machine working as Motor as well as Generator(Swinburne's Test)
2. Determination of Performance Characteristics of DC Shunt Motor(Brake Test)
3. Speed Control of DC Shunt Motor(Armature Control Method and Field Control Method)
4. Determination of Performance Characteristics of Three Phase Squirrel Cage Induction Motor(Brake Test)
5. Predetermination of efficiency and regulation of Single Phase Transformer at different power factors(OC and SC test on single phase transformers)
6. Study of V-I Characteristics of PN junction Diode.
7. Determination of Ripple Factor and Regulation of Half Wave Rectifier with and without capacitive filter.
8. Determination of Ripple Factor and Regulation of Full Wave Rectifier with and without capacitive filter.
9. Study of Input and Output Characteristics of Bipolar Junction Transistor in Common Emitter Configuration.
10. Study of Cathode Ray Oscilloscope.(CRO)
11. Determination of V-I Characteristics of ZENER Diode.
12. Study of Frequency response of a single stage CE amplifier

Note: Perform any ten experiments

Course Outcomes:

At the end of the course, the student will be able to	Blooms Level of Learning
1. Apply the conceptual knowledge of various electrical machines to understand their operation and control aspects through practical investigations.	L3
2. Apply the conceptual knowledge of semiconductor devices to analyze the electronic circuits through practical investigations.	L3
3. Apply ethics and norms of the engineering practices while exercising experimental investigations.	L3
4. Function effectively as an individual and as a member in a team.	L1
5. Communicate effectively in verbal and written forms.	L1

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A235L.1	3	-	-	3	-	-	-	-	-	-	-	-	-	-
20A235L.2	3	-	-	3	-	-	-	-	-	-	-	-	-	-
20A235L.3	-	-	-	-	-	-	-	3	-	-	-	-	-	-
20A235L.4	-	-	-	-	-	-	-	-	-	-	1	-	-	-
20A235L.5	-	-	-	-	-	-	-	-	-	-	1	-	-	-

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

Title of the Course Mechanics of Solids Lab
Category PCC
Course Code 20A331L

Year II B. Tech
Semester I Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	3	1.5

Course Objectives:
- To calculate the Young Modulus, torsional strength, hardness and tensile strength of given specimens.
- To calculate impact strength of given specimens.
- To calculate the compressive strength of given specimens.
- To calculate stiffness of springs.

List of experiments
1. Direct tension test
2. Torsion test
3. Hardness test
   a) Brinell hardness test b) Rockwell hardness test
4. Test on springs
5. Compression test on wood
6. Impact test
   a) Charpy test b) Izod test
7. Shear test

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Analyse the mechanical properties of the material by using UTM testing machine	L4
2. Analyse the mechanical properties of the material by using torsion testing machine	L4
3. Calculate the hardness of the given material by using hardness testing machine.	L3
4. Calculate the modulus of rigidity of the spring using spring testing machine	L3
5. Calculate the impact strength of the given material as per the ASTM standards	L3

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A331L.1	3	3	2	3	-	-	-	1	-	-	-	-	2	2
20A331L.2	3	3	2	3	-	-	-	-	-	-	-	-	2	2
20A331L.3	3	3	2	3	-	-	-	-	-	-	-	-	2	2
20A331L.4	3	3	2	3	-	-	-	-	-	-	-	-	2	2
20A331L.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 Manufacturing Processes Lab
Category PCC
Course Code 20A332L

Year II B. Tech
Semester I Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	3	1.5

Course Objectives:

- To acquire practical knowledge on making of patterns and calculation of its allowances, preparation of mould cavity and casting
- To impart hands on practical exposure of joining of metals by welding process and its heat affected zone on weldments.
- To acquire practical knowledge of joining thin metals by spot welding, joining of metals by TIG welding and Gas welding processes.
- To acquire practical knowledge of making hallow parts like bottles by the blow moulding machine and making of plastic components by the injection moulding machine.

Metal Casting:

1. Pattern Design and making
2. Sand properties testing - Exercise -for strengths, and permeability – 2 Experiments.
3. Moulding Melting and Casting - 1 Experiment.

Welding:

1. ARC Welding Lap & Butt Joint - 2 Experiments.
2. Spot Welding - 1 Experiment.
3. TIG Welding - 1 Experiment.
4. Plasma welding and Brazing - 2 Exercises (Water Plasma Device).

Mechanical Press Working:

1. Blanking & Piercing operation and study of simple, compound and progressive press tool.
2. Hydraulic Press: Deep drawing and extrusion operation.
3. Bending and other operations.

Processing Of Plastics

1. Injection Moulding.
2. Blow Moulding.

Note: Minimum of 10 Experiments need to be performed

Course Outcomes:

A student will be able to		Blooms Level of Learning
1.	Apply methods for finding sand properties by using permeability metres, universal sand strength machines.	L5
2.	Apply pattern material specifications for calculating pattern allowances to design and make patterns.	L6
3.	Apply the process of welding operation and analyse their heat affected zone on weldments.	L4
4.	Apply the knowledge of operating the hydraulic press machine to make the different products.	L6

5. Apply knowledge of operating moulding machines for making the components by processing plastics. L6

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A332L.1	3	3	2	3	-	-	-	1	-	-	-	-	2	2
20A332L.2	3	3	3	3	-	-	-	-	1	-	-	-	2	2
20A332L.3	3	3	2	1	-	-	1	-	-	1	-	-	2	2
20A332L.4	3	3	3	3	-	-	-	-	-	-	-	1	2	2
20A332L.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 Auto CAD
Category SC
Course Code 20A334L

Year II B. Tech.
Semester I Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
1	0	2	2

Course Objectives:

- To Explore Auto CAD software for drafting and modelling.
- To instruct the utility of drafting & modeling packages in orthographic and isometric drawings.

Course Content:

Introduction to AutoCAD: Basic drawing and editing commands: line, circle, rectangle, erase, view, undo, redo, snap, object editing, moving, copying, rotating, scaling, mirroring, layers, templates, polylines, trimming, extending, stretching, fillets, arrays, dimensions. Dimensioning principles and conventional representations.
Orthographic Projections: Systems of projections, conventions and application to orthographic projections.
Isometric Projections: Principles of isometric projection- Isometric scale; Isometric views: lines, planes, figures, simple and compound solids.

List of Exercises for 2D Drafting:

1. To create a 'square' of 50mm
2. To create a 'pentagon' of 50mm as shown in figure
3. To create a 'circle' of 100mm diameter
4. To create a 'polygon' of 'n' no. of sides
5. To draw, a line diagram as shown in figure using Absolute Coordinate Method
6. Draw a line diagram as shown in figure. Use Relative Polar Coordinate Method.
7. Draw a line diagram as shown in figure. Use Donut and Rectangular Array, commands
8. Draw a diagram as shown in figure. Use Ellipse and Polar Array Commands.
9. Draw a line diagram as shown in figure. Use of Hatch, Rotate, Stretch and Scale Commands
10. Draw a diagram of conversion of views Iso to Ortho as shown in figure

List of Exercises for 3D Modelling:

1. Draw an isometric line diagram as shown in figure using grid, snap and iso-plane commands
2. To Create Iso-circles in each iso-plane using Ellipse command for the previous figure.
3. To Create Aligned dimensions
4. To generate 3D Wireframe model, using 3D Absolute Coordinate and 3D Rectangular Coordinate Methods.
5. To draw a three dimensional diagram using 3D commands such as Region, Extrude and Subtract.

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Apply a diverse skill set that is essential for drafting various two-dimensional shapes using Auto CAD commands.	L3
2. Apply the commands for drafting the conversion of views 3D to 2D orthographic views in Auto CAD software	L3
3. Create the various 3D modelling shapes using commands in Auto CAD software	L6

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A321L.1	3	2	1	1	1	-	-	-	1	-	-	1	2	2
20A321L.2	3	2	1	1	1	-	-	-	1	-	-	1	2	2
20A321L.3	3	1	3	2	1	-	-	-	1	-	-	1	2	2

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

Title of the Course Probability and Statistics
Category BSC
Course Code 20AC41T

Year II Year
Semester II Semester
Branch CE, ME, CSE, AIDS& AIML

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To describe the measures of central tendency.
- To introduce the basic concepts of probability theory.
- To elucidate probability distribution for solving problems in engineering.
- To introduce test of Hypothesis and confidence interval for a population parameter of large samples
- To explain the steps of testing of hypothesis for small samples

Unit 1 Introduction to statistics **10**

Mean - Median and Mode for ungrouped and grouped data.
Correlation - correlation coefficient – Karl Pearson's coefficient - Spearman's rank correlation.
Learning Outcomes: At the end of the unit, the student will be able to:
- Summarize the basic concepts of data science and its importance in engineering (L2)
- Analyze the data quantitatively or categorically measure of averages variability (L4)
- Adopt Correlation methods and principle of least squares, regression analysis

Unit 2 Probability **10**

Axioms of probability – addition theorem of probability - conditional probability-multiplication theorem of probability (without proof) - Baye's theorem.
Random variables - discrete and continuous - Distribution functions - Mean and Variance.
Learning Outcomes: At the end of the unit, the student will be able to:
- Define the terms trail, events, sample space, probability and laws of probability (L1)
- Make use of probabilities of events in finite sample space from experiments (L3)
- Apply Baye's theorem to real time problems (L3)
- Explain the notation of random variable, distribution functions and expected value (L2)

Unit 3 Probability distributions **8**

Binomial and Poisson distribution - fitting - normal distribution - their properties.
Learning Outcomes: At the end of the unit, the student will be able to:
- Apply binomial, passion distributions for real data to compute probabilities, theoretical frequencies (L3)
- Interpret the probabilities of normal distribution and its applications (L2)

Unit 4 Estimation and testing of hypothesis for large samples **10**

Point estimation - Interval estimation of one mean (small and large) - one Proportion (large).
Test of Hypothesis: Types of errors, one and two tailed tests, level of significance, single mean -difference of means - single proportion - difference of proportions (large).

Learning Outcomes: At the end of the unit, the student will be able to:

- Explain the concepts of estimation, interval estimation and confidence intervals (L2)
- Apply the concepts hypothesis testing for large samples (L3)

Unit 5 Testing of hypothesis for small samples **10**

Student t-distribution test for single mean - two means and paired t-test,
Testing of equality of variances (F-test) - $\chi 2$ test for goodness of fit - $\chi 2$ test for independence of attributes.

Learning Outcomes: At the end of the unit, the student will be able to:

- Apply the concepts of testing hypothesis for small samples to draw the inferences (L3)
- Apply the concepts of estimation of the goodness of fit (L3)

Prescribed Textbooks:

1. Miller and Freund's, Probability and Statistics for Engineers,7/e, Pearson, 2008.
2. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Publications, 2012.

Reference Books:

1. S. Ross, a First Course in Probability, Pearson Education India, 2002.
2. W. Feller, an Introduction to Probability Theory and its Applications, 1/e, Wiley, 1968.
3. B.V. Ramana, a text bookof Probability and Statistics, McGraw Hill, 2008.
4. T.K.V. Iyengar, B. Krishna Gandhi and others, Probability and Statistics, S. Chand, 2007.

Course Outcomes:

Upon successful completion of this course, the student will be able to	Blooms Level of Learning
1. **calculate** the correlation between two variables	L3
2. **apply** the concepts of probability theorems in stochastic process	L2
3. **apply** the probability distribution in real life problems	L3
4. **evaluate** the hypotheses of large samples	L4
5. **evaluate** the hypotheses of small samples	L3

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
20AC41T.1	3	2	1	2	-	-	-	-	-	-	-	1
20AC41T.2	3	2	1	2	-	-	-	-	-	-	-	1
20AC41T.3	3	2	1	2	-	-	-	-	-	-	-	1
20AC41T.4	3	3	1	2	-	-	-	-	-	-	-	1
20AC41T.5	3	3	1	2	-	-	-	-	-	-	-	1

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

Title of the Course Theory of Machines
Category PCC
Course Code 20A341T

Year II B. Tech
Semester II Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To enable the students in selection of appropriate mechanisms.
- To analyze the straight line motion mechanisms, steering mechanisms.
- To know the importance of gyroscope and its effects in an aeroplane & ship.
- To understand the kinematics of mechanisms and gears.
- To understand the balancing of rotating masses and reciprocating masses
- To understand the concept of vibratory systems and their analysis

Unit 1 Simple Mechanisms, Lower Pair Mechanisms 12

Simple Mechanisms: Element or Link – Classification– Kinematic pair – Types – Constrained motion – types – Degree of freedom– Grashof's law, kinematic inversions of four bar chain, single and double slider crank chains.
Lower Pair Mechanisms: Pantograph – Peaucellier mechanism – Steering gear mechanism: Ackermann, Davis**.**
Learning Outcomes: At the end of the unit, the student will be able to:
- Contrast the difference between machine and structure. (L4)
- identify different types of kinematic pairs, kinematic chains, find degrees of freedom for different mechanisms, and identify the inversions of four bar mechanism (L2)

Unit 2 Velocity & Acceleration Analysis and Gyroscope 12

Velocity Analysis: Relative velocity method- Motion of Link – construction of velocity diagrams – determination of angular velocity of points and links – four bar chain, single slider crank chain and other simple mechanisms.
Acceleration Analysis: Acceleration diagram for simple mechanisms – four bar mechanism and single slider crank chain mechanism - determination of acceleration of points and angular acceleration of links. Coriolis component of acceleration.
Gyroscope: Principle of gyroscope, gyroscopic effect in an aeroplane, Ships.
Learning Outcomes: At the end of the unit, the student will be able to:
- calculate the velocities and acceleration of various links in a mechanism (L3)
- determine instantaneous centers for a given mechanism (L3)
- apply gyroscopic concept to various moving vehicles (L3)

Unit 3 Gears and Gear trains 14

Gears and Gear trains: Friction wheels and toothed gears – types – law of gearing – condition for constant velocity ratio for transmission of motion – forms of teeth – Cycloidal and involute profiles – velocity of sliding, path of contact, arc of contact and contact ratio – phenomena of interference –Types of gear trains-simple, compound, reverted, and epicyclic–kinematics- simple problems.
Learning Outcomes: At the end of the unit, the student will be able to:
- explain the different gear profiles and parameters (L2)
- identify different types of gear trains (L2)

Unit 4 Balancing of masses 10

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

Balancing of Reciprocating masses: Primary and Secondary balancing of reciprocating masses – graphical Method – balancing of locomotives – variation of tractive force, swaying couple, hammer blow.

Learning Outcomes: At the end of the unit, the student will be able to:

- explain the importance of balancing and analyze balancing problems in rotating engines and reciprocating engines. (L4)

Unit 5 Vibrations 18

Introduction, types of vibration – natural frequency of undamped longitudinal vibrations. Transverse vibrations – simple systems (Cantilever and Simply supported beams)- Dunkerly's method, Whirling of shafts or Critical speed of Horizontal shafts. Torsional vibrations - Single rotor, and Two-rotor system.

Learning Outcomes: At the end of the unit, the student will be able to:

- Estimate natural frequency of vibratory systems (L5)
- Calculate torsional vibrations of single and tow rotor systems. (L3)

Prescribed Text Books:

1. S.S.Rattan ,Theory of Machines, 4/e, Tata Mc-Graw Hill, 2014
2. R.S.Khurmi&J.K.Gupta, Theory of Mahines, S. Chand Publications.

Reference Books:

1. J.E.Shigley, Theory of Machines and Mechanisms, 4/e, Oxford, 2014
2. P.L.Ballaney, Theory of Machines & Mechanisms, 25/e, Khanna Publishers, Delhi, 2003.
3. Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers & Distributors, 2005.
4. JagadishLal, Theory of Mechanisms and Machines, Metropolitan company pvt. Ltd.
5. R.K.Bansal, Theory of Machines, Lakshmi Publications.

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Analyze different mechanisms, inversions of different kinematic chains and mobility of mechanisms.	**L4**
2. Analyze the velocity and acceleration diagrams of simple plane mechanisms by using relative velocity method and instantaneous centre method.	**L4**
3. Analyze the phenomenon of interference in gears and velocity ratio of gear trains.	**L4**
4. Estimate the balancing masses for rotating and reciprocating members in automotive applications.	**L5**
5. Analyze the natural frequencies of mechanical systems based on governing equations	**L4**

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A341T.1	3	3	2	2	-	-	-	1	-	-	-	-	2	2
20A341T.2	3	3	2	2	-	-	-	-	-	-	-	-	1	2
20A341T.3	3	3	2	2	-	-	-	1	-	-	-	-	1	1
20A341T.4	3	3	2	3	-	-	-	-	-	-	-	-	2	1
20A341T.5	3	3	2	2	-	-	-	1	-	-	-	-	1	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 PCC
Course Code 20A342T

Year II B. Tech
Semester II Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

- To give insight knowledge on fluid statics and kinematics.
- To gain knowledge on fluid dynamics.
- To give basic understanding of Hydro Electric power plant and importance of impact of jets.
- To become familiar about different types of turbines and able to analyze the performance characteristics of various turbines.
- To be able to understand the working of power absorbing devices like pumps and able to analyze their performance characteristics.

Unit 1 Fluid Statics & Fluid Kinematics 10

Dimensions and units: physical properties of fluids- specific gravity, viscosity, Newton's law of viscosity and surface tension vapour pressure - atmospheric gauge and vacuum pressure – measurement of pressure Piezometer, U-tube and differential manometers – Buoyancy, meta-centre, metacentre height, condition of equilibrium height of a floating and submerged bodies.

Fluid Kinematics: Stream line, path line, streak lines and stream tube, classification of flows-steady & unsteady, uniform & non uniform, laminar & turbulent, rotational & irrotational flows. Equation of continuity for one dimensional flow.

Learning Outcomes: At the end of the unit, the students will be able to

- Understand the concept of fluid mechanics fundamentals like fluid statics and fluid kinematics. (L2)
- Solve problems on pressures of fluids. (L3)
- Learn the different kind of flows and flow lines. (L1)

Unit 2 Fluid Dynamics & Closed Conduit Flow 8

Surface and body forces –Euler's and Bernoulli's equations for flow along a stream line, Applications of Bernoulli's equations- Measurement of flow: Pitot tube, venturi meter and orifice meter. Momentum equation and its application on force on pipe bend. Vortex flow-Free and forced (Elementary Treatment).

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.

Learning Outcomes: At the end of the unit, the students will be able to

- Understand the fundamental equations in fluid dynamics. (L2)
- Determine the total energy of fluids and able to draw the energy lines. (L4)

Unit 3 Hydroelectric Power Stations 8

Elements of hydroelectric power station-types. Concept of pumped storage plants- storage requirements.

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.

Learning Outcomes: At the end of the unit, the students will be able to

- Learn the concept of hydro electric power plants. (L1)
- Calculate the work done and efficiency of plates at different positions. (L3)
- Calculate the force exerted by the jet on vanes at different positions. (L3)

Unit 4 Hydraulic Turbines 10

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.

Performance of Hydraulic Turbines: Geometric similarity, Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, water hammer.

Learning Outcomes: At the end of the unit, the students will be able to

- Understand the working of different turbines. (L2)
- Draw the velocity triangles and able to determine the work done and efficiency of different turbines. (L3)
- Understand the performance of different turbines. (L2)

Unit 5 Hydraulic Pumps 11

Classification, working, work done – mano metric head, losses and efficiencies, specific speed, pumps in series and parallel .performance - characteristic curves, NPSH.

Reciprocating Pumps: Working, Discharge, slip, indicator diagrams.

Learning Outcomes: Students able to

- Classify the hydraulic pumps. (L2)
- Calculate the performance of the different types of Hydraulic Pumps. (L5)

Prescribed Text Books:

1. Fluid Mechanics and Hydraulic machines by Dr. R.K.Bansal
2. Hydraulics and Fluid Mechanics including Hydraulic Machines by Dr. P.N.Modi and Dr. S.M.Seth

Reference Books:

1. D.S. Kumar, Fluid Mechanics and Fluid Power Engineering. Kotaria& Sons – 2013 edition
2. D. Rama Durgaiah, Fluid Mechanics and Machinery. New Age International, 1st edition – 2002
3. Banga& Sharma, Hydraulic Machines.Khanna Publishers.
4. James W. Dally, William E. Riley, Instrumentation for Engineering Measurements. John Wiley & Sons Inc, 2nd edition – 2010.

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Solve the problems related to fluid statics and fluid kinematics.	L3
2. Apply the energy equation for flow through various conduits.	L3
3. Analyze the Force exerted by jet on turbine blades in hydroelectric power plant.	L4
4. Analyze the performance of Hydraulic Turbines.	L4
5. Analyze the performance of Hydraulic pumps.	L4

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A342L.1	3	2	2	2	-	-	-	-	-	-	-	-	1	1
20A342L.2	3	2	2	2	-	-	-	-	-	-	-	-	1	1
20A342L.3	3	2	2	2	-	-	-	-	-	-	-	-	1	1
20A342L.4	3	3	2	3	-	-	-	-	-	-	-	-	1	1
20A342L.5	3	3	2	3	-	-	-	-	-	-	-	-	1	1

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

Title of the Course Design of Machine Elements - I
Category PCC
Course Code 20A343T

Year II B. Tech
Semester II Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To introduce the concepts of design of machine elements.
- To familiarize with fundamental approaches to failure prevention for static and dynamic loading.
- To explain the design procedures of different types of joints.
- To familiarize with various theories related the design of machine elements for different loading conditions.

Unit 1 Design for Static Loads 11

Introduction: General considerations of design, design process. Selection of Engineering materials - properties – Manufacturing considerations in the design. BIS codes of materials. Preferred numbers.

Design for static loads: Modes of failure, Design of components subjected to axial, bending, torsion and combined loads. Theories of failure for static loads.

Learning Outcomes: At the end of the unit, the student will be able to:
- Learn the basics of machine elements (L1)
- Learn the Modes of failure under static load condition. (L1)
- Design of components subjected to different loads. (L6)

Unit 2 Design for Dynamic Loads 10

Stress concentration –notch sensitivity, Types of fluctuating loads– Design for fluctuating stresses –finite life - Endurance limit - Estimation of Endurance limit – Soderberg, Goodman and Modified Goodman criterion for fatigue failure.

Learning Outcomes: At the end of the unit, the student will be able to:
- Learn the basics of stress concentration, notch sensitivity and types of fluctuating loading. (L1)
- Apply the theories of failures in designing of machine elements subjected to dynamic loads. (L3)

Unit 3 Design of Bolted and Welded joints 14

Design of Bolted Joints: Preload of bolts, various stresses induced in the bolts, torque requirement for bolt tightening, eccentrically loaded joints.

Design of Welded Joints: Stresses of lap and butt welds, eccentrically loaded welded joints. Joints subjected to bending and torsion.

Learning Outcomes: At the end of the unit, the student will be able to:
- Learn the basics of different types of joints. (L1)
- Analyze stresses induced in joints subjected to different loads. (L4)
- Design different joints subjected to combined loading. (L6)

Unit 4 Design of Keys, Cotter and Knuckle Joints 8

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.

Learning Outcomes: At the end of the unit, the student will be able to:
- Gain knowledge on keys and cotter joints. (L1)
- Design procedure for keys. (L6)
- Design procedure for cotter joints. (L6)

Unit 5 Design of Shafts and Couplings **8**

Shafts: Design of solid and hollow shafts bending, torsion, axial and combined bending and axial loading.

Shaft Couplings: Design of Rigid couplings-Muff, Split muff and Flange couplings-Flexible couplings: bushed pin type.

Learning Outcomes: At the end of the unit, the student will be able to:

- Gain knowledge on shafts and couplings. (L1)
- Design shafts under different loading conditions. (L6)
- Design of couplings under loading conditions. (L6)

Note: Allow the date book for External examination

Prescribed Text Books:

1. V B Bhandari, Design of machine elements, 4th edition, TMH, 2017. ISBN 9780070611412
2. Pandya & Shah, Machine design, 20th edition, Charotar Publishers, 2009. ISBN : 978-93-85039-10-2
3. R.S. Khurmi &J.S.Gupta, Machine Design, S.Chand Publications, 2014. ISBN-13: 978-8121905015

Reference Books:

1. J.E. Shigley, Machine design, TMH, 2015. ISBN-10: 9780073398204
2. T. Krishna Rao, Design of Machine Elements-I. I.K. International, 2010. ISBN 9789381141373
3. M.F. Spotts, Design of Machine Elements. PHI, 2006. ISBN 9788177584219
4. Kannaiah,Machine Design. Scietech, 2009. ISBN 13: 9788183711517
5. Machine Design, Schaum series, ISBN 13: 9780070255951.

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Summarize the basic concepts of design of machine elements	L2
2. Analyse the components subjected to dynamic loading	L4
3. Design bolted and welded joints subjected to given loads.	L6
4. Design keys, cotter and knuckle joints for various applications.	L6
5. Design shafts and shaft couplings for given conditions.	L6

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A343T.1	3	2	1	1	-	-	-	-	-	-	-	-	1	2
20A343T.2	3	3	2	2	-	-	-	-	-	-	-	-	-	2
20A343T.3	3	3	3	3	-	-	-	-	-	-	-	-	2	-
20A343T.4	3	3	3	3	-	-	-	-	-	-	-	-	2	-
20A343T.5	3	3	3	3	-	-	-	-	-	-	-	-	2	-

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

Title of the Course Managerial Economics & Financial Analysis
Category HSMC
Course Code 20AC45T

Year II B. Tech.
Semester II Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To understand the concepts and tools of economic analysis.
- To apply concepts in real life by developing problem solving skills there exists a relationship between Managerial Economics and Financial Accounting.
- To focus on picking up the basics of accounting such as Accounting Data and Financial Statements, which constitute the language of Business.
- The student is exposed and made familiar with journalizing, interpretation and use of Accounting Data

Unit 1 Introduction to Managerial Economics and Demand Analysis 12

Managerial Economics: Meaning and Nature, Definition, Scope, relationship with other areas.
Demand Analysis: Definition and types of Demand, Demand Determinants, and Law of Demand and its exceptions, Elasticity of Demand-types, measurement and Significance, Demand forecasting methods.
Learning Outcomes: At the end of the unit, the student will be able to:
- Remember the scope and relationship with other areas of Managerial Economics. (L1)
- Explain types of demand and demand forecasting methods. (L2)

Unit 2 Production and Cost Analysis 10

Production: Production Function, Cobb-Douglas Production function, Iso-quants and Iso-costs, MRTS, Least Cost Combination of Inputs, Laws of Returns, Internal and External Economies of Scale.
Cost Analysis: Cost concepts, Determinants of cost, cost-output relationship in short run and Long run.
Break-Even Analysis (BEA): Objectives, Assumptions, Importance, Graphical representation, Limitations, simple numerical problems.
Learning Outcomes: At the end of the unit, the student will be able to:
- Remember production function and economies of Scale. (L1)
- Differentiate cost concepts. (L4)
- Explain BEP concepts in practically. (L1)

Unit 3 Market Structure and Forms of Business Organizations 12

Markets: Perfect market, imperfect market- Monopoly, Monopolistic and Oligopoly Markets. Price-output determination in perfect competition and monopoly in long run and short run.
Forms Of Business Organizations: Definition, Forms of Business Organizations-Private Sector-sole proprietorship, Partnership, Joint Hindu family business, co-operative societies, joint stock companies.
Public Sector- Departmental organizations, public corporations, government companies.
Learning Outcomes: At the end of the unit, the student will be able to:
- State the functions of different forms of business organizations. (L1)
- Define Perfect market, imperfect market- Monopoly, Monopolistic and Oligopoly Markets(L1)

Unit 4 Capital and Capital Budgeting 10

Capital: Definition of Capital and its significance, Types of Capital, Sources of raising Capital.
Capital Budgeting: Definition, Nature and scope of capital budgeting, features of capital budgeting, Methods of Capital Budgeting: Payback Method, Accounting Rate of Return (ARR) and Net Present Value Method,

Profitability Index Method (Simple Problems).
Learning Outcomes: At the end of the unit, the student will be able to:

- Remember types and Sources of raising Capital. (L1)
- Compare and select techniques of Investment Analysis.(L4)

Unit 5 Introduction to Financial Accounting and Analysis 10

Financial Accounting: Accounting definition, Principles of accounting, Book Keeping, Journal, Ledger, Trial Balance, Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments).
Financial Analysis: Definition of Financial Analysis, Ratios and its significance- types- liquidity Ratios, turnover Ratios - solvency Ratios and profitability ratios
Learning Outcomes: At the end of the unit, the student will be able to:

- Understand Financial Accounting Concepts(L1)
- Use Financial Accounting and Analysis in practical life (L3)

Prescribed Textbooks:

1. Gupta: Managerial Economics, TMH, 2009
2. Varshney & Maheswari: Managerial Economics, Sultan Chand, 2003
3. Mehta P.L., Managerial Economics-Analysis, Problems, Cases, S Chand and Sons,New Delhi, 2001.
4. M.E.Thukaram Rao., Accounting for Managers, New Age International Publishers.
5. T.S, Reddy and Y. Hari Prasad Reddy, Accounting and Financial Management, Margham Publications.

Reference Books:

1. Ambrish Gupta, Financial Accounting for Management, Pearson Education, New Delhi.
2. H. Craig Peterson & W. Cris Lewis, Managerial Economics, PHI, 4th Edition.
3. Suma Damodaran, Managerial Economics, Oxford University Press.
4. Lipsey & Chrystel, Economics, Oxford University Press.
5. Domnick Salvatore: Managerial Economics In a Global Economy, 4th Edition,Thomson.

Course Outcomes:

At the end of the course, the student will be able to	Blooms Level of Learning
1. Predict the demand for a product or product mix of a company and to analyze various factors influencing demand elasticity.	L1
2. Assess the cost behavior, costs useful for managerial decision making and determine Break Even Point (BEP) of an enterprise.	L2
3. Differentiate private and public sector undertakings in their promotion, incorporation, regulation, administration, legal formalities and existence.	L2
4. List features, steps, merits, uses & limitations of Pay Back, ARR, NPV, PI and IRR methods of Capital Budgeting and compute rank of the projects.	L3
5. Analyze, interpret and comment on the financial statements of a business enterprise by using liquidity leverage, coverage and turnover & profitability ratios.	L3 & L4

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20AC45T.1	2	-	-	-	2	-	2	-	-	-	-	-	-	-
20AC45T.2	-	3	-	-	-	-	-	-	-	-	-	-	-	-
20AC45T.3	2	-	1	-	2	-	-	-	-	-	2	-	-	-
20AC45T.4	-	-	-	-	-	-	-	-	-	-	3	-	-	-
20AC45T.5	2	2	-	-	-	-	2	-	-	-	-	-	-	-

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

Title of the Course Theory of Machines Lab
Category PCC
Course Code 20A341L

Year II B. Tech.
Semester II Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	3	1.5

Course Objectives:
- To understand the fundamentals of the theory of kinematics and dynamics of machines.
- To understand techniques for studying motion of machines and their components.
- To understand the vibrational behavior of systems, principles of gyroscope and governors.

List of Experiments:
1. To study various types of Links, Pairs, Chain and Mechanism
2. To study inversion of four Bar Mechanism, Single Slider Crank Chain Mechanism and Double Slider Crank Chain Mechanism.
3. To study various types of steering mechanisms
4. To study various kinds of belt drives
5. To study Different types of Gears
6. Forced vibrations of a spring-mass system
7. Determination of Torsional natural frequency of single and two rotor system
8. Study of gyroscopic effect and couple
9. Determination of characteristic curves of Watt Governor
10. Determination of damped natural frequency of Torsional vibrating system
11. Determination of characteristic curves of Proell Governor
12. To study various types of Cam and Follower arrangement

Note: Any 10 experiments need to be performed

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Analyze the different inversions of mechanisms and steering mechanisms and belt drives	L4
2. Apply the principle of law of gearing for different types of gears	L3
3. Apply the principles of gyroscopic effects and stabilization on various transport vehicles	L3
4. Analyze the characteristics of governors	L4
5. Analyze the vibration parameters of different systems	L4

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A341L.1	3	3	2	3	-	-	-	1	-	-	-	-	1	-
20A341L.2	3	3	2	3	-	-	-	-	-	-	-	-	1	-
20A341L.3	3	3	2	3	-	-	-	-	-	-	-	-	2	-
20A341L.4	3	3	2	3	-	-	-	-	-	-	-	-	2	-
20A341L.5	3	3	2	3	-	-	-	-	-	-	-	1	2	-

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

Title of the Course Fluid Mechanics and Hydraulic Machines Lab
Category PCC
Course Code 20A342L

Year II B. Tech
Semester II Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	3	1.5

Course Objectives:

- To provide knowledge in verifying Bernoulli's Theorem.
- To impact knowledge in fluid flow measuring devices like Venturimeter & Orifice meter.
- To understand frictional losses in pipes with various diameters.
- To acquire knowledge about various hydraulic machines like centrifugal pump, reciprocating pump, Pelton wheel, Francis turbine, Kaplan turbine etc.
- To understand impact of jet on vanes like flat vane & semi circular vane.
- To develop the students in learning the various principles of fluid mechanics & hydraulic machines, so that they can characterize, transform and use the knowledge gained in solving the various related engineering problems.

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.

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Apply the Bernoulli's Theorem for different flow channels.	L3
2. Calculate the flow rate of fluids by the instruments like Venturimeter and Orificemeter.	L3
3. Calculate the frictional losses in pipes.	L3
4. Evaluate impact of jet on vanes like Flat vane & Semi-circular vane.	L5
5. Evaluate different performance parameters of hydraulic machines	L5

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A342L.1	3	2	2	2	-	-	-	-	1	-	-	-	2	2
20A342L.2	3	2	2	2	-	-	-	-	1	-	-	-	2	2
20A342L.3	3	2	2	2	-	-	-	-	1	-	-	-	2	2
20A342L.4	3	3	2	3	-	-	-	-	1	-	-	1	2	2
20A342L.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 Machine Drawing lab
Category PCC
Course Code 20A344L

Year II B. Tech.
Semester II Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	3	1.5

Course Objectives:
- To understand drawing practice as per BIS conventions for mechanical elements.
- To familiarize the students bolted joints and riveted joints.
- To prepare assembly drawings.

List of Exercises:

Part – I: Exercises on conventional drawings of machine elements and simple parts
1. Conventional representation of materials and machine components.
2. Different types of thread profiles-Square, Metric, ACME, Worm.
3. Hexagonal and square headed bolts and nuts.
4. Riveted joints for plates.

Part – II: Exercises on conventional assembly drawings of any 5 assembly drawing from the following.
1. Assembly of Knuckle Joint
2. Assembly of Screw Jack
3. Assembly of Plummer Block
4. Assembly of Simple Eccentric
5. Assembly of Stuffing Box
6. Assembly of Steam engine Crosshead

Prescribed Textbooks:

1. K.L.Narayana, P.Kannaiah, A text book on Machine Drawing, SciTech Publications, 2014. ISBN-13: 978-8122440546, ISBN-10: 8122440541- 2014
2. N.D.Bhatt, Machine Drawing, Charotar, 50/e, ISBN: 9789385039232, 2014.
3. Dhawan, Machine Drawing. S.Chand Publications. 2015, ISBN: 8121908248, 9788121908245

Reference Books:

1. P.S.Gill, Machine Drawing, S K Kataria& Sons. 2013. ISBN: 9789350144169, 9350144166
2. Luzzader, Machine Drawing 11th edition, ISBN 13: 9780132844307. Prentice-Hall of India, 1995
3. K.C.John, Textbook of Machine Drawing. PHI learning, 2009 ISBN 9788120337213

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Describe the conventional representation of materials and machine components	L2
2. Summarize different types of bolts, nuts & screw threads	L2
3. Apply the fundamentals of riveted joints and couplings.	L3
4. Analyze the components of assembly drawings	L4

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A344L.1	2	1	1	1	-	-	-	1	1	1	-	1	1	1
20A344L.2	2	1	1	1	-	-	-	1	1	1	-	1	1	-
20A344L.3	3	2	2	1	-	-	-	1	1	1	-	-	1	-
20A344L.4	3	3	2	2	-	-	-	1	1	1	-	1	1	1

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

Title of the Course	Life Sciences for Engineers
Category	MC
Course Code	20AC44T
Year	II B. Tech.
Semester	II Semester
Branch	EEE, ECE, ME

Lecture Hours	Tutorial Hours	Practical	Credits
3	0	0	0

Course Objectives:

- To introduce the origin of life.
- To provide the basis for classification of living organisms.
- To describe the transfer of genetic information**.**
- To introduce the techniques used for modification of living organisms**.**
- To describe the applications of biomaterials

Unit 1 The Living World **8**

Nature and Scope of Biology,Origin and Evolution of Life, Systematics, Classification of living organisms, Viruses, Prokaryotes and Eukaryotes.

Learning Outcomes: At the end of the unit, the student will be able to:

- Explain the concept of origin of life. (L2)
- Classify the different types of organisms. (L2)

Unit 2 Cell and Cell Division **8**

Plant cell and Animal cell, Structure of the cell: Nucleus, Ribosome's. Molecules of the cell: Nucleic acids, Cell Cycle: Mitosis, Meiosis.

Learning Outcomes: At the end of the unit, the student will be able to:

- Discusses the structure and function of the cell. (L2)
- Differentiate the stages of cell division. (L2)

Unit 3 Physiology of Plants and Animals **12**

Photosynthesis, Respiration: Types of respirations, Glycolysis, TCA Cycle, Nervous system,Endocrine system in animals.

Learning Outcomes: At the end of the unit, the student will be able to:

- Describe the importance of photosynthesis and respiration process. (L1)
- Explain the vital role of Co-ordinate system in animals. (L2)

Unit 4 Genetics **12**

Genetic basis of Inheritance, Mendel's laws, Human genetic disorders: Hemophilia, Colour Blindness, Autosomal abnormalities: Down's, Patau's and Edward's syndromes. Genetic Engineering: Recombinant vaccines, Basis of DNA finger Printing, Animal cloning.

Learning Outcomes: At the end of the unit, the student will be able to:

- Define the gene and its importance in heredity. (L1)
- Describe the effects of gene mutations. (L2)
- Apply the concept of genetic engineering in development of vaccines. (L3)

Unit 5 Biology in Human Welfare **8**

Parasitism, Plasmodium vivax, Wuchereria bancrofti, Health and Disease: Bacterial, Viral diseases:HIV, Biomedical technologies: X-Ray, CT- Scan, MRI- Scan, PET-Scan.

Learning Outcomes :At the end of the unit, the student will be able to:

- Identify the causes of pathogenic diseases and effects on human health. (L1)
- Explain the importance of biomedical techniques. (L2)

Prescribed Textbooks

1. N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A global approach", Pearson Education Ltd, 2018.
2. Arthur T Johnson, Biology for Engineers, CRC press, 2011

Reference Books

1. Alberts Et.Al. The molecular biology of the cell, 6/e, Garland Science, 2014
2. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, "Outlines of Biochemistry", John Wiley and Sons, 2009.
3. John Enderle and Joseph Bronzino Introduction to Biomedical Engineering, 3/e, 2012
4. PS Verma | VK Agarwal.Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S. Chand Publishing, 2004.

Course Outcomes:

At the end of the course, the student will be able to	Blooms Level of Learning
1. Explain stages of Systematics.	L2
2. Summarize application of biomolecules.	L2
3. Identify DNA as a genetic material in the molecular basis of information transfer.	L3
4. Analyze biological processes at the Genetic Engineering.	L4
5. Identify the potential of recombinant DNA technology.	L3

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
20AC44T.1	2	2	-	-	-	2	-	-	-	-	-	2	-	-
20AC44T.2	2	2	-	-	-	2	-	-	-	-	-	2	-	-
20AC44T.3	3	3	-	-	-	3	-	-	-	-	-	3	-	-
20AC44T.4	3	3	-	-	-	3	-	-	-	-	-	3	-	-
20AC44T.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
Category SC
Course Code 20A545L

Year II B. Tech.
Semester II Semester
Branch EEE, ME and ECE

Lecture Hours	Tutorial Hours	Practical	Credits
1	0	2	2

Course Objectives:
- To learn basics of computational problem solving, python programming and basic control structures.
- To understand python programming basic constructs like lists, dictionaries, sets and functions
- To apply module design and usage of text files in python programming

Module 1 **Theory Hours: 4, Practice sessions: 6**
Introduction to python programming language, literals, variables and identifiers, operators, expressions and data types. Control Structures: Boolean expressions, selection control, and iterative control.
Learning Outcomes: At the end of the unit, the student will be able to
- Understand the importance of python programming (L2)
- remember control structures and use them in the python programs (L2)

Module 2 **Theory Hours: 3, Practice sessions: 06**
Lists: List structures, lists in python, iterating over lists in python, more on python lists. Dictionaries and sets, tuple.
Learning Outcomes: At the end of the unit, the student will be able to
- Construct python programs using list type (L3)
- Demonstrate programs on dictionaries and sets, tuple. (L3)

Module 3 **Theory Hours: 4, Practice sessions: 06**
Functions: Program routines, more on functions, Module Design: Modules, Top-Down design, python modules
Learning Outcomes: At the end of the unit, the student will be able to
- illustrate the importance of module and use them (L3)
- infer programs on text files (L4)

Module 4 **Theory Hours: 3, Practice sessions: 06**
Text Files: Text File, Using Text files, string processing, exception handling
Learning Outcomes: At the end of the unit, the student will be able to
- describe about text files and use in python programs (L3)
- analyze string processing and exception handling in programming (L4)

Module 5 **Theory Hours: 4, Practice sessions: 06**
Introduction to Object oriented programming: class, three fundamental features of object oriented programming, encapsulation-what is encapsulation, defining classes in python. Inheritance: subtypes, defining subclasses in python, Polymorphism: use of polymorphism.
Learning Outcomes: At the end of the unit, the student will be able to
- describe the fundamentals of object oriented programming (L3)
- reframe programs using class and object in python programming(L5)

Prescribed Text Books:
1. Introduction to Computer Science Using Python: A Computational Problem-Solving Focus, Charles Dierbach.

Reference Books:

1. Python Programming using problem solving approach, ReemaThareja, Oxford University press
2. Python Programming: An Introduction to Computer Science, John Zelle, Franklin,Beedle& Associates Inc.,3rd Edition
3. Think Python: How to think like a computer Scientist, Allen Downey 2nd Edition O'Reilly Publications.

Course Outcomes:

At the end of the course student will be able to	Blooms Level of Learning
1. Understand computational problem solving and basic elements of python programming.	L2
2. Construct python programming basic constructs like lists, tuple, dictionaries, and sets.	L3
3. Implement string processing and exception handling in programming	L5
4. Analyze string processing and exception handling in programming.	L4
5. Reframe programs using class and object in python programming.	L5

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A545L.1	3	-	3	-	-	-	-	-	-	-	-	3	-	-
20A545L.2	3	-	3	3	-	-	-	-	-	-	-	3	-	-
20A545L.3	3	-	3	3	-	-	-	-	-	-	-	3	-	-
20A545L.4	3	-	3	3	-	-	-	-	-	-	-	3	-	-
20A545L.5	3	-	3	3	-	-	-	-	-	-	-	3	-	-

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

Title of the Course Applied Thermodynamics
Category PCC
Course Code 20A351T

Year III B. Tech
Semester I Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To familiarize about the Rankine cycle used for steam power plant & steam boilers.
- To impart knowledge on the working of nozzles and condensers used in steam power plants.
- To impart knowledge on the working of steam turbines.
- To understand the principle and operation of gas turbines and jet propulsions.
- To acquire knowledge on different Refrigeration & Air conditioning systems

Unit 1 Introduction to steam power plant 9

Rankine cycle - Schematic layout, Thermodynamic Analysis, Concept of Mean Temperature of Heat addition, Methods to improve cycle performance – Regeneration – reheating.
Boilers: Classification based on Working principles - Fire tube boilers, water tube boilers – High pressure Boilers
Learning Outcomes: At the end of the unit, the student will be able to:
- Explain the concepts of vapour power cycle used in steam power plant. (L2)
- Classify the Boilers and to know their working principle. (L4)

Unit 2 Steam Nozzles & Condensers 9

Steam Nozzles: Function of nozzle – applications - types, Flow through nozzles, thermodynamic analysis – assumptions -velocity of nozzle at exit- Ideal and actual expansion in nozzle, velocity coefficient, condition for maximum discharge, critical pressure ratio.
Condensers: Requirements of steam condensing plant, rare fraction – Classification of condensers – working principle of different types – vacuum efficiency and condenser efficiency – air leakage, sources and its effects.
Learning Outcomes: At the end of the unit, the student will be able to:
- Compare the performance of nozzles, used in turbines. (L2)
- Classify the condensers and their application. (L4)

Unit 3 Steam Turbines 8

Classification of steam turbines -impulse turbine and reaction turbine -compounding in turbines - velocity diagrams in impulse and reaction turbines, efficiency, degree of reaction - governing of turbines.
Learning Outcomes: At the end of the unit, the student will be able to:
- Classify steam turbines and applications. (L4)
- Analyse the performance of steam turbines under different operating conditions. (L5)

Unit 4 Gas Turbines & Jet Propulsion 8

Gas Turbines: Simple gas turbine plant, Brayton cycle, closed cycle and open cycle for gas turbines, actual cycle. Methods to improve performance: regeneration, intercooling and reheating.
Introduction to jet propulsion: working principle of ramjet, turbojet, turboprop and pulse jet engines, Thrust, Thrust Power and Propulsion Efficiency.
Learning Outcomes: At the end of the unit, the student will be able to:
- Evaluate the cycles used in gas turbines. (L5)
- Outline the jet propulsion system (L2)

Unit 5 Refrigeration & Air Conditioning 12

Refrigeration: Bell-Coleman cycle - Unit of refrigeration and C.O.P. vapour compression cycle, effect of sub cooling and super heating- numerical Problems.

Vapour Absorption Refrigeration System: Description and working of NH_3- water system, Li Br –water (Two shell & Four shell) System, Principle of operation of three Fluid absorption systems, properties of common refrigerants.

Principles of Psychrometry and Air Conditioning: Psychrometric properties & processes and air conditioning systems - Summer, Winter & year round air conditioning systems.

Learning Outcomes: At the end of the unit, the student will be able to:

- Outline the operation of refrigerators. (L2)
- Identify different refrigerants and applications.(L3)
- Use properties of moist air in calculations for air-conditioning system. (L3)

Prescribed Text Books:

1. Thermal Engineering. Mahesh M Rathore, TMH.1st Ed.2010 - ISBN-13: 978-0070681132
2. Thermal Engineering, R.K. Rajput, S.Chand & Co., 6th edition, Laxmi publications, 2010. ISBN-9788131808047.
3. Thermal Engineering, M.L.Mathur and F.S.Mehta, 4th edition, Jain brothers,2016, ISBN-13 : 978-8183600781
4. A Course in Refrigeration and Air conditioning, SC Arora & Domkundwar, Dhanpat Rai & Co 2015. ISBN-13: 978-1111644475.
5. Gas Turbines, V. Ganesan, TMH Publishers, New Delhi.3rd Ed 2017, ISBN: 978-0-07-068192-7.

Reference Books:

1. Thermodynamics: An Engineering Approach, Cengal .Y.A and Boles M.A, 5/e, McGraw-Hill,8th Ed 2017, ISBN-13 : 978-9339221652.
2. Thermal Engineering. R. S Khurmi & JS Gupta, S.Chand. 16th Ed.2020. ISBN 9788121925730.
3. Gas Turbine & Jet Rocket Propulsion, Mathur ML, Standard Publishers Distributors, 2010, ISBN-13 : 978-8180140624
4. Basic Refrigeration and Air Conditioning, Ananthanarayanan, TMH 3rd Edition. 2013. ISBN: 9781259062704.
5. A text book of Refrigeration and Air Conditioning by R.K Rajput , S K Kataria & sons, 4th Edition 2013. ISBN-13 : 978-9350142554.

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Evaluate the performance of steam power plants.	L5
2. Explain the functions of steam nozzles and condensers.	L2
3. Evaluate the performance of Steam Turbines.	L5
4. Summarize the concepts of gas turbines and Jet propulsions.	L2
5. Evaluate the performance of different refrigeration and air conditioning systems.	L5

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A351L.1	3	3	2	3	-	-	-	-	-	-	-	-	2	2
20A351L.2	2	2	2	2	-	-	-	-	-	-	-	-	2	2
20A351L.3	3	3	2	3	-	-	-	-	-	-	-	-	2	2
20A351L.4	2	2	2	2	-	-	-	-	-	-	-	-	2	2
20A351L.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 Machining Processes
Category PCC
Course Code 20A352T

Year III B. Tech
Semester I Semester
Branch **ME**

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To explain parameters in the metal cutting operation.
- To relate tool wear and tool life and the variables that controls them.
- To calculate machining times for different machining processes.
- To teach various metal cutting processes. (Lathe, drilling, boring shaping, slotting, milling and grinding).
- To familiarize the principles of jigs and fixtures and types of clamping and work holding devices.

Unit 1 Theory of Metal Cutting **12**

Introduction to orthogonal and oblique cutting, Merchant Circle Diagram, Mechanics of Machining, types of chip, single point, Nomenclature (ORS & ASA) and multi-point cutting tools, forces in turning process; Cutting tool materials, tool wear, tool life and cutting fluids

Learning Outcomes: At the end of the unit, the student will be able to:
- Classify various types of chips, cutting tool materials and cutting fluids. (L2)
- Solve problems on cutting force, speed and feed finding techniques during machining. (L3)
- Describe cutting processes and variables. (L2)

Unit 2 Turning Machines & Operations **12**

Centre lathe, constructional features, specifications, lathe operations – taper turning methods, thread cutting – calculations of machining time. Capstan and turret lathes-tool layout – Automatic lathes: semi-automatic – single spindle: Swiss type, automatic screw type – multi spindle

Learning Outcomes: At the end of the unit, the student will be able to:
- List the specifications for various types of lathes. (L1)
- Determine cutting speeds for different machining operations. (L3)

Unit 3 Reciprocating and Rotary Based Machine Tools **10**

Shaper, Planer and Slotter- Construction, Types and operations.
Drilling machines -construction, specifications, types, and operations performed – Reaming and Boring
Milling machines: types, working principle, Dividing head and Index, methods of indexing – Simple Indexing, Milling cutters types

Learning Outcomes: At the end of the unit, the student will be able to:
- Recognize the parts of milling, shaping, slotting and planning machine. (L1)
- Compare tool geometry for milling, shaping, slotting and planning operations. (L4)
- Identify parts of drilling. (L1)

Unit 4 Abrasive Processes and Broaching **10**

Grinding wheel – Specification of grinding wheel and selection, types of grinding process– cylindrical grinding, surface grinding, Center less grinding, internal grinding- micro finishing methods - Typical applications – concepts of surface integrity.
Broaching machines: broach construction, types – push, pull broach.
Super finishing: Honing (Types and Construction), Lapping, Buffing, Burnishing and polishing process.

Learning Outcomes: At the end of the unit, the student will be able to:

- Understand the basic principles of abrasive processes. (L2)
- Explain the designation of the grinding wheel and the significance of the various codes. (L2)
- Explain various types of abrasive processes such as honing and lapping for final finishing operation. (L2)

Unit 5 Jigs & Fixtures 6

Materials used in Jigs & Fixtures, Principles of work holding, design of Jigs and fixtures and uses, Classification of Jigs & Fixtures – Principles of location and clamping– Types of clamping - Typical examples of jigs and fixtures.

Learning Outcomes: At the end of the unit, the student will be able to:

- Classify various types of jigs and fixtures. (L2)
- Identify various types of work and tool holding devices. (L2)
- Explain the design principles of jigs and fixtures. (L2)

Prescribed Text Books:

1. P.N. Rao, Manufacturing Technology: Metal Cutting and Machine Tools, (Volume 2), 3/e, Tata McGraw-Hill Education, 2013 ISBN-13 : 978-0074638439
2. R.K. Jain and S.C. Gupta, Production Technology, 17/e, Khanna Publishers, 2012. ISBN:978-81-7409-099-7

Reference Books:

1. Kalpakzian S and Schmid SR, Manufacturing Engineering and Technology, 7/e, Pearson, 2018. ISBN-13 : 978-9332587908
2. Milton C.Shaw , Metal Cutting Principles, 2/e, Oxford, 2012. 2012ISBN: 9780195142068
3. V.K.Jain, Advanced Machining Process,12/e, Allied Publications, 2010. ISBN 11, 577–583
4. Halmi A Yousuf& Hassan, , Machine Technology: Machine Tools and Operations, CRC Press Taylor and Francis Group, 2008. ISBN-13 : 978-0136353010.

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Evaluate the cutting process parameters in machining process	L5
2. Summarize the types of lathes and their operations performed on cylindrical parts	L2
3. Demonstrate the different types of Reciprocating Machines and operating procedures for machining the plain surfaces	L2
4. Summarize the types of Grinding and Super finishing processes	L2
5. Use the different types of jigs and fixtures	L3

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A352T.1	3	3	2	3	-	-	-	-	-	-	-	-	3	3
20A352T.2	3	3	2	2	-	-	-	-	-	-	-	-	3	3
20A352T.3	3	3	2	2	-	-	-	-	-	-	-	-	3	3
20A352T.4	3	3	2	3	-	-	-	-	-	-	-	-	3	3
20A352T.5	3	3	2	3	-	-	-	-	-	-	-	-	3	3

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

Title of the Course Design of Machine Elements - II
Category PCC
Course Code 20A353T

Year III B. Tech
Semester I Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To learn the basic concepts of design of power transmission elements & various types of springs.
- To understand the design concepts of sliding contact bearings
- To understand the design concepts of rolling contact bearings
- To understand the design concepts of various types of gears
- To help the students in applying design concepts of IC engine parts like Pistons, connecting rod and crank shaft.

Unit 1 Design of Flat & V belt drives and Springs 12

Flat & V belt drives: Design of Flat belt drives, Design of V-belt drives.
Springs: Introduction- types of Springs -design of helical springs (tension, compression & torsion) - Leaf springs.
Learning Outcomes: At the end of the unit, the student will be able to:
- learn the basic concepts of springs and belt drives (L3)
- design the belt drives under different conditions (L4)
- design and analyze the stresses induced in springs (L4)

Unit 2 Sliding Contact Bearings 10

Introduction, Types of Journal bearings – Lubrication – Petroff's equation, McKee's investigation, nomenclature, Bearing Modulus –bearing materials – journal bearing design – Cap design.
Learning Outcomes: At the end of the unit, the student will be able to:
- Learn the different types of journal bearings (L2)
- Design of Journal bearing (L6)

Unit 3 Rolling Contact Bearings: **10**

Types of rolling contact bearings – Selection of bearing type, Static loading of ball & roller bearings Stribeck's equation, Dynamic load carrying capacity, equivalent bearing load, selection of bearing life, design for cyclic loads and speeds, bearing with a probability of survival other than 90%.
Learning Outcomes: At the end of the unit, the student will be able to:
- Identify the different types of Rolling contact journal bearing (L2)
- Design of Rolling contact Journal bearing subjected to different loads (L6)

Unit 4 Design of Spur & Helical Gears 12

Spur Gears: Introduction, classification of gears, terminology of spur gears Force analysis, beam strength of gear tooth, effective load on gear tooth, Design analysis of spur gears – Estimation of module and face width, check for plastic deformation. Check for dynamic and wear considerations for spur gears.
Helical Gears: Introduction, terminology of helical gears, Force analysis, beam strength of gear tooth, effective load on gear tooth, Design analysis of helical gears – Estimation of module and face width, check for plastic deformation. Check for dynamic and wear considerations for helical gears**.**
Learning Outcomes: At the end of the unit, the student will be able to:
- learn the concepts of gear (L1)
- analyze the forces induced in the gears (L4)
- design the gear for different loading condition (L6)

Unit 5 Design of IC engine components **12**

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.
Learning Outcomes: At the end of the unit, the student will be able to:

- Learn the basics concepts of IC engine parts (L1)
- analyze forces induced in IC Engine parts (L4)
- design the different IC engine parts subjected to different loads (L6)

Prescribed Text Books:

1. V B Bhandari, Design of machine elements, 4th edition, TMH, 2017. ISBN 9780070611412
2. R.S. Khurmi&J.S.Gupta, Machine Design, S.Chand Publications, 2014. ISBN-13: 978-8121905015
3. Kannaiah,Machine Design. Scietech, 2009. ISBN 13: 9788183711517

Reference Books:

1. J.E. Shigley, Machine design, TMH, 2015. ISBN-10: 9780073398204
2. T. Krishna Rao, Design of Machine Elements-I. I.K. International, 2010. ISBN 9789381141373
3. Pandya & Shah, Machine design, 20th edition, Charotar Publishers, 2009. ISBN: 978-93-85039-10-2
4. Data Books: (i) Balaveerareddy and Mahadevan

Tables/Codes: Design data books are to be supplied in examination

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Design the leaf springs, flat belt drives and V belt drives for the given applications.	L6
2. Design the sliding contact bearings for various engineering applications.	L6
3. Design the different types of rolling contact bearings subjected to different loads.	L6
4. Design the spur and helical gears for different input conditions.	L6
5. Design the Internal Combustion engine parts like piston, connecting rod, crankshaft for the given gas load.	L6

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A353T.1	3	3	3	3	-	-	-	-	-	-	-	-	1	1
20A353T.2	3	3	3	3	-	-	-	1	-	-	-	-	1	1
20A353T.3	3	3	3	3	-	-	-	-	-	-	-	1	1	1
20A353T.4	3	3	3	3	-	-	-	-	-	-	-	-	1	1
20A353T.5	3	3	3	3	-	-	-	1	-	-	-	-	1	1

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

Title of the Course Water Resources and Harvesting
Category OEC
Course Code 20A15ET

Year III Year
Semester I Semester
Branch ME,EEE & ECE

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To familiarize students about the occupational hazards and remedial measures to say safe at work place.
- To enable students to learn the basics of the environmental management in order to make them job ready.

Unit 1 Water and waste water **9**
Introduction – Water resources (Surface and subsurface) and its significance – Water: distribution on earth, Water quality and standards; Water pollution: Types, sources and impacts – Surface water, ground water pollution, Wastewater: Domestic – black and grey water; industrial and agricultural wastewater. Waste water treatment – Methods.
Learning Outcomes: At the end of the unit, the student will be able to learn
- Know the significance of surface and sub surface water resources. (L1)
- Know the impact of waste water on domestic, agricultural and industrial. (L1)

Unit 2 Water Resource Management **10**
Hydrological cycle, Precipitation Evaporation and condensation, Groundwater - Classification, Aquifers – types and management. Soil conservation and water recharge. Ground water management and key factors.
Learning Outcomes: At the end of the unit, the student will be able to
- Learn the elements in hydrological cycle (L1)
- Recharge and preserve subsurface water. (L1)

Unit 3 Rainwater Harvesting **10**
Conservation and Harvesting of rain. Types and design of water harvesting structures; catchments – type and methods. Rainwater harvesting-Catchment and roof top harvesting, Check dams, Artificial recharge, Farm ponds, Percolation tanks, traditional rain water harvesting structures
Learning Outcomes: At the end of the unit, the student will be able to
- Know the difficulties in design of water harvesting structures. (L1)
- Know the rain water harvesting techniques. (L1)

Unit 4 Watershed Management **8**
Definition, watershed delineation; watershed development: concepts, objectives and need- Integrated and multidisciplinary approach for watershed management- Characteristics of watershed: size, shape, physiography, slope, climate, drainage, land use, vegetation, geology and soils, hydrology and hydrogeology- Socio-economic characteristics.
Learning Outcomes: At the end of the unit, the student will be able to
- Know Multidisciplinary approaches and characteristics for water shed managements. (L1)
- Know the hydrology, hydrogeology and socio economic characteristics. (L1)

Unit 5 Basin Management **12**
Definition, Factors affecting basin management- Preparation of land drainage schemes-Types and design of surface drainage -Controlling of soil erosion and soil characteristics; Estimation of soil loss due to erosion. Water

availability assessment – Surface water and groundwater-Water demand assessment: municipal, industrial, agricultural and environmental-Water allocation - Principles and policies, State and National water conflicts and management.

Learning Outcomes: At the end of the unit, the student will be able to

- Know the schemes of various drainage systems (L1)
- Assess the availability of water and water demand. (L2)

Prescribed Text Books:

1. Irrigation and Water Resources Engineering- G.L. Asawa, New age international Publisher
2. Watershed management and Field manuals -FAO
3. Watershed management in India, J.V.S. Moorthy, Wiley India.
4. Hydrology & Water Resources Engg., S K Garg, Khanna Pub., Delhi.

Reference Books:

1. Hydraulics &Fluid Dynamics-P.M.Modi and S.M.Seth,Standard book house, Delhi
2. Applied Hydrology - Chow V T., McGraw-Hill, Inc
3. Irrigation, Water Resources & Water Power Engg., P N Modi, New Age Publishers.

Course Outcomes:

At the end of the course, the student will be able to	Blooms Level of Learning
1. Know about various sustainable materials	L4
2. Understand the concept of sustainable buildings	L3
3. Learn to maximize the efficacy of existing processes.	L4
4. Understand the importance of HVAC	L4
5. Understand the importance of using renewable materials and ambient air quality.	L3

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
20A15ET.1	-	1	2	-	-	-	3	-	-	-	-	1	-	-
20A15ET.2	-	1	1	-	-	-	1	-	-	-	-	1	-	-
20A15ET.3	-	1	1	-	-	-	1	-	-	-	-	1	-	-
20A15ET.4	-	1	1	-	-	-	1	-	-	-	-	1	-	-
20A15ET.5	-	1	1	-	-	-	1	-	-	-	-	1	-	-

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

Title of the Course Disaster Management
Category OEC
Course Code 20A15FT

Year III Year
Semester I Semester
Branch ME,EEE & ECE

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To enable the learner to understand how disasters occur and keep them aware about different disasters.
- To enable students to plan measures against different disasters.
- To make students familiar with the topics of crisis, disaster and emergency management techniques.

Unit 1 Introduction to disasters and Natural Disasters 9
Introduction to disasters and Natural Disasters, Definitions Of Risk, Vulnerability and Disasters and Their Relationship; Classification of Disasters; Natural Disasters; Environmental; Floods: Urban Floods; Flash Floods; Cyclones; Earthquakes; Landslides; Avalanches; Mudslides, Impacts of Natural Disasters; Important Case Studies (2006 Tsunami, Covid 19 etc.,).
Learning Outcomes: At the end of the unit, the student will be able to learn
- Various natural disasters and what their preconditions. (L1)
- Impacts of different natural disasters on different aspects of human life. (L1)

Unit 2 Manmade Disaster 10
Classification of Manmade Disasters: Preconditions Various Manmade Disasters; Impacts of Manmade Disasters; Important Case Studies (Bhopal Gas Tragedy, Fukushima Disaster, Ennore Oil Spill, Vizag Styrene Leak).
Learning Outcomes: At the end of the unit, the student will be able to
- Discern between natural and manmade disasters (L1)
- Learn about cascading disasters (L1)
- Find the reasons why manmade disasters happen and how to avert them. (L1)

Unit 3 Crisis and Emergency Management 8
Definition, scope and methods of - Crisis Management, Emergency management; Importance of emergency management.
Learning Outcomes: At the end of the unit, the student will be able to
- Understand the importance of crisis and emergency management. (L4)
- Understand how evacuation drills are conducted and their importance. (L4)
- Devise plans for industrial monitoring and analyse various real-time disasters. (L1)

Unit 4 Disaster Risk Reduction 12
Global and national disaster trends, Common Disasters in India, Disaster management cycle–its phases; prevention, mitigation, preparedness, relief and recovery; structural and non structural safety and rehabilitation measures; Roles and responsibilities of government. DRR programs in India and the activities of National Disaster Management Authority
Learning Outcomes: At the end of the unit, the student will be able to
- Understand various phases in disaster management and importance of decision making (L3)
- Learn relating risk, vulnerability and capacity. (L3)
- Know various stages involved in disaster management and various disaster management authorities.(L3)

Unit 5 Aftermath Disaster **8**

Post disaster situations; Rebuilding – Concepts, Types, Guiding Principles of Rehabilitation and Reconstruction Post-Disaster Story: The Tsunami Aftermath.

Learning Outcomes: At the end of the unit, the student will be able to

- Understand and analyze and understand dealing with post disaster situations. (L3)
- Learn the importance of incorporating environment in the design. (L3)
- Methods and strategies involved in rebuilding the society. (L3)

Prescribed Text Books:

1. Disaster Management, Dr. Mrinalini Pandey, 2014, Wiley India.
2. Introduction to Emergency Management, Bullock et al., 2020, Elsevier.
3. Techniques for Disaster Risk Management and Mitigation, Mohanty et al., 2020, Wiley.

Reference Books:

1. Harsh K Gupta, Disaster Management, 2003, Universities Press.
2. Larry Collins, Disaster Management and Preparedness, 2001, Lewis Publishers.
3. Li et al., Geomatics Solutions for Disaster Management, 2007, Springer International.

Course Outcomes:

At the end of the course, the student will be able to	Blooms Level of Learning
1. Know about various natural disasters and what their preconditions and impacts of different natural disasters on human life.	L1
2. Learn about cascading disasters and to find the reasons why manmade disasters happen and how to avert them.	L1, L4
3. Understand how evacuation drills are conducted and their importance, devise plans for industrial monitoring and analyse various real-time disasters.	L3
4. Learn relating risk, vulnerability and capacity and to know about various stages involved in disaster management and various disaster management authorities	L3
5. Understand and analyse the dealing with post disaster situations and methods and strategies involved in rebuilding the society	L3

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
20A15FT.1	-	-	-	-	-	1	1	1	1	-	-	1	-	-
20A15FT.2	-	1	-	-	-	1	1	1	1	-	-	1	-	-
20A15FT.3	-	1	1	1	1	1	1	-	-	-	-	-	-	-
20A15FT.4	-	-	-	1	1	1	1	-	-	-	-	-	-	-
20A15FT.5	1	1	1	1	-	-	1	1	-	1	-	-	-	-

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

Title of the Course	Energy Auditing Conservation and Management
Category	OEC
Course Code	20A25ET
Year	III B. Tech
Semester	I Semester
Branch	CE, ME & ECE

Lecture Hours	Tutorial Hours	Practical	Credits
3	0	0	3

Course Objectives:

- To illustrate the present scenario of Energy Production and laws associated with it
- To illustrate the Energy conservation Codes
- To develop Management skills and communications of Energy manager/ Energy Auditor
- To illustrate the techniques, procedures, evaluation and energy audit reporting
- To evaluate life cycle costing analysis and return on investment on energy efficient technologies.

Unit 1 Energy Scenario **9**

Global and Indian energy Scenario. Energy production, consumption and pricing. Long-term energy scenario. Salient features of Electricity Act 2003. Energy Conservation Act – 2001 and its features. Energy poverty and Human Development Indices, Energy and Human Development, Energy development index; Link between economic growth and energy consumption.

Learning Outcomes: At the end of the unit, the student will be able to

- Discuss the Scenario of energy production (L2)
- Explain the Electricity Act 2003 (L2)

Unit 2 Energy conservation **9**

Energy conservation areas, Energy transmission and storage, Plant Lecture wise energy optimization Models, Data base for energy management, Energy conservation through controls, Computer aided energy management, Program organization and methodology. Energy environment interaction, Energy Conservation in Buildings, Energy Efficiency Ratings & ECBC (Energy Conservation Building Code).

Learning Outcomes: At the end of the unit, the student will be able to

- Describe the Energy conservation through controls (L2)
- Discuss the Energy conservation in building with efficiency ratings and code (L2)

Unit 3 Energy Management **9**

History of Energy Management, Definition and Objective of Energy Management and its importance. Need of energy management, General Principles of Energy Management, Energy Management Skills, and Energy Management Strategy. Organizing, Initiating and Managing an energy management program. Roles, responsibilities and accountability of Energy Managers.

Learning Outcomes: At the end of the unit, the student will be able to

- Explain the importance of Energy management. (L2)
- Discuss the roles and responsibility of Energy manager (L2)

Unit 4 Energy Audit **9**

Energy audit concepts, Definition, Need and Types of energy audit. Energy Audit Approach and Methodology. Systematic procedure for technical audit. Describing energy audit costs. Duties and responsibilities of energy auditors. Energy audit instruments and their usage for auditing. Report-writing, preparations and presentations of energy audit reports.

Learning Outcomes: At the end of the unit, the student will be able to

- Discuss the concepts of Energy Audit and its types (L2)
- Write the Energy Audit in the form of Report. (L1)

Unit 5 Economic Analysis **9**

Economic analysis methods-cash flow model, time value of money, evaluation of proposals, pay-back method, average rate of return method, internal rate of return method, present value method, life cycle costing approach, Case studies.

Learning Outcomes: At the end of the unit, the student will be able to

- Analyze the benefits of adapting energy efficient equipment's with respect to investment. (L4)
- Analyze the benefits of usage of power factor equipment. (L4)

Prescribed Text Books:

1. AmlanChakrabarti, Energy Engineering and Management, PHI learning, 2nd edition, 2011.
2. Smith CB, Energy Management Principles, science direct, 2nd edition, 2016.
3. Hamies, Energy Auditing and Conservation; Methods, Measurements, Management & Case discuss. Hemisphere Pub. Corp: Washington, 1980
4. UmeshRathore, Energy management, S.K.Kataria&Sons,2nd edition,2014

Reference Books:

1. W.R.Murphy, G.Mckay, Energy Management, Butterworth-Heinemann Ltd, 2nd edition, 2009
2. Archie, W. Culp, Principles of Energy Conservation, McGraw Hill, 1979
3. Munasinghe, Mohan Desai, Ashok V, Energy Demand: Analysis, Management and Conservation, Wiley Eastern Ltd., New Delhi.1990.
4. A. J. McMichael, D. H. Campbell-Lendrum, C. F. Corvalan, K. L. Ebi, A. Githeko, J. D. Scheraga, A. Woodward, Climate Change and Human Health Risks and Responses, 2003.

Course Outcomes:

Student will be able to	Blooms Level of Learning
1. Describe the energy scenario and laws associated with it.	L2
2. Discuss the technical and commercial aspects of energy conservation	L2
3. Analyze the energy management	L4
4. Discuss the significance and procedure for Energy Audit.	L2
5. Evaluate the pay back periods for energy savings equipment	L5

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
20A25ET.1	3	2	-	2	-	-	3	-	-	-	-	2	-	-
20A25ET.2	2	2	-	2	-	-	2	-	-	-	-	1	-	-
20A25ET.3	3	2	-	2	-	-	2	-	-	-	-	-	-	-
20A25ET.4	3	2	-	2	-	-	2	-	-	-	-	1	-	-
20A25ET.5	2	2	-	1	-	-	2	-	-	-	-	1	-	-

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

Title of the Course Electric Vehicles
Category OEC
Course Code 20A25FT

Year III B. Tech
Semester I Semester
Branch CE, ME & ECE

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

- To explain the concepts and configurations of electric vehicles
- To describe different electric propulsion systems and energy storage devices
- To discuss the different types of electrical vehicles.

Unit 1 Introduction to Electric Vehicles 8

A brief history of Electric Vehicles (EV), Types of EV, advantages over conventional vehicles, limitations of EV, impact on environment of EV technology, disposal of battery, cell and hazardous material and their impact on environment.

Learning Outcomes: At the end of the unit, the student will be able to

- Describe the history of electric vehicles(L2)
- Describe electric vehicle configuration and its components(L2)
- Describe the impact on environment of electric vehicles technology(L2)

Unit 2 Power Management and Energy Sources of EV 8

Power and Energy management strategies and its general architecture of EV, various battery sources, energy storage, battery-based energy storage and simplified models of battery, Battery Management Systems (BMS), fuel cells.

Learning Outcomes: At the end of the unit, the student will be able to:

- Describe the general architecture of EV(L2)
- Describe various battery energy sources of EV(L2)

Unit 3 Power Electronics in EV 8

Introduction, various power electronics converter topologies and its comparisons, Control of converter operations in EV, battery chargers used in EV.

Learning Outcomes: At the end of the unit, the student will be able to:

- Describe the various power electronics converter topologies(L2)
- Describe the control of converter operations in EV(L2)

Unit 4 DC and AC Machines & Drives in EV 8

Various types of motors, selection and size of motors, Induction motor drives and control characteristics, Permanent magnet motor drives and characteristics, Brushed & Brushless DC motor drive and characteristics, switched reluctance motors and characteristics.

Learning Outcomes: At the end of the unit, the student will be able to:

- Describe the various types of motors for EV(L2)
- Describe the characteristics of AC & DC motors (L2)

Unit 5 Design Considerations of EV **8**

Design parameters of batteries, ultra-capacitors and fuel cells, aerodynamic considerations, calculation of the rolling resistance and the grade resistance, calculation of the acceleration force, total tractive effort, torque required on the drive wheel, transmission efficiency.

Learning Outcomes: At the end of the unit, the student will be able to:

- Describe the design parameters for EV(L2)
- Describe calculation of tractive effort in EV(L2)

Prescribed Text Books:

1. Iqbal Hussain, "Electric and Hybrid Vehicles Design Fundamentals", 1st Edition, CRC Press, 2003.
2. James Larminie, John Lowry "Electric Vehicle Technology Explained", 1st Edition, John Wiley and Sons, 2003.
3. Chris Mi, M. AbulMasrur, David WenzhongGao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", Wiley publication ,2011
4. Allen Fuhs, "Hybrid Vehicles and the future of personal transportation", CRC Press, 2009.

Reference Books:

1. Web course on "Introduction to Hybrid and Electric Vehicles" by Dr. Praveen Kumar and Prof. S Majhi, IIT Guwahati available on NPTEL at https://nptel.ac.in/courses/108/103/108103009/.
2. Video Course on "Electric Vehicles" by Prof. Amit Kumar Jain, IIT Delhi available on NPTEL at https://nptel.ac.in/courses/108/102/108102121/

Course Outcomes:

At the end of the course, the student will be able to	Blooms Level of Learning
1. Explain the operation of electric vehicles	L2
2. Select a suitable drive scheme for developing an electric vehicle depending on resources	L1
3. Identify proper energy storage systems for vehicle applications.	L1

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
20A25FT.1	-	2	-	3	-	-	2	-	3	-	-	-	-	-
20A25FT.2	3	-	-	2	-	3	-	-	3	-	-	-	-	-
20A25FT.3	3	2	2	-	-	-	-	-	2	-	-	-	-	-

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

Title of the Course Electronic Circuits & its Applications
Category OEC
Course Code 20A45ET

Year III B. Tech
Semester I Semester
Branch CE, EEE & ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To analyze and design the transistor and feedback amplifiers.
- To understand and analyze the concepts of oscillators

Unit 1 Single Stage Amplifiers **10**
Classification of Amplifiers - Distortion in amplifiers, Analysis of CE, CC and CB configurations with simplified hybrid model, Analysis of CE amplifier with emitter resistance and emitter follower, Miller's theorem and its dual, Design of single stage RC coupled Amplifier using BJT.
Learning Outcomes: At the end of the unit, the student will be able to:
- Understand the concepts of basic transistor amplifier circuits. (L2)
- Design and analysis of single stage amplifiers using BJTs (L6)

Unit 2 Multistage Amplifiers **10**
Analysis of Cascaded RC coupled BJT amplifiers, Cascode Amplifier, Darlington Pair, Different Coupling Schemes used in Amplifiers - RC coupled amplifiers, Transformer Coupled Amplifier, Direct Coupled Amplifier.
Learning Outcomes: At the end of the unit, the student will be able to:
- Understand the purpose of cascading single stage amplifiers. (L2)
- Analyse the different types of amplifiers, operation and it's characteristics. (L4)

Unit 3 Feedback Amplifiers **12**
Concept of feedback amplifiers, General characteristics of negative feedback amplifiers, effect of feedback on amplifier characteristics. Voltage series, voltage shunt, current series and current shunt feedback amplifiers with discrete components (Topologies).
Learning Outcomes: At the end of the unit, the student will be able to :
- Understand the concepts of feedback amplifiers. (L2)
- Analyse the effect of negative feedback on amplifier characteristics (L4)
- Design and analysis of various feedback amplifiers (L6)

Unit 4 Oscillators **10**
Condition for oscillations, Oscillator types, Frequency and amplitude stability of oscillators, LC oscillators - Hartley and Colpitts oscillators, RC phase shift and Wein bridge oscillators, Crystal Oscillators.
Learning Outcomes: At the end of the unit, the student will be able to:
- Understand the basic principle of oscillator circuits. (L2)
- Design and Analysis of different oscillator circuits (L6)

Unit 5 Large Scale Amplifiers **8**
Classification of Power amplifiers – Class A power Amplifiers – Direct coupled and Transformer Coupled, Class B power Amplifiers – Push – pull and Complementary Symmetry-Transistor power dissipation, Power and Efficiency calculations, Distortion of Power Amplifiers.
Learning Outcomes: At the end of the unit, the student will be able to:

- Understand the concepts of different power amplifiers (L2)
- Determine the efficiencies of various power amplifiers (L3)

Prescribed Text Books:

1. Millman and Christos C. Halkias- "Integrated Electronics", McGraw-Hill,1972.
2. Robert T. Paynter- "Introductory Electronic Devices and Circuits", Pearson Education, 7thEdition.

Reference Books:

1. Robert L. Boylestad and Louis Nashelsky - "Electronic Devices and Circuits Theory", Pearson/Prentice Hall, 9th Edition, 2006.
2. Donald A. Neumann- "Electronic Circuit Analysis and Design", McGraw Hill
3. "Micro Electronic Circuits" Sedra and Smith, Oxford University Press

Course Outcomes:

At the end of the course, the student will be able to	Blooms Level of Learning
1. Analyze the single stage and multi-stage amplifiers using h-parameter model at low frequencies	L4
2. Understand the feedback amplifiers and oscillators	L2
3. Analyse the concepts of large signal amplifiers	L4
4. Understand the working principle and operation of oscillators	L2
5. Analyze the concepts of large signal amplifiers	L4

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
20A45ET.1	3	3	2	3	3	1	-	-	2	-	-	-	-	-
20A45ET.2	3	3	2	3	3	1	-	-	2	-	-	-	-	-
20A45ET.3	1	3	3	2	2	-	-	-	2	-	-	-	-	-
20A45ET.4	1	3	3	2	2	-	-	-	2	-	-	-	-	-
20A45ET.5	3	3	3	2	2	1	-	-	2	-	-	-	-	-

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

Title of the Course Introduction to Communication Systems
Category OEC
Course Code 20A45FT

Year III B. Tech
Semester I Semester
Branch CE, EEE & ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

- To learn the fundamental concept of analog communication systems.
- To acquire basics involved in digital communication.
- To Impart knowledge of analog and digital pulse modulation techniques.
- To review and apply different analog and digital modulation Techniques.

Unit 1 Amplitude Modulation – I 12

Elements of communication system need for modulation, types of modulation, amplitude modulation single tone modulation, power relations in am waves, generation and detection of am waves.

Learning Outcomes: At the end of the unit, the student will be able to:

- Describe the Elements of Analog communication system. (L2)
- Solve different power relations in AM. (L3)

Unit 2 Amplitude Modulation – II 10

DSB-SC: generation and detection of DSB-SC, SSB-SC: G generation and detection of SSB-SC, vestigial side band modulation: G generation and detection of VSB waves.

Learning Outcomes: At the end of the unit, the student will be able to:

- Compare different Amplitude modulation methods (L4)
- Describe generation and detection methods (L2)

Unit 3 Angle Modulation 8

Basic concepts of Frequency Modulation, Single tone frequency modulation, Narrowband FM, Wideband FM, Generation of FM Waves and Detection of FM Waves.

Learning Outcomes: At the end of the unit, the student will be able to :

- Classify different angle modulation methods. (L2)
- Distinguish Amplitude modulation with Angle Modulation. (L4)

Unit 4 Pulse Digital Modulation 10

Elements of digital communication system, Elements of PCM, Bandwidth requirements of PCM, Noise in PCM Systems, Differential PCM systems (DPCM), Delta modulation systems and drawbacks.

Learning Outcomes: At the end of the unit, the student will be able to:

- Discuss the Elements of digital communication system. (L2)
- Analyze Noise in PCM and DM (L4)
- Distinguish and Design different Modulation Schemes. (L4)

Unit 5 Digital Carrier Modulation Schemes 8

Introduction, Binary ASK Signaling Scheme-Generation and detection methods, Binary FSK Signaling Scheme-Generation and detection methods, Binary PSK Signaling Scheme-Generation and detection methods, DPSK

Learning Outcomes: At the end of the unit, the student will be able to:

- Classify and review different generation methods for Digital Modulation schemes (L2)
- Classify and review different detection methods for Digital Modulation schemes. (L2)

Prescribed Text Books:

1. Simon Haykin, John Wiley- Principles of Communication systems , 2nd Ed.,
2. K. Sam Shanmugam – Digital and Analog Communication Systems, Wiley, 2010.
3. R.P.Singh&S.D.Sapre- Communication Systems Analog & Digital, TMH, 2008

Reference Books:

1. H Taub & D. Dchilling, Gautam Sahe- Principles of Communication Systems, TMH, 2007 3rd Edition
2. John G. Proakis, Masood Salehi- Fundamentals of Communication Systems PEA, 2006.

Course Outcomes:

At the end of the course, the student will be able to	Blooms Level of Learning
1. Recall fundamentals of Analog communication system and Demonstrate Analog modulation techniques.	L2
2. Analyze various analog modulation methods and discriminate them.	L4
3. Differentiate among different angle modulation techniques.	L4
4. Apply and understand Digital communication system and demonstrate digital pulse modulation techniques.	L2 & L3
5. Analyze digital modulation methods and discriminate them.	L4

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A45FT.1	3	3	3	2	-	1	-	-	-	3	-	3	-	-
20A45FT.2	3	3	3	2	-	1	-	-	-	3	-	3	-	-
20A45FT.3	3	3	3	2	-	1	-	-	-	3	-	3	-	-
20A45FT.4	3	3	3	2	-	1				3	-	3	-	-
20A45FT.5	3	3	3	2	-	1				3	-	3	-	-

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

Title of the Course	Data Structures using Python
Category	OEC
Course Code	20A55FT
Year	III B. Tech.
Semester	I Semester
Branch	EEE, ME and ECE

Lecture Hours	Tutorial Hours	Practical	Credits
3	0	0	3

Prerequisite: Prerequisite for this course is python programming language

Course Objectives:
- To learn basic of data structures.
- To analyze algorithms and understand sets, maps, linked list using python programming
- To apply recursion in python programming and understand hashing operation
- To learn the implementation of binary trees, binary search trees and AVL trees.

Unit 1 **7**

Introduction to Data structures, definition, types of data structures, Array-Based Sequences: Python's Sequence Types, Low-Level Arrays, Dynamic Arrays and Amortization, Efficiency of Python's Sequence Types, Using Array-Based Sequences, Multidimensional Data Sets.

Learning Outcomes: At the end of the unit, the student will be able to
- Understand the definition of data structures (L2)
- Remember various data structures (L1)

Unit 2 **11**

Linked list structures: The Singly Linked List, Double linked list, Stacks. The Stack Abstract Data Type, Simple Array-Based Stack Implementation, Reversing Data Using a Stack, Queue, The Queue Abstract Data Type, Array-Based Queue Implementation

Learning Outcomes: At the end of the unit, the student will be able to
- Understand the linear data structure linked list (L2)
- Illustrate Abstract Data types for various data structures (L4)

Unit 3 **9**

Recursion: Recursive functions, properties of recursion, recursion works, recursive applications-recursive binary search, towers of Hanoi, exponential operation. Sorting: Merge sort, Quick sort

Learning Outcomes: At the end of the unit, the student will be able to
- understands the importance of recursion (L2)
- use recursion in various examples (L3)

Unit 4 **9**

Binary Trees: The Tree structure, The binary search tree, The Priority Queue Abstract Data Type, Implementing a Priority Queue, heap sort.

Learning Outcomes: At the end of the unit, the student will be able to
- explain binary tree data structure (L3)
- demonstrate priority queue and heap sort (L2)

Unit 5 **9**

Pattern-Matching Algorithms: Brute Force, The Boyer-Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Tries:

Standard Tries, Compressed Tries, Suffix Tries.
Graphs, Graph Traversals, Depth-First Search, Breadth-First Search.

Learning Outcomes: At the end of the unit, the student will be able to

- describe the pattern matching algorithms (L3)
- justify the importance of graphdata structure(L4)

Prescribed Text Books:

1. Data Structures and Algorithms in Python, Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, Wiley Publications
2. Data Structures and Algorithms using Python, RanceD. Necaise, Wiley Publications

Reference Books:

1. Python Programming using problem solving approach, ReemaThareja, Oxford University press
2. Core Python Programming, R. Nageswara Rao, Dream Tech Press (Wiley India), 2017 Edition
3. Problem solving with algorithms and data structures using python, Bradley Miller, David L. Ranum, Franklin, Beedle& Associates incorporated, independent publishers.

Course Outcomes:

Student will be able to	Blooms Level of Learning
1. Remember and Understand he basics data structures.	L2
2. Illustrate Abstract Data types for various data structures	L4
3. use recursion in different examples	L3
4. explain binary tree, priority queue data structure	L3
5. justify the importance of pattern matching, tires and graphdata structure	L4

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A55FT.1	3	3	3	-	-	-	-	-	-	-	-	2	-	-
20A55FT.2	3	3	3	-	-	-	-	-	-	-	-	-	-	-
20A55FT.3	3	3	3	-	3	-	-	-	-	-	-	2	-	-
20A55FT.4	3	3	-	-	-	-	-	-	-	-	-	-	-	-
20A55FT.5	3	3	3	-	3	-	-	-	-	-	-	-	-	-

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

Title of the Course	Database Management System
Category	OEC
Course Code	20A55GT
Year	III B. Tech
Semester	I Semester
Branch	EEE, ME and ECE

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

- To understand the role and uses of DBMS in an organization.
- To understand fundamental concepts of Database Management Systems like database design, database languages, and database-system implementation.
- To construct simple and moderately advanced database queries using Structured Query Language (SQL).
- To understand and successfully apply logical database design principles, including E-R diagrams and database normalization techniques.
- To explain the principle of transaction management design.

Unit 1 **9**

Introduction: Database-System Applications, Purpose of Database Systems, View of Data, Database Languages, Relational Databases, Data Storage and Querying, Transaction Management, Data Base Architecture, Database Users and Administrators, History of Database Systems.

Learning Outcomes: At the end of the unit, the student will be able to

- Explain the Features of Database Management Systems, Architecture of database systems.(L2)
- Define the role of database users (L1)

Unit 2 **10**

Database Design: Database Design and ER Diagrams, Entities, Attributes and Entity Sets, Relationships and Relationship Sets, Additional Features of the ER Model, Conceptual Design with the ER Model, Case study: The Internet Shop.

THE RELATIONAL MODEL: Introduction to the Relational Model, Integrity Constraints over Relations, Enforcing Integrity Constraints, Querying Relational Data, Logical Data Base Design: ER to Relational.

Learning Outcomes: At the end of the unit, the student will be able to:

- Develops an Entity-Relationship model based on user requirements.(L5)
- Defines the basics of the relational data model. (L1)

Unit 3 **9**

SQL AND PL/SQL: Introduction to SQL, Data Definition Commands, Data Manipulation Commands, Select Queries, Virtual Tables: Creating View, Altering View, Updating View, Destroying View, Relational Set Operators, SQL Join Operators, Sub Queries and Correlated Queries, Aggregate Functions, Procedural SQL: Stored Procedures, Stored Functions, Triggers, Cursors.

Learning Outcomes: At the end of the unit, the student will be able to:

- Designs SQL queries to create database tables and make structural modifications. (L5)
- Define and enforces integrity constraints on a database. (L1)

Unit 4 **12**

Introduction to Schema Refinement: Problems Caused by Redundancy, Decompositions, Problems Related to Decomposition, Functional Dependencies, Reasoning about FDs, Normal Forms: 1NF, 2NF, 3NF, BCNF, Properties of Decomposition: Lossless Join Decomposition, Dependency Preserving Decomposition, Multivalued Dependencies, 4 NF.

Learning Outcomes: At the end of the unit, the student will be able to:

- Describes Functional Dependency and Functional Decomposition. (L2)
- Applies various Normalization techniques for database design improvement. (L3)

Unit 5 **9**

ACID Properties: Consistency and Isolation, Atomicity and Durability, Transactions and Schedules, Concurrent Execution of Transactions, Lock-Based Concurrency Control, Performance of Locking, Transaction Support in SQL.

Learning Outcomes: At the end of the unit, the student will be able to:

- Applies transaction processing mechanisms in relational databases.(L3)
- Explain the Concurrency Control and Recovery Algorithms. (L2)

Prescribed Text Books:

1. Silberschatz, Korth, Sudarshan, Database System Concepts. McGraw Hill, 5th Edition.
2. C.J.Date, Introduction to Database Systems. Pearson Education.

Reference Books:

1. RaghuRamaKrishnan, Johannes Gehrke, Database Management Systems, McGraw Hill, Third Edition.
2. Elmasri,Navate, Fundamentals of Database Systems. Pearson Education.
3. Peter Rob, A. Ananda Rao, Carlos Coronel, Database Management Systems, CENGAGE Learning.

Course Outcomes:

At the end of the course, the student will be able to	Blooms Level of Learning
1. Memorize and recall the basic concepts of Database Systems to examine the applications of database systems.	L1
2. Demonstrate an Entity-Relationship (E-R) model from specifications and to convert the transformation of the conceptual model into corresponding logical data structures.	L2
3. Illustrate database concepts in structure query languages.	L3
4. Analyze the problems with redundancies and eliminate redundancies in a database schema using normalization.	L4
5. Judge the need of concurrency control in transaction management concepts in database systems.	L5

COs-POs Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A55GT.1	-	3	-	3	3	-	-	-	-	-	-	-	-	-
20A55GT.2	-	3	3	3	3	-	-	-	-	-	-	-	-	-
20A55GT.3	-	3	3	3	3	-	-	-	-	-	-	-	-	-
20A55GT.4	-	3	3	3	3	-	-	-	-	-	-	-	-	-
20A55GT.5	-	3	3	3	3	-	-	-	-	-	-	-	-	-

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

Title of the Course Foundations of Artificial Intelligence and Data Science
Category OEC
Course Code 20A305GT

Year III B. Tech
Semester I Semester
Branch CE, EEE, ME & ECE

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To comprehend the building blocks of AI in terms of intelligent agents.
- To understand the main approaches of artificial intelligence such as heuristic search, game search and logical inference.
- Fundamental knowledge of concepts underlying data science and give a hands-on experience with real-world data analysis.
- Demonstrate an understanding of statistics and machine learning concepts that are vital for data science.
- Critically evaluate data visualizations based on their design and use for communicating stories from data

Unit 1 Introduction **9**

What is AI? Foundations of AI, History of AI, Agents and environments, The nature of the Environment, structure of agents, Problem solving Agents, Problem Formulation, Uninformed Search Strategies.

Learning Outcomes: At the end of the unit, the student will be able to:
- Understands the basics of AI and Intelligent Systems (L2)
- Represents the problem formulation in real world environment (L3)

Unit 2 Informed Search methods **9**

Informed search methods–heuristic Functions, Hill Climbing, Simulated Annealing, A*, PerformanceEvaluation.ConstrainedSatisfactionProblems:Constraint Satisfaction Problems like– map Coloring, Crypt Arithmetic, and Back tracking for CSP, Local Search. Adversarial search techniques.

Learning Outcomes: At the end of the unit, the student will be able to:
- Solves a problem for solution using state space search (L5)
- Learns different search methods for problem solving (L1)

Unit 3 Introduction to Data Science **9**

What is Data Science: Big Data and Data Science hype – and getting past the hype, why now? – Deification, Current landscape of perspectives, Skill sets needed

Statistics for Data science: Populations and samples, Statistical modeling, probability distributions, fitting a model, Data Description, Probability, Distributions -Discrete and Continuous Distributions, Hypothesis testing, Regression Models – Linear and Multiple Regression models.

Learning Outcomes: At the end of the unit, the student will be able to:
- Understands the fundamental concepts of Data Science (L2)
- Apply the statistical methods for Data science problems (L3)

Unit 4 Data exploration and Data Learning algorithms **9**

Exploratory Data Analysis (EDA), Philosophy of EDA, tools for EDA, The Data Science Process, Feature Selection, Feature Generation and Extraction - Feature Selection algorithms – Filters; Wrappers.

Data Learning algorithms: Machine Learning Algorithms, Three Basic Algorithms - Linear Regression - k-Nearest Neighbors (k-NN) - k-means – SVM, Naïve Bayes, Logistic Regression.

Learning Outcomes: At the end of the unit, the student will be able to:
- Performs Exploratory Data Analysis for feature selection and decision making. (L5)
- Understands different Data Learning algorithms (L2)

Unit 5 Data visualization 9

Data visualization and presentation: Basic principles, ideas and tools for data visualization, Examples of inspiring (industry) projects.

Applications of Data science in Business, Insurance, Energy, Health care, Biotechnology, Manufacturing, Utilities, Telecommunication, Travel, Governance, Gaming, Pharmaceuticals, Geospatial analytics and modeling

Learning Outcomes: At the end of the unit, the student will be able to:

- Design visual representations for processed data (L6)
- Apply data science methods in different application domains (L3)

Prescribed Text Books:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 2nd Edition, Pearson Publication.
2. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk from the Frontline. O'Reilly Edition, 2014.

Reference Books:

1. Rich ,E. and Knight, K., "Artificial Intelligence", Tata McGraw-Hill
2. GeorgeLugar,"AI-StructuresandStrategiesforComplexProblemSolving",4/e,2002,PearsonEducation
3. RobertJ.Schalkolf,ArtificialIntelligence:anEngineeringapproach,McGrawHill,1990
4. PatrickH.Winston,ArtificialIntelligence,3rdedition,Pearson
5. Jure Leskovek, Anand Rajaraman and Jerey Ullman. Mining of Massive Datasets. v2.1 Cambridge University Press. 2014
6. Foster Provost and Tom Fawcett. Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking. ISBN 1449361323. 2013

Course Outcomes:

At the end of the course, the student will be able to	Blooms Level of Learning
1. UnderstandtheimportanceofartificialIntelligenceinrealworldenvironment	L1, L2
2. Apply the artificial intelligence algorithms for problem solving	L3
3. Understand the key concepts, notations in data science and implement the standard methods of data analysis and decision making	L2, L3
4. Demonstrate the problem of knowledge extraction as combinations of data filtration, analysis and exploration methods	L3
5. Understand the importance of data visualization and the design and use of many visual components for effective communications and applications of data visualization in various domains.	L5, L6

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
20A305GT.1	3	3	-	-	-	3		-	3	2	-	2	-	-
20A305GT.2	3	3	3	3	-	3	2	-	3	-	-	2	-	-
20A305GT.3	3	-	-	-	-	-	-	-	3	-	-	3	-	-
20A305GT.4	3	3	3	-	3	-	-	-	3	-	3	3	-	-
20A305GT.5	3	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 Machine Learning
Category OEC
Course Code 20A305HT

Year III B. Tech
Semester I Semester
Branch CE, EEE, ME & ECE

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- Formulate machine learning problems corresponding to different applications.
- Understand machine learning algorithms along with their strengths and weaknesses.
- Understand the basic theory underlying machine learning.
- Apply machine learning algorithms to solve problems of moderate complexity.
- Understand different types of learning approaches.

Unit 1 Introduction **9**

Well-posed learning problems, Designing a learning system, Perspectives and issues in machine learning Concept learning and the general to specific ordering – Introduction, A concept learning task, Concept learning as search, Find-S: finding a maximally specific hypothesis, Version spaces and the candidate elimination algorithm, Remarks on version spaces and candidate elimination, Inductive bias

Learning Outcomes: At the end of the unit, the student will be able to:
- Explore how to build computer programs that improve their performance at some task through experience. (L4)
- Analyze sample complexity and computational complexity for several learning Problems (L4)

Unit 2 Decision Tree learning & Artificial Neural Networks **9**

Decision Tree learning – Introduction, Decision tree representation, Appropriate problems for decision tree learning, The basic decision tree learning algorithm, Hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning

Artificial Neural Networks – Introduction, Neural network representation, Appropriate problems for neural network learning, Perceptrons, Multilayer networks and the back propagation algorithm, Remarks on the back propagation algorithm, An illustrative example face recognition Advanced topics in artificial neural networks

Learning Outcomes: At the end of the unit, the student will be able to:
- Analyze artificial neural networks as one of the most effective learning methods currently known to interpret complex real-world sensor data (L4)
- Analyze and solves learning problem using Decision Tree (L5)

Unit 3 Bayesian learning & Genetic Algorithms **9**

Bayesian learning – Introduction, Bayes theorem, Bayes theorem and concept learning, Maximum likelihood and least squared error hypotheses, Maximum likelihood hypotheses for predicting probabilities, Minimum description length principle, Bayes optimal classifier, Gibs algorithm, Naïve Bayes classifier, An example learning to classify text, Bayesian belief networks The EM algorithm

Genetic Algorithms – Motivation, Genetic Algorithms, An illustrative Example, Hypothesis Space Search, Genetic Programming, Models of Evolution and Learning, Parallelizing Genetic Algorithms

Learning Outcomes: At the end of the unit, the student will be able to:
- Apply the principles of Probability for classification as an important area of Machine Learning Algorithms (L3)
- Illustrates the use of the genetic algorithm approach, and examine the nature of its hypothesis space search (L3)

Unit 4 Learning Sets of Rules & Analytical Learning 9

Learning Sets of Rules – Introduction, Sequential Covering Algorithms, Learning Rule Sets: Summary, Learning First Order Rules, Learning Sets of First Order Rules: FOIL, Induction as Inverted Deduction, Inverting Resolution Analytical Learning - Introduction, Learning with Perfect Domain Theories: Prolog-EBG Remarks on Explanation-Based Learning, Explanation-Based Learning of Search Control Knowledge.

Learning Outcomes: At the end of the unit, the student will be able to:

- Analyze the Instance based algorithms can be used to overcome memory complexity and overfitting problems. (L4)
- Infer the significance of Domain Theories (L2)

Unit 5 Reinforcement Learning 9

Reinforcement Learning – Introduction, The Learning Task, Q Learning, Non-Deterministic Rewards and Actions, Temporal Difference Learning, Generalizing from Examples, Relationship to Dynamic Programming

Learning Outcomes: At the end of the unit, the student will be able to:

- Infer that the combined methods outperform both purely inductive and purely analytical learning methods (L3)
- Recognize the importance of Reinforcement Learning in the industry (L1)

Prescribed Text Books:

1. Machine Learning – Tom M. Mitchell, - MGH
2. Machine Learning: An Algorithmic Perspective, Stephen Marsland, Taylor & Francis (CRC) Reference

Reference Books:

1. Machine Learning Methods in the Environmental Sciences, Neural Networks, William W Hsieh, Cambridge Univ Press
2. Richard o. Duda, Peter E. Hart and David G. Stork, pattern classification, John Wiley & Sons Inc., 2001
3. Chris Bishop, Neural Networks for Pattern Recognition, Oxford University Press

Course Outcomes:

At the end of the course, the student will be able to	Blooms Level of Learning
1. Understand the basic knowledge about the key algorithms of machine learning	L1
2. Learn and use different machine learning algorithms	L2
3. Apply various machine learning algorithms Bayesian learning and genetic approaches	L3
4. Design the classification, pattern recognition, optimization and decision problems using machine learning algorithms	L4
5. Analyze different types of learning approaches	L5

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
20A305HT.1	3	3	3	1	-	1	-	-	1	-	-	3	-	-
20A305HT.2	3	-	3	-	3	-	-	-	-	-	-	3	-	-
20A305HT.3	3	3	3	-	3	-	-	-	-	-	-	-	-	-
20A305HT.4	3	3	3	-	-	-	-	-	-	-	-	3	-	-
20A305HT.5	3	-	3	-	3	-	-	-	-	-	-	3	-	-

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

Title of the Course Human Resource Management
Category OEC
Course Code 20AE5AT

Year III B. Tech.
Semester I Semester
Branch CE, EEE, ME & ECE

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

- The course is designed broadly to promote understanding of procurement, development, maintenance, evaluation and overall effective utilization of manpower.

Unit 1 Introduction to Human Resource Management 10

Introduction-Definition-Nature of HRM-Scope of HRM-Functions of HRM-Managerial functions and Operative functions-Role of HRM-Personnel Management and HRM-Competitive challenges influencing HRM- Ethical aspects of HRM.

Learning Outcomes: At the end of the unit, the student will be able to:

- Understand the differences between Personnel and Human resource Management (L2)
- Identify the ethical issues to be followed in the organization (L1)

Unit 2 Manpower Planning , Job analysis and Job design 12

Introduction to Manpower Planning- Nature of HRP-Need and Importance of HRP in Organizations-Factors affecting HRP-HRP process-Barriers to HRP- Human Resource Information System.

Job analysis: Definitions, Nature of Job analysis, process of Job analysis-methods of collecting job data.

Job design: Definition-Factors affecting Job Design-Job design Approaches.

Learning Outcomes: At the end of the unit, the student will be able to:

- Identify the need of Manpower planning in Organizations' (L1)
- Find the basic requirements of job analysis and job design (L1)

Unit 3 Recruitment and Selection of Human Capital 10

Recruitment: Nature of Recruitment-Purpose and Importance- Factors governing Recruitment-Recruitment process- Sources of Recruitment.

Selection: Nature of Selection-Selection Process- Selection tests-Barriers to effective selection.

Placement and orientation.

Learning Outcomes: At the end of the unit, the student will be able to:

- Determine the requirements of recruitment and selection (L3)
- Prepare himself when attending for different selection tests (L3)

Unit 4 Training and Development 10

Nature of Training and Development-Inputs in Training and development-Benefits of Employee Training-Training Process-Training Methods-Impediments to effective training-Career development: Definition-Initiatives-stages.

Learning Outcomes: At the end of the unit, the student will be able to:

- Extend the dynamic aspects of training and its applicability for the growth of organization(L2)
- Apply Training methods in order to make training effective(L3)

Unit 5 Evaluation and Compensation management 10

Performance Appraisal: Nature-objectives-Appraisal Process-Methods of Appraisal.

Compensation: Objectives-Objectives of Remuneration-Theories of Remuneration-Wage policy in India-Concept of Wages.

Grievance process- Importance and Approaches of Industrial relations-Collective Bargaining.
Learning Outcomes: At the end of the unit, the student will be able to:

- Understand the various performance appraisal methods in an Organization(L2)
- Finds ways for evaluating compensation related pay in various organizations(L1)

Prescribed Textbooks:

1. K. Aswathappa, Human Resource Management: Text and cases, The McGraw-Hill Companies, 5th Edition,.
2. P. SubbaRao, Personnel and Human Resource Management, Himalaya Publishing House, 5th Revised Edition.

Reference Books:

1. Noe A.Raymond, John Hollenbeck, Barry Gerhart and Patrick Wright, Human Resource Management, Tata Mc Graw Hill.
2. Ian Beardwell & Len Holden, Human Resource Management, Macmillan India Ltd.
3. Ivansevich, Human Resource Management, Tata McGraw Hill, 10th Edition.
4. Dessler Gary, Human Resource Management, Prentice Hall, 10th Edition.
5. Bernardi, Human Resource Management, Tata McGraw Hill, 4th Edition.

Course Outcomes:

At the end of the course, the student will be able to	Blooms Level of Learning
1. Understand the basics of Human Resource Management.	L2
2. Know the basic requirements of Job and the way of designing the jobs in the organization.	L1
3. Apply different Recruitment and selection techniques in their practical life when attending for recruitment and selection processes.	L3
4. Get awareness of various Training and Development methods in the Organization.	L2
5. Identify various types of performance appraisal methods and compensation designs in the organization.	L1

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
20AE5AT.1	-	-	-	-	-	-	-	2	-	-	-	3	-	-
20AE5AT.2	-	-	1	-	-	-	-	-	3	-	-	3	-	-
20AE5AT.3	-	-	1	-	-	-	-	-	-	-	3	3	-	-
20AE5AT.4	-	-	-	-	-	-	-	3	-	-	3	-	-	-
20AE5AT.5	2	-	-	-	-	-	-	-	-	-	-	3	-	-

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

Title of the Course Intellectual Property Rights
Category OEC
Course Code 20AE5BT

Year III B. Tech
Semester I Semester
Branch CE, EEE, ME & ECE

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

- To introduce fundamental aspects of Intellectual property rights to student who are going to play a vital role in development and management of innovative projects in industries
- To disseminate knowledge of kinds and types of intellectual property in India and abroad and registration aspects.
- To get aware about current trend in IPR and government steps in fostering IPR

Unit 1 Concept of Property **12**

Meaning of Property, Kinds of property: Movable and Immovable property; Tangible and Intangible property; Intellectual property; Private and Public property. Possession and ownership.

Learning Outcomes: At the end of the unit, the student will be able to:

- Explain the meaning of property and kinds of properties (L1)
- Able to distinguish between different types of properties (L4)

Unit 2 Intellectual Property Rights **12**

Introduction and the need for Intellectual Property Rights (IPR), IPR in India – Genesis and Development, Forms of Intellectual Property- Copyright, Trademarks, Patents, Designs, Geographical Indicators, Merchandise, Franchise and Forms of Unfair Competition. Competing rationales of the legal regimes for the protection of Intellectual Property.

Learning Outcomes: At the end of the unit, the student will be able to:

- To get awareness of need for Intellectual Property Rights (IPR) (L1)
- To acquire knowledge in different forms of Intellectual Property- Copyright, Trademarks, Patents, Designs and Geographical Indicators (L2)

Unit 3 Copyrights & Trademarks **14**

Copy Right: Meaning of Copyright, Copyright in literary, dramatic, musical work and cinematograph films Ownership, Assignment, Author's special rights, Importation and infringement, Fair use provisions. Trademarks: Definition; conception of trademarks, Registration, Distinction between trademark and property mark, Standards of proof in passing off action.

Learning Outcomes: At the end of the unit, the student will be able to:

- understand the meaning of Copyright and infringement (L1)
- find the importance of Trademarks and its registration(L1)

Unit 4 Patents, Designs and Geographical Indicators **14**

Conception of Patent, Patentable Inventions, Process of obtaining a Patent: application, examination, opposition and sealing of patents; Rights and obligations of a Patentee, International Patents, Transfer of technology, know-how and problems of self-reliant development. Basic provisions related to Designs, Geographical Indicators.

Learning Outcomes: At the end of the unit, the student will be able to:

- understand the role of patent in innovation and Process of obtaining a Patent (L1)
- acquire knowledge about basic provisions related to Designs and Geographical Indicators (L2)

Unit 5 International Instruments Concerning intellectual Property Rights 10

The Berne Convention, Universal Copyright Convention, The Paris Union, The World Intellectual Property Rights Organization (WIPO), UNESCO, TRIPS, TRIMS, and WTO.

Learning Outcomes: At the end of the unit, the student will be able to:

- become familiar with international instruments concerning intellectual property (L2)
- Able to understand role of The World Intellectual Property Rights Organization (WIPO) and WTO in promoting IPRs(L2)

Prescribed Textbooks:

1. Intellectual Property Rights: Basic Concepts, MMS Karki, Atlantic, 2009.
2. Intellectual Property Rights, Pandey, Neeraj, Dharani, Khushdeep.

Reference Books:

1. Intellectual Property Rights in India: General Isuues and Implications, Dr. Prankrishna Pal, Regal Series.
2. Intellectual Property, W.R. Cornish, Sweet & Maxwell, London, 2012.
3. Principles of Intellectual Property, N.S. Gopalakrishnan & T.G. Agitha, Eastern BookCompany, Lucknow, 2009.

Course Outcomes:

At the end of the course, the student will be able to	Blooms Level of Learning
1. Gain awareness about Intellectual Property Rights (IPRs).	L2
2. Acquire adequate knowledge in the kinds of Intellectual Property Rights (IPRs)	L1
3. learn the process of patent filing and registration in India	L3
4. Learn the basic concepts of relating to copy rights, trademarks, geographical indications and others Intellectual properties.	L2
5. Gain more insights into the regulatory aspects of Intellectual Property Rights (IPRs). in India	L2

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
20AE5BT.1	1	1	-	-	1	-	-	-	-	-	-	-	-	-
20AE5BT.2	2	-	2	-	2	-	2	-	2	-	-	1	-	-
20AE5BT.3	-	2	-	-	-	2	1	3	-	2	1	-	-	-
20AE5BT.4	1	-	2	-	-	-	-	1	-	-	-	-	-	-
20AE5BT.5	-	1	-	2	-	-	-	2	-	-	2	-	-	-

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

Title of the Course IC Engines
Category PEC
Course Code 20A35AT

Year III B. Tech
Semester I Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To provide the basic concept of engines and its operation cycles
- To understand the combustion phenomenon in internal combustion engines and its important systems
- To acquaint with the various methods for measurement of engine performance
- To provide insight into the harmful effects of engine pollutants and its control

Unit 1 Introduction 8

Classification - Working principles, Valve and Port Timing Diagrams, Engine systems – Fuel, Simple Carburetor, Fuel Injection System – Air Injection system, Solid Injection system and Electronic Injection system. Ignition – Battery ignition system and Magneto ignition system, Cooling – Air cooling (Cooling Fins) and liquid cooing system – Thermo syphon system and Forced Circulation system and Lubrication - Importance - Mist Lubrication System, Wet sump Lubrication system and Dry sump Lubrication system.

Actual Cycles And Their Analysis: Introduction, Comparison of Air Standard and Actual Cycles, Time Loss Factor, Heat Loss Factor, Exhaust Blow down - Loss due to Gas exchange process, Volumetric Efficiency. Loss due to Rubbing Friction, Actual and Fuel-Air Cycles of CI Engines.

Learning Outcomes: At the end of the unit, the student will be able to:
- Gain the knowledge on basic information of engines. (L1)
- Know about air standard cycle, fuel air cycle and Actual cycle. (L2)

Unit 2 Combustion in SI, Fuel Supply and Ignition System Engines 12

Combustion In S.I. Engines: 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, combustion chamber – requirements, types.

Learning Outcomes: At the end of the unit, the student will be able to:
- Understand the concept of working and combustion phenomenon in SI engine. (L2)

Unit 3 Combustion in CI Engines and Fuel Supply System 12

Combustion In C.I. Engines: Four stages of combustion – Delay period and its importance – Effect of engine variables – Diesel Knock– Need for air movement, suction, compression and combustion induced turbulence – open and divided combustion chambers and nozzles used – fuel requirements and fuel rating.

Learning Outcomes: At the end of the unit, the student will be able to:
- Understand the concept of working and combustion phenomenon in CI engine. (L2)

Unit 4 Engine Testing and Performance 08

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.

Learning Outcomes: At the end of the unit, the student will be able to:
- Understand the measurements of performance of an engine. (L2)
- Know about the distribution of heat in IC engines

Unit 5 Engine Exhaust Emission and its control and Alternative Fuels for IC Engines 06

Engine Exhaust Emission and its control Formation of NOx, HC, CO and particulate emissions, Methods of controlling emissions; Two way and three way Catalytic convertors, Exhaust Gas Recirculation. EURO and BHARAT norms

Alternative Fuels: Alcohol, Hydrogen, and Liquefied Petroleum Gas, Biodiesel, Merits and Demerits as fuels.

Learning Outcomes: At the end of the unit, the student will be able to:

- Know about emissions standards. (L2)
- Analyze emission formation I engines. (L3)
- Know about the methods of controlling emissions. (L2)

Prescribed Text Books:

1. V. Ganesan, I.C. Engines. TMH.6th edition, 2018. ISBN: 9781259006197
2. B.P. Pundir, IC Engines:Combustion and Emissions, Narosa, 2014. ISBN: 978-81-8487-087-9
3. Heywood, I.C. Engines. McGrawHill. 2nd edition, 2018. ISBN: 9781260116113, 1260116115

Reference Books:

1. Mathur& Sharma, IC Engines. DhanpathRai& Sons, 2016. ISBN: 9788170237440, 8170237440
2. Pulkrabek, Engineering fundamentals of IC Engines. Pearson, PHI, 4th edition, 2013. ISBN:9781292054971
3. Rajput, Thermal Engineering. Lakshmi Publications. 8th edition, 2010. ISBN: 9788131808047
4. R.S. Khurmi&J.K.Gupta, Thermal Engineering. S.Chand, 16th edition, 2016. ISBN: 9788121925730
5. Omkar Singh, Applied thermodynamics, 4th edition, New age Int.pub, 2015. ISBN: 9788122417630
6. Ramalingam K. K., IC Engines, Scitech Publications (India) Pvt Ltd,2018, ISBN: 9788183716734

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Summarize the concept of engines and its operation cycles.	L2
2. Summarize the concept working and combustion phenomenon in SI engine.	L2
3. Summarize the concept working and combustion phenomenon in CI engine.	L2
4. Analyze the engine performance parameters.	L3
5. Summarize the emissions and its control techniques in I C Engines	L2

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A35AT.1	2	2	1	1	-	-	-	-	-	-	-	-	1	1
20A35AT.2	2	2	1	1	-	-	-	-	-	-	-	-	1	1
20A35AT.3	2	2	1	1	-	-	-	-	-	-	-	-	1	1
20A35AT.4	3	2	1	2	-	-	-	-	-	-	-	-	1	1
20A35AT.5	2	2	1	1	-	-	-	-	-	-	-	-	1	1

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

Title of the Course Design of Transmission System
Category PEC
Course Code 20A35BT

Year III B. Tech
Semester I Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To gain knowledge on the principles and procedure for the design of Mechanical power Transmission components.
- To understand the standard procedure available for Design of Transmission of Mechanical elements
- To learn to use standard data and catalogues (Use of P S G Design Data Book permitted)

Unit 1 Design of Flexible Elements 11
Design of Flat belts and pulleys – Selection of V belts and pulleys – Selection of hoisting wire ropes and pulleys – Design of Transmission chains and Sprockets.
Learning Outcomes: At the end of the unit, the student will be able to:
- Learn the basics of Flat belts and pulleys(L2)
- Design of Flat belts and pulleys (L6)
- Design of Transmission chains and Sprockets (L6)

Unit 2 Design of Spur gear and Helical gear 10
Speed ratios and number of teeth-Force analysis -Tooth stresses – Dynamic effects – Fatigue strength – Factor of safety – Gear materials – Design of straight tooth spur & helical gears based on strength and wear considerations - Equivalent number of teeth-forces for helical gears.
Learning Outcomes: At the end of the unit, the student will be able to:
- learn the concepts of gear (L2)
- analyze the forces induced in the gears (L4)
- design the gear for different loading condition (L6)

Unit 3 Design of Bevel and Worm Gears 14
Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Design of bevel gears.
Worm Gear: worm gear – terminology – forces – efficiency – thermal capacity and efficiency – merits and demerits
Learning Outcomes: At the end of the unit, the student will be able to:
- learn the concepts of gear (L2)
- analyze the forces and stresses induced in the gears (L4)
- design the gear for different loading condition (L6)

Unit 4 Design of Gear Boxes 8
Gear boxes – introduction – different types of gear boxes – speed selection - Geometric progression — Ray diagram, -Design of sliding mesh gear box – Design of multi speed gear box .
Learning Outcomes: At the end of the unit, the student will be able to:
- Learn the basics of gear box(L2)
- design procedure for gear box (L6)

Unit 5 Design of Clutches and Brakes 8
Design of plate clutches –axial clutches-cone clutches-internal expanding rim clutches- Electromagnetic clutches.

Band and Block brakes – external shoe brakes – Internal expanding shoe brake

Learning Outcomes: At the end of the unit, the student will be able to:

- Gain knowledge on Clutches and Brakes. (L1)
- Design procedure for clutches. (L6)
- Design procedure for Brakes. (L6)

Text Books:

1. Bhandari V, "Design of Machine Elements", 4th Edition, Tata McGraw-Hill Book Co, 2017 ISBN 9780070611412.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 8th Edition, Tata McGraw-Hill, 2008. ISBN: 9780070668614

Reference Books:

1. Sundararaja moorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003. ISBN: 978-81-7409-190-1
2. Shigley J.E and Mischke C. R., "Mechanical Engineering Design", Sixth Edition, Tata McGraw - Hill , 2003. ISBN-13 : 978-0070494626
3. Data Books: (i) Balaveera reddy and Mahadevan

Tables/Codes: Design data books are to be supplied in examination

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Design the belt drives, chain drives and rope belt drives for the given applications.	L6
2. Design the spur and helical gears for different input conditions.	L6
3. Design the worm and bevel gears for different input conditions.	L6
4. Design the gear box for the given applications.	L6
5. Design the brakes and clutches for the given applications.	L6

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A35BT.1	3	3	3	3	-	-	-	-	-	-	-	-	1	1
20A35BT.2	3	3	3	3	-	-	-	1	-	-	-	-	1	1
20A35BT.3	3	3	3	3	-	-	-	-	-	-	-	1	1	1
20A35BT.4	3	3	3	3	-	-	-	-	-	-	-	-	1	1
20A35BT.5	3	3	3	3	-	-	-	1	-	-	-	-	1	1

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

Title of the Course Industrial Management
Category PEC
Course Code 20A35CT

Year III B. Tech
Semester I Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To create awareness to learn principles, concepts, and functions of management and also to design organizational structures.
- To Gain knowledge on plant location, layouts, and materials management concepts in organizational context.
- To familiarize the students regarding work study and marketing
- To analyze concepts of network techniques.
- To get awareness on Strategic Management & Human Resource Management and its functions

Unit 1 Management and Organization 10

Concepts of Management and Organization – Functions of Management – Evolution of Management Thought: Taylor's Scientific Management, Fayol's Principles of Management - Maslow's Theory of Human Needs, Douglas McGregor's Theory X and Theory Y, Social responsibilities of Management

Basic concepts related to Organization - Departmentation and Decentralization, Types of organization, Line organization, Line and staff organization, functional organization, Committee organization, matrix organization and their merits and demerits

Learning Outcomes: At the end of the unit, the student will be able to:
- explain concepts of management (L3)
- differentiate leadership styles (L4)
- explain Taylor's Scientific Management Theory (L3)

Unit 2 Plant Location & Materials Management 8

Plant location, definition, factors affecting the plant location, comparison of rural and urban sites-methods for selection of plant. Plant Layout – definition, objectives, types of production, types of plant layout

EOQ, ABC Analysis, Purchase Procedure and Stores Management. Inventory — functions. Types, inventory classification techniques

Learning Outcomes: At the end of the unit, the student will be able to:
- explain the concept of Plant location (L3)
- define EOQ (L2)
- explain functions of inventory management (L3)

Unit 3 Work Study& Marketing 8

Definition, objectives, Method study - definition, objectives, steps involved- various types of associated charts-Work measurement- definition, time study, steps involved-equipment, different methods of performance rating-allowances, standard time calculation. Work Sampling – definition, steps involved, standard time calculations, differences with time study- Applications. Predetermined motion time study – Method time measurement (MTM)

Marketing: Functions of Marketing, Marketing Mix, and Marketing Strategies based on Product Life Cycle, Channels of distribution.

Learning Outcomes: At the end of the unit, the student will be able to:
- explain the concept of work-study(L2)
- differentiate between method study and time study(L3)
- discuss 4Ps of Marketing (L3)

Unit 4 Project Management 9

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.

Learning Outcomes: At the end of the unit, the student will be able to

- define CPM (L1)
- explain the concept of PERT (L4)
- Demonstrate Project Crashing. (L5)

Unit 5 Human Resource Management & Strategic Management 10

Functions of HRM, Job Evaluation, different types of evaluation methods. Job description, Merit Rating- difference with job evaluation, different methods of merit ratings, wage incentives, different types of wage incentive schemes. Strategic Management: Vision, Mission, Goals, Objectives, Policy, Strategy, Programmes, Elements of Corporate Planning Process, Environmental Scanning, Value Chain Analysis, SWOT Analysis, Steps in Strategy Formulation and Implementation

Learning Outcomes: At the end of the unit, the student will be able to:

- explain the concept of HRM (L2)
- distinguish between Personnel Management and HRM (L3)
- discuss steps in strategy formulation and implementation (L2)
- differentiate between Vision and Mission (L3)

Prescribed Text Books:

1. Armine, Manufacturing Organization and Management. Pearson, 2009, 6thed. ISBN-10: 8177582755
2. O.P. Khanna, Industrial Engineering and Management., DhanpatRai, 2018,17thed, ISBN-10: 818992835X
3. Stoner, Freeman, Gilbert, Management, Pearson Edu., 2007, 6th Ed., ISBN: 9788131707043
4. Pannerselvam, Production and Operations Management. PHI, 2010,ISBN-10: 9788120345553

Reference Books:

1. Ralph M Barnes, Motion and Time Studies. John Wiley and Sons, 2007, ISBN: 978-0-471-05905-9
2. Chase, Jacobs, Aquilano, Operations Management. TMH, 2007, 10th Ed, ISBN-10: 0071215557
3. L.S. Srinath, PERT/CPM. East-West Press, 2005, ISBN 10: 8185336202

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Describe the principles and functions of management & decide the competitive strategy that works best for the organization	L2
2. Apply the concept of plant layouts and factors affecting 3. plant location in an enterprise and apply the knowledge of inventory management	L3
4. Describe the concept of work study, method study and types of associated charts, the work measurement work sampling and marketing strategies in work setting.	L2
5. Solve related project management techniques	L3
6. Describe the importance of various sub systems of HRM &Strategic Management	L2

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A35CT.1	2	2	2	2	-	-	-	-	-	-	-	-	1	1
20A35CT.2	3	2	2	2	-	-	-	-	-	-	-	-	1	1
20A35CT.3	2	2	2	2	-	-	-	-	-	-	-	-	1	1
20A35CT.4	3	2	2	2	-	-	-	-	-	-	-	-	1	1
20A35CT.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 Optimization Techniques
Category PEC
Course Code 20A35DT

Year III B. Tech
Semester I Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To Introduce basics of MATLAB
- To Familiarize the fundamentals of optimization
- To Explain single variable optimization using various methods
- To Implement multi variable optimization using various methods
- To Train various evolutionary algorithms.

Unit 1 Introduction to MAT LAB **8**

Overview, MATLAB Preliminaries, Basics of MATLAB, Beyond the Basics of MATLAB, Popular Functions and Commands, Plotting using MATLAB, Optimization with MATLAB.

Learning Outcomes: At the end of the unit, the student will be able to:
- Write simple codes in MATLAB. (L4)
- Plot the data using MATLAB. (L4)
- Implement optimization models in MATLAB. (L4)

Unit 2 Introduction to Optimization **8**

Statement of an optimization problem, Classifications of optimization Problems: Single variable optimization, Multi variable optimization with no constraints, Multi variable optimization with equality constraints, Multi variable optimization with inequality constraints, Convex and Concave programming.

Learning Outcomes: At the end of the unit, the student will be able to:
- Build optimization problem. (L3)
- Solve various optimization problems. (L3)
- Compare convex and concave programming. (L3)

Unit 3 Single Variable Optimization **8**

Finite difference method, Central difference method, Runge - Kutta method, interval halving method, golden section method with MATLAB code.

Learning Outcomes: At the end of the unit, the student will be able to:
- Understand various methods involving single variable optimization. (L3)
- Develop codes in MATLAB for different methods. (L3)
- Identify methods for solving a single variable optimization problem. (L3)

Unit 4 Multi Variable Optimization **8**

Conjugate gradient method, Newton's method, Powell's method, Flectcher- Reeves method, Hook and Jeeves method, interior penalty function with MATLAB code.

Learning Outcomes: At the end of the unit, the student will be able to
- Apply various methods involving multi variable optimization. (L5)
- Develop codes in MATLAB for solving various multi variable optimization problems. (L5)
- Choose methods for solving a multi variable optimization problem. (L4)

Unit 5 Evolutionary Algorithms 8

Overview, Genetic Algorithms: Basics of Genetic Algorithms, Options in MATLAB, Multi Objective Optimization using Genetic Algorithms, Ant Colony Optimization, Simulated Annealing, Particle Swarm Optimization.

Learning Outcomes: At the end of the unit, the student will be able to:

- Apply different types of genetic algorithms. (L4)
- Model optimization problems using genetic algorithms in MATLAB. (L4)
- Compare different genetic algorithms for performance. (L4)

Prescribed Text Books:

1. Rao V.Dukkipati, MATLAB: An Introduction with Applications, Anshan, 2010. ISBN-10:9781848290433
2. AchilleMessac, Optimization in practice with MATLAB, Cambridge University Press, 2015. ISBN:9781107109186
3. Jasbir S Arora, Introduction to optimum design, 2/e. Elsevier, 2004. ISBN: 9780120641550

Reference Books:

1. Cesar Perez Lopez, MATLAB Optimization Techniques, Academic press, Springer publications, 2014. ISBN: 978-1-4842-0292-0.
2. Steven C.Chapra, Applied Numerical Methods with MATLAB for Engineers and scientists, 4/e, McGraw-Hill Education, 2018. ISBN: 978-0-07-339796-2

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Analyze the basic concepts of MATLAB.	L4
2. Solve the single variable and multi variable optimization problems	L3
3. Apply MATLAB for single variable optimization problems	L3
4. Apply MATLAB for multi variable optimization problems	L3
5. Analyze the basic concepts of genetic Algorithms, and various optimization methods.	L4

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A35DT.1	2	2	1	3	-	-	-	-	-	-	-	-	1	1
20A35DT.2	3	2	1	2	-	-	-	-	-	-	-	-	1	1
20A35DT.3	3	2	1	2	-	-	-	-	-	-	-	-	1	1
20A35DT.4	3	3	2	2	-	-	-	-	-	-	-	-	1	1
20A35DT.5	2	2	1	3	-	-	-	-	-	-	-	-	1	1

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

Title of the Course Thermal Engineering Lab
Category PCC
Course Code 20A351L

Year III B. Tech
Semester I Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	3	1.5

Course Objectives:

- To recognize various engine components and demonstrate assemble / disassemble the IC engine.
- To illustrate the concept of valves / ports actuating mechanism.
- To evaluate the performance characteristics of I.C engine, Vapour compression Refrigeration system and reciprocating air compressor.
- To evaluate and the energy dissipation and importance of heat balance sheet in IC engine.
- To describe the working principle of various boilers used for power generation.

List of Experiments:

1. Disassembly/assembly of given engine.
2. Performance test on air compressor test rig.
3. Load test on 4-stroke diesel engine
4. Load test on 2-stroke petrol engine
5. Heat balance sheet on 4-stroke diesel engine.
6. Heat balance sheet on 2-stroke petrol engine.
7. Motoring test on 2- stroke petrol engine.
8. Demonstration of boiler
9. (a) valve timing diagram (vtd)
   (b) port timing diagram (ptd)
10. (a) Flash and fire point by clevel and (open) cup apparatus.
    (b) Calorific value of fuel using bomb calorimeter.
11. Viscosity of the oil through saybolt viscometer apparatus.
12. Performance test on refrigeration test rig.

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Calculate of the performance of I.C engines.	L3
2. Summarize the components of the I.C engine.	L2
3. Summarize the working of boiler models.	L2
4. Calculate the Coefficient of performance for Vapour compression Refrigeration system	L3
5. Calculate the fluid properties for a given sample	L3

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO12	PSO1	PSO2
20A351L.1	3	2	1	2	-	-	-	1	1	-	-	1	1	1
20A351L.2	3	2	1	2	-	-	-	1	1	1	-	1	-	-
20A351L.3	3	3	2	3	-	-	-	1	1	-	-	1	-	-
20A351L.4	3	2	1	2	-	-	-	1	1	-	-	1	-	1
20A351L.5	3	2	1	2	-	-	-	1	1	-	-	1	-	1

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

Title of the Course Machine Tools Lab
Category PCC
Course Code 20A352L

Year III B. Tech
Semester I Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	3	1.5

Course Objectives:
- To demonstrate the usage of machine tools lab equipment.
- To learn the Step turning and taper turning and thread cutting on lathe machine.
- To learn the operations of Drilling, Tapping, Shaping, Slotting and milling.

List of Experiments:
1. Demonstration of construction & operations of general purpose machines: Lathe, Drilling machine, Milling machine, Shaper, Planning machine, Slotting machine, Cylindrical Grinder, Surface grinder and Tool & cutter grinder.
2. Job on Step turning and taper turning on lathe machine
3. Job on Thread cutting and knurling on -lathe machine.
4. Job on Drilling and Tapping
5. Job on Shaping and Planning
6. Job on Slotting
7. Job on Milling Job on Cylindrical Surface Grinding
8. Job on Grinding of Tool angles.

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Demonstrate knowledge of different machines tools used in machine shop.	L4
2. Have practical exposure on flat surface machining, shaping, slotting, and milling.	L5
3. Apply turning procedure to perform turning operation on lathe	L3
4. Apply grinding machining basics to achieve better surface finish	L3
5. Apply drilling procedure to produce holes on the work piece for given dimensions.	L3

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A352L.1	2	2	1	1	3	-	-	-	3	3	-	3	3	3
20A352L.2	3	3	2	3	-	-	-	-	2	-	-	3	3	2
20A352L.3	3	2	1	2	-	-	-	-	3	-	-	-	3	2
20A352L.4	3	2	1	2	-	-	-	-	3	-	-	-	3	3
20A352L.5	3	2	1	2	-	-	-	-	3	-	-	-	3	3

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

Title of the Course Professional Communication
Category SC
Course Code 20AC51L

Year III
Semester I Semester
Branch EEE, ECE, ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
1	0	2	2

Course Objectives:
- To understand various strategies of resume building
- To understand interview process and be prepared for facing it
- To learn group discussion techniques
- To learn about professional writing and presentations
- To be aware of managerial skills

Syllabus
Résumé preparation: Structure, formats and styles – planning - defining career objective - projecting one's strengths and skills - creative self-marketing - sample résumés -cover letter.

Interview Skills: Concepts and process - pre-interview planning - preparation body language -answering strategies - frequently asked questions - mock interviews - students taking up the roles of interviewer and interviewee

Group Discussion: Communicating views and opinions - discussing - intervening - agreeing and disagreeing – asking for and giving clarifications – substantiating - providing solutions on any given topics across a cross – section of individuals - modulations of voice and clarity - body language - case study – observation of group behaviors – social etiquette

Presentation Skills (Individual and Team): Collection of data from various sources - planning, preparation, and practice - types of audience - attention-getting strategies – transitions - handling questions from audience **–** dealing with difficult audience

Technical Report Writing: Types of formats and styles, subject matter, clarity, coherence and style, planning – data collection and analysis, report preparation, preparation of figures and tables, references

Managerial skills: Personality traits such as integrity, accountability, assertiveness, adaptability, diplomacy and dynamism - innovative strategies for dealing with different people in different contexts - showcasing live examples, sharing anecdotes and inspiring quotes related to leadership qualities

Learning Resources: Soft Skills lab manual prepared by Dept. of H&S, AITS Rajampet

Course Outcomes: Upon successful completion of the course, students will be able to	Bloom's Level of Learning
1. Describe himself/herself fluently in social contexts and to write resumes.	L2
2. Analyze the skills of Interview in professional world.	L4
3. Demonstrate effectively to face interviews and, to participate meetings effectively.	L2
4. Demonstrate presentation effectively.	L2
5. Evaluate the managerial skills for professional development.	L5

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
20AC51L/61L.1	-	-	-		-	-	-	-	-	3	-	3
20AC51L/61L.2	-	-	-	-	-	-	-	-	-	3	-	3
20AC51L/61L.3	-	-	-	-	-	-	-	-	-	3	-	3
20AC51L/61L.4	-	-	-	-	-	-	-	-	-	3	-	3
20AC51L/61L.5	-	-	-	-	-	-	-	-	-	3	-	3

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

Title of the Course Constitution of India
Category MC
Course Code 20AC52T

Year III
Semester I Semester
Branch EEE, ECE, ME

Lecture Hours	Tutorial Hours	Practical	Credits
3	0	0	0

Course Objectives:

- To understand the importance of the constitution
- To learn the structure of executive, legislature, and judiciary
- To understand the philosophy of fundamental rights and duties
- To learn the autonomous nature of constitutional bodies like the Supreme Court and High Court, Controller and Auditor General of India and Election Commission of India.
- To understand the union and state financial and administrative relations

Unit1 8

IntroductiontoIndianConstitution:Constitution,meaningoftheterm,IndianConstitution-Sourcesand Constitutional history, Features Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy.

Learning Outcomes: At the end of the unit, the student will be able to:

- Understand the necessity of framed rules of constitution
- Understand the process of citizenship
- Distinguish fundamental rules from fundamental duties

12

Unit2

Union Government and its Administration Structure of the Indian Union: Federalism, Centre – State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, LokSabha, Rajya Sabha, The Supreme Court and High Court: Powers and Functions

Learning Outcomes: At the end of the unit, the student will be able to:

- Understand administrative structure of union government
- Understand the federal nature of Indian Union
- Understand judicial structure at various levels

10

Unit3

State Government and its Administration – Governor – Role and Position – CM and Council of ministers, State Secretariat: Organization, Structure and Functions

Learning Outcomes: At the end of the unit, the student will be able to:

- Understand the administrative structure of state government
- Know the power distribution between CM and Governor

8

Unit4

Local Administration – District Administration Head – Role and Importance, Municipalities – Mayor and role of Elected Representative – CEO of Municipal Corporation Panchayati Raj: Functions PRI: Zila Panchayat, Elected officials and their roles, CEO Zila Panchayat: Block level Organization all Hierarchy - (Different departments), Village level – Role of Elected and Appointed officials – Importance of grass root democracy.

Learning Outcomes: At the end of the unit, the student will be able to:

- Understand district administrative structure
- Understand various kinds of local governance in practice
- Know the relevance of local administration in accomplishing grass-root democracy

10

Unit5

Election Commission: Election Commission – Role of Chief Election Commissioner and Election Commissionerate State Election Commission: Functions of Commissions for the welfare of SC/ST/OBC and women

Learning Outcomes: At the end of the unit, the student will be able to:

- Understand the autonomous role of ECI in conducting free and fair elections
- Need of various National commissions in the uplift of weaker sections

Prescribed Textbooks:

1. Durga Das Basu, Introduction to the Constitution of India, Prentice-Hall of India Pvt. Ltd. New Delhi
2. Subash Kashyap, Indian Constitution, National Book Trust

ReferenceBooks

1. J.A.Siwach, Dynamics of Indian Government & Politics
2. D.C.Gupta, Indian Government and Politics
3. M.V.Pylee, India's Constitution

Course Outcomes:

Upon successful completion of the course, student will be able to	Blooms Level of Learning
1. Understand the historical background of the constitution making and its importance for building a democratic India.	L2
2. Understand the functioning of three wings of the government, i.e., executive, legislative and judiciary.	L2
3. Understand the value of the fundamental rights and duties for becoming good citizens of India.	L2
4. Understand the decentralization of power between union, state and local self - government.	L2
5. Understand the operation of constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy	L2

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
20AC52T.1	-	-	-	-	-	-	-	-	-	-	-	2	-	-
20AC52T.2	-	-	-	-	-	-	-	-	-	-	-	3	-	-
20AC52T.3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
20AC52T.4	-	-	-	-	-	-	-	-	-	-	-	2	-	-
20AC52T.5	-	-	-	-	-	-	-	-	-	-	-	3	-	-

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

Title of the Course Heat Transfer
Category PCC
Course Code 20A361T

Year III B. Tech
Semester II Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To impart the basic laws of conduction, convection, radiation heat transfer and their applications
- To provide knowledge about heat flow in various systems.
- To familiarize the convective heat transfer concepts.
- To understand the principles of phase change processes and radiation heat transfer.
- To make conversant about heat transfer in various heat exchangers

Unit 1 Introduction to conduction heat transfer 6

Introduction: Modes and mechanisms of heat transfer – Basic laws of heat transfer –General applications of heat transfer. Conduction Heat Transfer: Fourier heat transfer equation – General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates. Simplification and forms of the field equation – steady, unsteady and periodic heat transfer – boundary and Initial conditions.

Learning Outcomes: At the end of the unit, the student will be able to:
- Identify the different modes of Heat Transfer. (L2)
- Applying Basic Governing Equation of different modes of Heat Transfer. (L3)

Unit 2 One dimensional steady state & transient heat conduction 12

One Dimensional Steady State Heat Conduction: In homogeneous slabs, hollow cylinders and spheres – overall heat transfer coefficient – electrical analogy – Critical radius/thickness of insulation–System with internal heat generation (elementary treatment-Plane Wall-Uniform). Extended surface (fins) Heat Transfer – Long Fin, Fin with insulated tip and Short Fin, Application to error measurement of Temperature. One Dimensional Transient Heat Conduction: Systems with negligible internal resistance – Significance of Biot and Fourier Numbers - Chart solutions of transient conduction systems- Problems on semi-infinite body.

Learning Outcomes: At the end of the unit, the student will be able to:
- Gain the knowledge on one Dimensional Steady state heat conduction in slabs, hollow cylinder and Spheres. (L2)
- Apply the Knowledge on different types of Fins And their Efficiency. (L3)
- Gain knowledge on Transient Heat Conduction. (L2)

Unit 3 Convective heat transfer 10

Convective Heat Transfer: Forced Convection: External Flows-Concepts of hydrodynamic and thermal boundary layer and use of empirical correlations for flow over-flat plates, cylinders. Internal Flows:-Division of internal flow through concepts of Hydrodynamic and Thermal entry lengths – Use of empirical relations for horizontal pipe flow, annular flow. Free Convection: -Development of Hydrodynamic and thermal boundary layer along a vertical plate – Use of empirical relations for plates and cylinders in horizontal and vertical orientation. Dimensional analysis Buckingham π Theorem- examples- Free & Forced convection.

Learning Outcomes: At the end of the unit, the student will be able to:
- Gain knowledge on Natural and Forced Convections and their applying skills for Solving Problems. (L3)
- Gain knowledge on Dimensional analysis for in Solving Problems. (L3)

Unit 4 Heat transfer with phase change & Radiation 12

Heat Transfer with Phase Change: Boiling- Pool boiling – Regimes, determination of heat transfer coefficient in Nucleate boiling, Critical Heat flux and Film boiling. Condensation: -Film wise and drop wise condensation. Radiation Heat Transfer: Emission characteristics and laws of black-body radiation – Irradiation – Total and Monochromatic quantities– Laws of Planck, Wien, Kirchoff, Lambert, Stefan and Boltzmann– Heat exchange between two black bodies – Concepts of shape factor – Emissivity –Heat exchange between gray bodies – Radiation shields– Electrical analogy for radiation networks.

Learning Outcomes: At the end of the unit, the student will be able to

- Gain the knowledge on Heat Transfer with Phase Change. (L2)
- Gain the knowledge on radiation and Radiation shields. (L2)

Unit 5 Heat Exchangers 8

Heat Exchangers: Classification of heat exchangers – Overall heat transfer Coefficient and fouling factor – Concepts of LMTD and NTU methods - Problems using LMTD and NTU methods.

Learning Outcomes: At the end of the unit, the student will be able to:

- Gain knowledge on different types of Heat exchangers and their Application. (L2)
- Gain the Basic knowledge on Heat Exchanger Design.(L2)

Prescribed Text Books:

1. R.C. Sachdeva, Fundamentals of Engg. Heat and Mass Transfer. New Age International, 5th Ed.2017, ISBN13: 978-1781831038.
2. P.K.Nag, Heat Transfer. TMH, 3rd Ed. 2011, ISBN-13: 978-0070702530
3. J.P.Holman, Heat Transfer. TMH, 10th Ed. 2010, ISBN-13: 978-0073529363.

Reference Books:

1. Incropera, Fundamentals of Heat and Mass transfer. Wiley India, 8th Ed,2017 ISBN: 978-1-119-35388-1.
2. M. Thirumaleswar, Fundamentals of Heat and Mass Transfer. Pearson Edu. 2006 ISBN 13: 9788177585193.
3. Arora and Domkunduwar/ A course in Heat and Mass transfer /Dhanpathrai and sons.2007, ISBN-13: 978-8177000290
4. C.P.kothandaraman & S.Subramanyam, Heat and Mass transfer data hand book, New Age Publications, 2014, ISBN-13: 978-8122435955.

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Summarize the modes of heat transfer.	L2
2. Apply the knowledge of conduction heat transfer for various geometry.	L3
3. Calculate heat transfer rates in forced and free convection.	L3
4. Calculate the heat transfer rates during phase change process and radiation.	L3
5. Evaluate the performance of the heat exchangers.	L5

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A361T.1	2	2	1	1	-	-	-	-	-	-	-	-	1	1
20A361T.2	3	2	1	2	-	-	-	-	-	-	-	-	1	1
20A361T.3	3	2	1	2	-	-	-	-	-	-	-	-	1	1
20A361T.4	3	2	1	2	-	-	-	-	-	-	-	-	1	1
20A361T.5	3	3	2	3	-	-	-	-	-	-	-	-	1	1

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

Title of the Course Metrology & Measurements
Category PCC
Course Code 20A362T

Year III B. Tech.
Semester II Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

- To understand the principles of Limits, Fits, Tolerances and Gauges to design the machine elements and to check the dimensional accuracy of machine components.
- To understand the principles of linear measurements and angular measurements to measure the dimensional accuracy of machine components.
- To understand the principles of roughness of surface, and also learn about the screw thread and gear measuring methods.
- To understand the principles of various transducers to measure displacement like Piezoelectric, Inductive, capacitance, resistance, ionization and Photoelectric transducers and also learn about measurement of speed using various types of tachometers.
- To understand the principles of various sensors and instruments to measure the temperature, pressure, force, torque and power.

Unit 1 **9**

Limits, Fits And Tolerances: Introduction, Definitions, fits and their types –unilateral and bilateral tolerance system, hole and shaft basis systems – interchangeability and selective assembly. Indian standard system – International Standard organization system for plain work.

Limit Gauges And Gauge Design: Plug, Ring, Snap, Gap, Taper gauges. Taylor's principle. Design of Go and No Go gauges.

Blooms

Learning Outcomes: At the end of the unit, the student will be able to:

- learn about providing the tolerances to the assembling machined components (L1)
- learn about checking the tolerances of machined components using Gauges (L2)

Unit 2 **8**

Linear Measurement: Length standard, line and end & wave length standards, slip gauges – calibration of the slip gauges, Dial indicator, micrometers, vernier height gauges.

Measurement Of Angles And Tapers: Different methods – Bevel protractor –angle gauges – spirit levels – sine bar – Sine plate, rollers and spheres used to determine the tapers.

Learning Outcomes: At the end of the unit, the student will be able to:

- Learn about various linear measurement instruments (L1).
- Learn about various methods to measure the angles and tapers (L2).

Unit 3 **11**

Surface Roughness Measurement: Differences between surface roughness and surface waviness- Numerical assessment of surface finish – CLA, R.M.S Values –Ra, Rzvalues, Methods of measurement of surface finish - profilograph, Talysurf, BIS symbols for indication of surface finish.

Screw Thread Measurement: Elements of measurement – errors in screw threads – measurement of effective diameter, angle of thread and thread pitch- profile thread gauges.

Gear measurement: Gear measuring instruments, Gear tooth profile measurement. Measurement of diameter, pitch, pressure angle and tooth thickness.

Learning Outcomes: At the end of the unit, the student will be able to:

- Learn about, how to measure the surface roughness parameters. (L1)
- Learn about, how to measure the various parameters of Screw and Gear components. (L2)

Unit 4 **8**

Measurement Of Displacement: Theory and construction of various transducers to measure displacement - Piezoelectric, Inductive, capacitance, resistance, ionization and Photo electric transducers, Calibration procedures.

Measurement Of Speed: Mechanical Tachometers – Electrical tachometers -Stroboscope, Non contact type of tachometer.

Learning Outcomes: At the end of the unit, the student will be able to:

- Learn about various displacements measurement transducers. (L1)
- Learn about various speeds measurement principles of various Tachometers. (L2)

Unit 5 **12**

Measurement Of Temperature: Standards and calibration, thermal expansion methods, thermoelectric sensors (thermocouples), Electrical Resistance sensors, Junction semiconductor sensors, Digital thermometers, Radiation methods.

Measurement Of Pressure: Standards and calibration, basic methods of pressure measurement, deadweight gauges and manometers, Elastic transducers, High and low pressure measurement.

Measurement Of Force, Torque, Power: Standards and calibration, Basic methods of Force Measurement, Torque measurement on rotating shafts, shaft power measurement (dynamometers), Vibrating wire force transducers

Learning Outcomes: At the end of the unit, the student will be able to:

- Learn about various temperature and pressure measurement techniques. (L1)
- Learn about the various instruments principles to measure the Force, Torque and Power parameters.(L2)

Prescribed Textbooks:

1. Engineering Metrology, R.K. Jain, Khanna Publishers, 20th edition, 2013
2. Engineering Metrology, Mahajan, DhanpatRai, 2nd edition, 2013.
3. D.S. Kumar, Mechanical Measurements and Control. Metropolitan Books, New Delhi, 2015.
4. Beckwith and Buck, Mechanical Measurements. Narosa Publication.2012
5. S. Ghosh, Control Systems – Theory & Applications. Pearson Education, New Delhi, 2012.

Reference Books:

1. Metrology & Measurement by Anand K Bewoor, vinay A kulkarni, Mc Graw Hill, 2013.
2. Fundamentals of Dimensional Metrology, Connie Dotson , 4e, Thomson
3. B.S.Manke, Linear Control Systems. Khanna Publishers, New Delhi, 2009.
4. Nagarathan and Gopal, Control System Engineering, Narosa Publishers.
5. Naresh K. Sinha, Control Systems, NAI Publishers, New Delhi, 2008

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Summarize the concepts of limits, fits and limit gauges used for designing and manufacturing of mechanical components	L2
2. Use the various linear, angular and flatness measuring instruments for measuring the component tolerances.	L3
3. Use the different types of instruments for measuring Surface roughness, screw thread elements and Gear Tooth profile parameters.	L3
4. Apply the working principles of various instruments for measuring the displacement and speed.	L3
5. Apply the working principles of various instruments for measuring the temperature, pressure, force torque and power	L3

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A362T.1	2	2	1	1	-	-	-	-	-	-	-	-	1	1
20A362T.2	3	2	1	2	-	-	-	-	-	-	-	-	1	1
20A362T.3	3	2	1	2	-	-	-	-	-	-	-	-	1	1
20A362T.4	3	2	1	2	-	-	-	-	-	-	-	-	1	1
20A362T.5	3	2	1	2	-	-	-	-	-	-	-	-	1	1

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

Title of the Course	CAD/CAM
Category	PCC
Course Code	20A363T
Year	III B. Tech
Semester	II Semester
Branch	ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

- To understand the basic concepts of CAD/CAM and Transformations.
- To understand the different geometric modeling techniques like solid modeling, surface modeling, feature based modeling etc. and to visualize how the components look like before its manufacturing or fabrication
- To Develop NC and CNC programs to manufacture industrial Components.
- To Understand the importance of Group Technology and Flexible Manufacturing System
- To Understand the elements of an automated manufacturing environment

Unit 1 Introduction to Computer Graphics 10

Introduction: Introduction to CAD and CAM- Elements of CAD-Computers in Industrial Engineering-Product Cycle-CAD/CAM Hardware-Basic Structure of CPU-Input and Output Devices-Display Devices (CRT and DVST)-Raster Scan Graphics Coordinate System-Representation of Line and Circles, Database Structure for Graphics Modeling-Transformation -2D and 3D

Learning Outcomes: At the end of the unit, the student will be able to:

- Apply CAD/CAM concepts to product design and manufacturing (L3)
- Describe the basic structure of CAD workstations, input devices and output devices etc (L2)

Unit 2 Curve Representation 10

Geometric Modeling-Classification of wireframe entities, Curve representation methods, Parametric representation of analytic curves: line, circle, arc, conics, Parametric representation of synthetic curves: Hermite cubic curve, Bezier curve, B-Spleen curve-Representation of surface modelling, -Hermite bicubic surface patch-Bezier and B-spline Surfaces, Solid modelling techniques, CSG and B-rep.

Learning Outcomes: At the end of the unit, the student will be able to:

- Develop a mathematical model to represent curves. (L6)
- Develop different types of surfaces with the help of different curves (L6)

Unit 3 Numerical Control 10

NC, NC modes, NC elements, NC machine tools, structure of CNC machine tools, features of Machining center, turning center, CNC Part Programming: fundamentals, manual part programming methods, Computer Aided Part Programming.

Learning Outcomes: At the end of the unit, the student will be able to:

- Explain the basic concepts of CNC programming and machining (L2)
- Understand the concepts of Machining centers. (L2)

Unit 4 Group Technology And Flexible Manufacturing System 10

Group Technology: Part family, coding and classification, production flow analysis, advantages and limitations, Computer Aided Processes Planning, Retrieval type and Generative type.

Flexible Manufacturing System: Introduction to FMS – Material Handling System – Computer Control Systems – Human Labor in Manufacturing system – Applications – Advantages and Limitations

Learning Outcomes: At the end of the unit, the student will be able to:

- Design and Analyze the layouts of manufacturing system (L6)
- Design material handling for a typical production system (L6)

Unit 5 Computer Integrated Production Planning And Computer Aided Quality Control 10

Computer Aided Quality Control (CAQC): Capacity planning, shop floor control, MRP-I, MRP-II, CIMS benefits, JIT approach. Terminology in quality control, the computer in QC, contact inspection methods, non-contact inspection methods-optical and non-optical, computer aided testing, integration of CAQC with CAD/CAM.

Learning Outcomes: At the end of the unit, the student will be able to:

- Describe the automation inspection systems. (L2)
- Understand the role of computers in quality systems. (L2)

Prescribed Text Books:

1. P N Rao, CAD/CAM – Principle and Applications
2. A Zimmer & P Groover, CAD/CAM. PE,PHI
3. RadhaKrishnan and Subramaniah, CAD/CAM/CIM. New Age

Reference Books:

1. Groover, P.E, Automation, Production systems & Computer integrated Manufacturing
2. Farid Amirouche, Principles of Computer Aided Design and Manufacturing. Pearson
3. CSP Rao, A text book of CAD/CAM, Hitech Publ.

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Summarize the concepts of CAD/CAM and its transformations	L2
2. Summarize the geometric modelling techniques	L2
3. Write the NC and CNC programs with basic fundamentals	L6
4. Explain the significance of Group Technology and Flexible Manufacturing System	L2
5. Summarize the concepts of Computer Integrated Production Planning and Computer Aided Quality Control.	L2

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A363T.1	2	2	1	1	-	-	-	-	-	-	-	-	2	2
20A363T.2	2	2	1	1	-	-	-	-	-	-	-	-	3	3
20A363T.3	3	3	3	3	-	-	-	-	-	-	-	-	3	3
20A363T.4	2	2	1	1	-	-	-	-	-	-	-	-	2	2
20A363T.5	2	2	1	1	-	-	-	-	-	-	-	-	2	2

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

Title of the Course	Automobile Engineering
Category	PEC
Course Code	20A36AT
Year	III B. Tech
Semester	II Semester
Branch	ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To gain the basic knowledge on automobile components and its electrical systems.
- To understand various emission control techniques.
- To obtain knowledge on power transmission systems used in automobiles.
- To get the basic idea on steering, suspension, and braking systems employed in automobiles.
- To gain knowledge on Safety Systems used in automobiles.

Unit 1 Introduction **10**

Introduction: Components of a four wheeler automobile – chassis and body – power unit –power transmission – rear wheel drive, front wheel drive, 4 wheel drive – types of automobile engines, engine construction, turbo charging and super charging – oil filters, oil pumps – crank case ventilation.

Electrical System : Charging circuit, generator, current – voltage regulator – starting system, Bendix drive, mechanism of Solenoid switch, Lighting systems, Horn, wiper, Fuel gauge – oil pressure gauge, Engine temperature indicator.

Learning Outcomes: At the end of the unit, the student will be able to
- Understand the basic lay-out of an automobile. (L2)
- Understand the basic concepts of electrical systems. (L2)

Unit 2 Transmission System **9**

Transmission System: Clutches- Principle- types: cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel – gear box- types: sliding mesh, constant mesh, synchromesh, epi-cyclic, over drive, torque converter. Propeller shaft – Hotch – Kiss drive, Torque tube drive, universal joint, differential, rear axles.

Learning Outcomes: At the end of the unit, the student will be able to
- Understand the function and components of clutches. (L2)
- Understand the types of gear boxes and transmission systems. (L2)

Unit 3 Steering System, Suspension System and Braking System **10**

Steering System: Steering geometry – camber, castor, king pin rake, combined angle toe-in, center point steering. Steering gears – types, steering linkages.

Suspension System: Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system.

Braking System: Mechanical brake system, Hydraulic brake system, Pneumatic and vacuum brake systems.

Learning Outcomes: At the end of the unit, the student will be able to
- Understand the steering geometry. (L2)
- Understand the different types of suspension systems. (L2)
- Understand the importance of braking systems. (L2)

Unit 4 Safety System 8

Safety System: Antilock braking system, air bag restraint system, voice warming system, seat belt system, road navigating system, anti-theft system.

Learning Outcomes: At the end of the unit, the student will be able to

- Understand the different types of Safety System. (L2)
- Understand the anti-theft system. (L2)

Unit 5 Introduction to Electric Vehicles (EV) 9

National and International emission standards role in controlling the Automobile emissions. History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles. Components of electric vehicle. General layout of EV. Advantages and disadvantages of EV compared to ICE vehicles.

Learning Outcomes: At the end of the unit, the student will be able to

- Understand the concepts of Pollution standards National and international (L2)
- Know the concept of to Electrical Vehicles (L2)

Prescribed Text Books:

1. Kirpal Singh, Automobile Engineering –Vol.1&Vol.2., standard publisher's distributors, 13th Ed.2013 & 2014. ISBN: 9788180141966, 818014196.
2. Iqbal Hussein, "Electric and Hybrid vehicles: Design fundamentals", CRC Press, 3 rd Ed.2021. ISBN 9780367693930.
3. John Heywood, Internal combustion engine fundamentals, McGraw-Hill 2nd Ed 2018. ISBN: 9781260116106.

Reference Books:

1. James Larminie, John Lowry, "Electric Vehicle Technology Explained", Wiley, 2nd Ed.2012. ISBN: 978-1-119-94273-3.
2. G.B.S. Narang, Automobile Engineering, Khanna Publishers.2009. ISBN. 8174092823.
3. S. Srinivasan, Automotive Mechanics, 2nd Ed., Tata McGraw Hill 2003. ISBN 13: 9780070494916, ISBN 10: 0070494916.
4. R.B. Gupta, Automobile Engineering, Tech India Publications.2016.ISBN NO.:81-7684-821-2.

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Summarize the components of Automobile and their driving systems.	L2
2. Summarize the various elements of transmission system.	L2
3. Summarize the basic concept of steering, braking and suspension system	L2
4. Summarize the safety systems.	L2
5. Summarize the basic concept of Electric Vehicles.	L2

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
20A36AT .1	2	2	1	1	-	-	-	-	-	-	-	-	1	1
20A36AT .2	2	2	1	1	-	-	-	-	-	-	-	-	1	1
20A36AT .3	2	2	1	1	-	-	-	-	-	-	-	-	1	1
20A36AT .4	2	2	1	1	-	-	-	-	-	-	-	-	1	1
20A36AT .5	2	2	1	1	-	-	-	-	-	-	-	-	1	1

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

Title of the Course	Design for manufacturing
Category	PEC
Course Code	20A36BT
Year	III B. Tech
Semester	II Semester
Branch	ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

- To explain the product development cycle and manufacturing issues to be considered in design.
- To familiarize manufacturing consideration in cast, forged, and weld components.
- To describe the manufacture of sheet metal components.
- To impart knowledge plastics as substitution to metallic parts.

Unit 1 Introduction 10

Introduction: Design philosophy-steps in design process-general design rules for manufacturability-basic principles of designing for economical production-creativity in design.

Materials: Selection of materials for design-developments in material technology-criteria for material selection-material selection interrelationship with process selection.

Learning Outcomes: At the end of the unit, the student will be able to

- Understand the design mechanical components with economical consideration. (L2)
- Select the materials for design – developments for material selection. (L2)

Unit 2 Machining processes 9

Machining processes: Overview of various machining processes-general design rules for machining-dimensional tolerance and surface roughness-Design for machining – ease –redesigning of components for machining ease with suitable examples. General design recommendations for machined part.

Learning Outcomes: At the end of the unit, the student will be able to

- Describe various machining processes and designs for machining with suitable examples. (L2)

Unit 3 Metal casting and Metal joining 12

Metal casting: Appraisal of various casting processes, selection of casting process,-general design considerations for casting-casting tolerance-use of solidification, simulation in casting design-product design rules for sand casting.

Metal joining: Appraisal of various welding processes, factors in design of weldments – general design guidelines-pre and post treatment of welds-effects of thermal stresses in weld joints-design of brazed joints.

Learning Outcomes: At the end of the unit, the student will be able to

- Understand the various casting processes and casting tolerance for product design. (L2)
- Understand the various welding processes and general design guide lines for treatment on welds. (L2)

Unit 4 Forging, Extrusion & Sheet metal work 8

Forging: Design factors for forging – closed die forging design – parting lines of dies – drop forging die design – general design recommendations.

Extrusion & Sheet metal work: Design guide lines extruded sections-design principles for punching, blanking, bending, and deep drawing-Keeler Goodman forging line diagram – component design for blanking.

Learning Outcomes: At the end of the unit, the student will be able to

- Identify the design factors for forging and its types. (L2)
- Understand the design guide lines and principles for various extrusion and sheet metal work. (L2)

Unit 5 Plastics **10**

Plastics: Visco elastic and creep behavior in plastics-design guidelines for plastic components-design considerations for injection moulding – design guidelines for machining and joining of plastics.

Learning Outcomes: At the end of the unit, the student will be able to

- Design plastic parts with manufacturing considerations. (L6)

Prescribed Text Books:

1. George E Dieter and Linda Schmidt, Engineering Design, 4th Edition, McGraw Hill (2015) ISBN: 9780073398143
2. A.K.Chitale and R.C.Gupta, Product Design and Manufacturing, 5th Edition, PHI Learning (2011). ISBN-10: 8120342828
3. David M Anderson, Design for Manufacturability, CRC Press (2013). ISBN: 9781482204926

Reference Books:

1. James G Bralla, Design For Manufacturability Handbook, 2nd Edition, McGraw Hill (2004). ISBN: 9780070071391
2. Dr. P.C.Sharma, Production Technology, S.Chand& Company (2009). ISBN-10 : 8121911141

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Design mechanical components with economic considerations.	L6
2. Summarize the materials and machining processes	L2
3. Explain for redesigning components out of manufacturing considerations.	L2
4. Design for forging, extrusion and sheet metal works.	L6
5. Design plastic parts with manufacturing considerations	L6

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A36BT.1	2	2	2	2	-	-	-	2	-	-	-	2	2	2
20A36BT.2	2	-	-	2	-	-	-	2	-	-	-	2	2	2
20A36BT.3	2	-	-	2	-	-	-	2	-	-	-	2	2	2
20A36BT.4	3	3	3	3	-	-	-	2	-	-	-	2	2	2
20A36BT.5	3	3	3	3	-	-	-	2	-	-	-	2	2	2

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

Title of the Course Non-Destructive Testing
Category PEC
Course Code 20A36CT

Year III B. Tech
Semester II Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives: This course will able to
- Introduce basic concepts of nondestructive testing.
- Familiarize with characteristics of ultrasonic test, transducers, rejection and effectiveness.
- Describe concept of liquid Penetrant, eddy current and magnetic particle tests, its applications and limitations.
- Explain the principles of infrared and thermal testing, applications and honey comb and sandwich structures case studies.
- Impart NDE and its applications in pressure vessels, casting and welded constructions

Unit 1 Introduction to non-destructive testing 6

Radiographic test**,** Sources of X and Gamma Rays and their interaction with Matter, Radiographic equipment, Radiographic Techniques, Safety Aspects of Industrial Radiography.

Learning Outcomes: At the end of the unit, the student will be able to:
- explain nondestructive testing techniques & radiographic techniques (L2)
- Discuss the safety aspects of industrial radiography. (L4)
- outline the concepts of sources of X and Gamma Rays (L2)

Unit 2 Ultrasonic Testing 10

Principle of Wave Propagation, Reflection, Refraction, Diffraction, Mode Conversion and Attenuation, Sound Field, Piezo-electric Effect, Ultrasonic Transducers and their Characteristics, Ultrasonic Equipment and Variables Affecting Ultrasonic Test, Ultrasonic Testing, Interpretations and Guidelines for Acceptance, Rejection - Effectiveness and Limitations of Ultrasonic Testing.

Learning Outcomes: At the end of the unit, the student will be able to:
- Explain the principle of ultrasonic test. (L2)
- Discuss the characteristics of ultrasonic transducers. (L4)
- Analyze the performance of wave propagation, reflection, refraction, diffraction and sound field in ultrasonic test. (L4)

Unit 3 Liquid Penetrant, Eddy Current & Magnetic Particle Testing 12

Liquid Penetrant Test, Basic Concepts, Liquid Penetrant System, Test Procedure, Effectiveness and Limitations of Liquid Penetrant Testing. Principle of Eddy Current, Eddy Current Test System, Applications of Eddy Current-Testing Effectiveness of Eddy Current Testing. Magnetic Materials, Magnetization of Materials, Demagnetization of Materials, Principle of Magnetic Particle Test, Magnetic Particle Test Equipment, Magnetic Particle Test Procedure, Standardization and Calibration, Interpretation and Evaluation, Effective Applications and Limitations of the Magnetic Particle Test.

Learning Outcomes: At the end of the unit, the student will be able to:
- Illustrate the procedure of Liquid Penetrant, eddy current and magnetic particle tests. (L2)
- Outline the limitations of Penetrant, eddy current and magnetic particle tests. (L2)
- Explain the effectiveness of Penetrant, eddy current and magnetic particle tests. (L2)

Unit 4 Infrared and Thermal Testing 10

Introduction and fundamentals to infrared and thermal testing–Heat transfer –Active and passive techniques –Lock

in and pulse thermography–Contact and non-contact thermal inspection methods–Heat sensitive paints –Heat sensitive papers –-thermally quenched phosphors liquid crystals –techniques for applying liquid crystals –other temperature sensitive coatings –Inspection methods –Infrared radiation and infrared detectors–thermo mechanical behavior of materials–IR imaging in aerospace applications, electronic components, Honey comb and sandwich structures–Case studies.

Learning Outcomes: At the end of the unit, the student will be able to

- illustrate thermal inspection methods & outline the limitations of thermal testing (L2)
- Discuss the fundamentals of thermal testing. (L6)
- Explain the techniques of liquid crystals, active and passive. (L2)

Unit 5 Industrial Applications of NDE 8

Span of NDE Activities Railways, Nuclear, Non-nuclear and Chemical Industries, Aircraft and Aerospace Industries, Automotive Industries, Offshore Gas and Petroleum Projects, Coal Mining Industry, NDE of pressure vessels, castings, welded constructions

Learning Outcomes: At the end of the unit, the student will be able to:

- Illustrate applications of NDE. (L2)
- Outline the limitations and disadvantages of NDE. (L2)
- Explain the applications of Railways, Nuclear and chemical industries. (L2)

Prescribed Text Books:

1. J Prasad, GCK Nair , Nondestructive test and evaluation of Materials, Tata mcgraw-Hill Education Publishers, 2008 , ISBN:9780070620841
2. Josef Krautkrämer, Herbert Krautkrämer, Ultrasonic testing of materials, 3/e, Springer-Verlag, 1983, ISBN 978-3-662-10680-8
3. X. P. V. Maldague, Non destructive evaluation of materials by infrared thermography, 1/e, Springer-Verlag, 1993, ISBN 978-1-4471-1995-1

Reference Books:

1. Gary L. Workman, Patrick O. Moore, Doron Kishoni, Non-destructive, Hand Book, Ultrasonic Testing, 3/e, Amer Society for Nondestructive, 2007, ISBN-10: 1571171630
2. ASTM Standards, Vol 3.01, Metals and alloys, 2020, ISBN 978-1-6822-1620-0

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Understand the knowledge on basic concepts of non-destructive testing, Radiographic Techniques and Safety Aspects of Industrial Radiography.	L2
2. Understand the concepts of Ultrasonic Testing and Limitations of Ultrasonic Testing	L2
3. Analyse the Basic Concepts of Liquid Penetrant, Eddy Current & Magnetic Particle Testing and Effective Applications and Limitations of the Magnetic Particle Test	L4
4. Analyse the concept of Infrared and Thermal Testing and Honey comb and sandwich structure	L4
5. Analyse the o impart NDE and its applications in pressure vessels, casting and welded constructions	L4

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A36CT.1	3	2	1	2	-	-	-	-	-	-	-	-	1	2
20A36CT.2	3	2	1	2	-	-	-	-	-	-	-	-	1	2
20A36CT.3	3	2	1	2	-	-	-	-	-	-	-	-	1	2
20A36CT.4	3	3	2	2	-	-	-	-	-	-	-	-	1	1
20A36CT.5	3	2	1	2	-	-	-	-	-	-	-	-	1	1

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

Title of the Course Automation & Robotics
Category PEC
Course Code 20A36DT

Year III B. Tech
Semester II Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To acquire basic knowledge on automation and automated flow lines in automatic manufacturing systems.
- To learn about the line balancing methods and automated assembly systems
- To learn about the robotics and fundamentals of robots with their needs in present trend.
- To understand robot kinematics, dynamics and to acquire knowledge on importance of trajectory planning in robots.
- To learn about the sensors, actuators and robot programming methods used in robots.

Unit 1 Automation & Automated flow lines 7

Introduction to Automation , Need, automation principles, automation strategies, Types, Basic elements of an automated system, levels of automation, hardware components for automation and process control,.
Automated flow lines: Part transfer methods and mechanisms, types of Flow lines, flow line with/without buffer storage

Learning Outcomes: At the end of the unit, the student will be able to:
- Understand the need and types of automation. (L2)
- Learn the strategies and principles of automation. (L1)
- Apply the concept of an automated flow lines in an automated manufacturing industry. (L3)

Unit 2 Assembly Systems and Line Balancing 8

The Assembly Process, Assembly Systems, Manual Assembly Lines, The Line Balancing Problem, Methods of Line Balancing, Other ways to improve the Line Balancing, Flexible Manual Assembly Lines.

Learning Outcomes: At the end of the unit, the student will be able to:
- Understand the importance of Line balancing in Assembly systems. (L2)
- Solve problems on the concepts of line balancing method (L3)

Unit 3 Introduction to Industrial Robots 7

Need for robots in Present customization, Classification, laws of robots. Robot configurations, Functional line diagram, Degrees of Freedom, Components, common types of arms, joints, grippers.

Learning Outcomes: At the end of the unit, the student will be able to:
- Understand the fundamentals of robots. (L2)
- Recall the functional line diagrams and configurations of robots. (L1)
- Remember about the robot end effectors. (L1)

Unit 4 Manipulator Kinematics, Dynamics & Trajectory Planning 8

Manipulator Kinematics: Homogeneous transformations as applicable to rotation and translation –
D-H notation, Forward and inverse kinematics
Manipulator dynamics: Differential transformation, Jacobians. Lagrange – Euler
Trajectory Planning: Trajectory planning and avoidance of obstacles, path planning, Skew motion, joint integrated motion – straight line motion.

Learning Outcomes: At the end of the unit, the student will be able to:
- Understand and apply Robot Kinematics. (L2)

- Understand the concepts of manipulator dynamics. (L2)
- Solve problems by applying the concept of trajectory planning. (L3)

Unit 5 Robot- Actuators, Sensors, Programming 7

Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors, comparison Position sensors – potentiometers, resolvers, encoders – Velocity sensors, tactile sensors, Proximity sensors. Robot Programming: Types – features of languages and software packages. Robot applications- Assembly, Spray painting, Loading &unloading, Inspection and material handling.

Learning Outcomes: At the end of the unit, the student will be able to:

- Understand the concept of Robot actuators and sensors. (L2)
- Memorize the Robot programming languages. (L1)
- Understand the applications of Robot in different sectors. (L2)

Prescribed Text Books:

1. M.P.Groover, Automation, Production systems and CIM. Pearson Edu 2004. ISBN-10: 9789332572492, ISBN-13: 978-9332572492
2. Niku Saeed B., Introduction to Robotics: Analysis, systems, Applications, PHI New Delhi. ISBN-10: 0130613096
3. M.P. Groover, Industrial Robotics. TMH 2003. ISBN-10 : 007024989X

Reference Books:

1. Fu KS, Robotics. McGraw Hill. 2014. ISBN: 9780071822282
2. Richard D. Klafter, Robotics Engineering. Prentice Hall. 1989. ISBN-10 : 0134687523
3. Ashitave Ghosal, Robotics, fundamental Concepts and analysis. Oxford Press, 2006. ISBN-10 : 0195673913
4. Saha, S.K., Introduction to Robtics, Second Edition McGraw Hill New Edition 2014. ISBN: 9789332902800.
5. John J. Craig, Introduction to Robotics. Pearson Edu 2017. ISBN: 0133489795

Course Outcomes:

A student will be able to	Blooms Level of Learning
1.Summarize the concepts of an automation and automated flow lines	L2
2.Analyze the line balancing methods and automated assembly systems	L4
3.Summarize the fundamentals of Robots	L2
4.Analyze the Robot kinematics, dynamics and trajectory planning	L4
5. Summarize the concept of Robot actuators, sensors and robot programming methods.	L2

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A36DT.1	2	2	1	1	-	-	-	-	-	-	-	-	1	1
20A36DT.2	3	3	2	2	-	-	-	-	-	-	-	-	2	2
20A36DT.3	2	2	1	1	-	-	-	-	-	-	-	-	1	1
20A36DT.4	3	3	2	2	-	-	-	-	-	-	-	-	2	2
20A36DT.5	2	2	1	1	-	-	-	-	-	-	-	-	1	1

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

Title of the Course Heat Transfer Lab
Category PCC
Course Code 20A361L

Year III B. Tech
Semester II Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	3	1.5

Course Objectives:
- To acquire Knowledge of the principle of mode of heat transfer
- To design and applications of heat exchanger
- To gain knowledge transient heat conduction and heat pipe
- To provide practical knowledge to determine heat transfer coefficient in boiling and condensation.

List of experiments
1. Thermal Conductivity of metal (conductor)
2. Thermal conductivity of insulating powder through Concentric Sphere
3. Overall heat transfer co-efficient through Composite Slab
4. Heat transfer coefficient in natural convection
5. Heat transfer coefficient in forced convection
6. Heat transfer from pin-fin
7. Emissivity of a gray body through Emissivity apparatus
8. Stefan Boltzman constant determination.
9. Parallel and counter flow heat exchanger
10. Critical heat flux determination in pool boiling process.
11. Thermal conductivity of insulating material through lagged pipe apparatus
12. Transient Heat Conduction
13. Heat transfer in drop and film wise condensation
14. Heat pipe demonstration

Note: Consider any 12 experiments out of 14.

Course Outcomes:

A student will be able to	Blooms Level of Learning
1.Calculate the thermal conductivity of metal bar, insulating powder, lagged pipe and composite wall.	L3
2. Calculate the fin efficiency and fin effectiveness and performance of heat exchanger.	L3
3. Calculate convective heat transfer coefficient in free, forced convection, unsteady state heat conduction, and drop and film wise condensation.	L3
4. Calculate the Stefan Boltzmann constant and emissivity of gray body.	L3
5. Calculate the Critical heat flux for pool boiling, heat transfer in Heat pipe and two phase heat flow.	L3

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
19A361L.1	3	3	1	2	-	-	-	1	-	1	-	1	1	1
19A361L.2	3	3	1	2	-	-	-	1	-	1	-	1	1	1
19A361L.3	3	3	1	2	-	-	-	1	-	1	-	1	1	1
19A361L.4	3	3	1	2	-	-	-	1	-	1	-	1	1	1
19A361L.5	3	3	1	2	-	-	-	1	-	1	-	1	1	1

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

Title of the Course Metrology & Measurements Lab
Category PCC
Course Code 20A362L

Year III B. Tech
Semester II Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	3	1.5

Course Objectives:
- To demonstrate the usage of metrology lab equipment.
- To know the working principles of different instruments.
- To learn the measurement of the Angle and taper s by Bevel protractor, Sine bar, etc.
- To understand the working of pressure gauge, LVDT, Strain gauge, transducers and anemometer.
- To calibrate different types of thermocouple.

Contents: Metrology Lab
1. Measurement of lengths, heights, diameters by Vernier calipers, micrometers etc.
2. Measurement of bores by internal micrometers and dial bore indicators.
3. Use of gear teeth, Vernier calipers and checking the chordal addendum and chordal height of spur gear.
4. Alignment test on the lathe.
5. Alignment test on milling machine.
6. Study of Tool makers microscope and its application
7. Angle and taper measurements by Bevel protractor, Sine bars, etc.
8. Use of spirit level in finding the flatness of surface plate.
9. Thread measurement by two wire/ three wire method.
10. Surface roughness measurement by Talysurf instrument.

Contents: Measurements Lab
1. Calibration of Pressure Gauges.
2. Calibration of Transducer for Temperature measurement.
3. Study and Calibration of LVDT Transducer for Displacement Measurement.
4. Calibration of Strain Gauge for the measurement of Strain.
5. Calibration of Thermocouple for Temperature Measurement.
6. Calibration of Capacitive Transducer for Angular Measurement.
7. Calibration of Resistance Temperature Detector for Temperature Measurement.
8. Study and Calibration of a Rotometer for flow measurement.
9. Study and Calibration of Photo and Magnetic Speed Pickups for the measurement of speed.
10. Study of anemometer.

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Use different instruments to measure different dimensions of work pieces	L2
2. Evaluate alignment of lathe and milling machines	L2
3. Solve temperature distribution by using different instruments	L3
4. Solve pressure, linear and angular displacement by using different instruments	L3
5. Solve strain, fluid flow rate, and speed by using different instruments	L3

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A362L.1	2	2	1	2	-	-		3	3	2	-	2	3	3
20A362L.2	3	3	3	3	-	-	-	3	3	2	-	2	3	3
20A362L.3	3	2	1	1	-	-	-	3	3	2	-	-	3	3
20A362L.4	3	2	1	1	-	-	-	3	3	2	-	-	3	3
20A362L.5	3	2	1	1	-	-	-	3	3	2	-	-	3	3

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

Title of the Course CAD/CAM Lab.
Category PCC
Course Code 20A363L

Year III B. Tech
Semester II Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	3	1.5

Course Objectives:
- To introduce the basics in modeling software.
- To get the knowledge on Analysis Package
- To enable the student to develop and to write the part programs for CNC Machines.

Part 1: Modelling
1. Sketcher
2. Part Modelling

Learning Outcomes: At the end of the unit, the student will be able to:
- Develop 2 dimensional sketches. (L6)
- Prepare 3 dimensional models. (L3)

Part 2: Analysis
1. Structural analysis
2. Thermal analysis

Learning Outcomes: At the end of the unit, the student will be able to:
- Analyses of different models. (L4)

Part 3: CAM
1. Development of G – code and M – code files for CNC Turning Machine.
2. Development of G – code and M – code files for CNC Milling Machine.
3. Developing CNC code by using CAM package

Learning Outcomes: At the end of the unit, the student will be able to:
- Develop G and M codes based part programs from different 3 dimensional models. (L6)

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Create a sketch using sketcher workbench	L6
2. Develop a part model	L6
3. Write a program on CNC Milling Machine for different operations	L6
4. Write a program on CNC Turning Machine for different operations	L6

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A363L.1	3	3	3	3	3	-	-	2	2	2	-	2	2	2
20A363L.2	3	3	3	3	3	-	-	2	2	2	-	2	2	2
20A363L.3	3	3	3	3	3	-	-	2	2	2	-	2	2	2
20A363L.4	3	3	3	3	3	-	-	2	2	2	-	2	2	2

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

Title of the Course Java Programming
Category SC
Course Code 20A564L

Year III B. Tech.
Semester II Semester
Branch EEE, ME, and ECE

Lecture Hours	Tutorial Hours	Practice Hours	Credits
1	0	2	2

Course Objectives: This course will be able to

- Understand the basic concepts of java programming.
- Analyze and apply concepts like packages, interfaces, and exception handling.
- Implement the multi-threading and GUI applications developed using JAVA.

Module 1 **Theory Hours: 4, Practice sessions: 6**

What is Java? Install Java & Java IDE, First Java Program, Variables and Data Types in Java, Operators in Java, Flow Control Statements in Java, functions in java, arrays in java, Strings in java

Learning Outcomes: At the end of the unit, the student will be able to

- Understand the data types, operators and control statements in Java (L2)
- Know the importance of functions, arrays and strings in Java Programming (L2)

Module 2 **Theory Hours: 3, Practice sessions: 6**

Object-Oriented Programming, Classes and Objects, Encapsulation, Abstraction, Inheritance, polymorphism

Learning Outcomes: At the end of the unit, the student will be able to:

- Demonstrate the importance of object oriented programming (L3)
- Define object oriented concepts (L2)

Module 3 **Theory Hours: 3, Practice sessions: 6**

Packages and Interfaces: Packages, Defining a Package, A Short Package Example, Access Protection, an Access Example, Importing Packages.
Abstract keyword, Interfaces: Defining an Interface, Implementing Interfaces, Nested Interfaces, Applying Interfaces, Variables in Interfaces, Interfaces Can Be Extended

Learning Outcomes: At the end of the unit, the student will be able to:

- Apply packages in the java programs (L3)
- Differentiate abstract class and interfaces (L3)

Module 4 **Theory Hours: 4, Practice sessions: 8**

Exception Handling: Exception-Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and catch, Displaying a Description of an Exception, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Built-in Exceptions
Multithreaded Programming: The Java Thread Model, Thread Priorities, Synchronization, Messaging, The Thread Class and the Runnable Interface, The Main Thread, Creating a Thread, Implementing Runnable, Extending Thread, Choosing an Approach, Creating Multiple Threads

Learning Outcomes: At the end of the unit, the student will be able to:

- Acquire knowledge on multithreading, exception handling and apply the same in developing real time java based applications (L1)
- Construct and classify error and exception handling (L4)

Module 5 **Theory Hours: 3, Practice sessions: 6**

Generics: What Are Generics, Generics Work Only with Reference Types, A Generic Class with Two Type Parameters, The General Form of a Generic Class
JavaFX Basic Concepts, Using Image and Image View, Button, Radio Button, CheckBox, TextField

Learning Outcomes: At the end of the unit, the student will be able to:

- Articulate the generics in java programming (L3)
- Implement JavaFX Basic Concepts in java programs (L5)

Prescribed Text Books:

1. Herbert Schildt. Java. The complete reference, TMH, 9th Edition.

Reference Books:

1. J.Nino and F.A. Hosch, An Introduction to programming and OO design using Java, John Wiley&sons.
2. Y. Daniel Liang, Introduction to Java programming, Pearson Education. 6th Edition
3. R.A. Johnson- Thomson, An introduction to Java programming and object oriented application development,

Course Outcomes:

At the end of the course, the student will be able to	Blooms Level of Learning
1. Understand the importance of datatypes, operators, functions, arrays and strings in Java Programming.	L2
2. apply reusability concepts like Inheritance, interfaces and packages in real time applications developed using JAVA	L3
3. relate the abstract class and interfaces in java programming	L3
4. Construct and classify error and exception handling	L4
5. Implement genetics and JavaFX basic concepts in java programs.	L5

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A564L.1	3	3	-	-	-	-	-	-	-	-	-	-	-	-
20A564L.2	-	3	3	2	-	-	-	-	-	-	-	-	-	-
20A564L.3	3	3	3	2	-	-	-	-	-	-	3	3	-	-
20A564L.4	3	3	3	-	-	-	-	-	-	-	3	3	-	-
20A564L.5	3	3	3	-	-	-	-	-	-	-	3	3	-	-

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

Title of the Course	Essence of Indian Traditional Knowledge
Category	MC
Course Code	20AC63T
Year	III Year
Semester	II Semester
Branch	EEE, ECE, ME

Lecture Hours	Tutorial Hours	Practical	Credits
3	0	0	0

Course Objectives:

- To learn basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature.
- To understand Holistic life style of Yogic-science and wisdom capsules in Sanskrit literature in modern society with rapid technological advancements and societal disruptions.
- To understand Indian Knowledge System, Indian perspective of modern scientific world-view and basic principles of Yoga and holistic health care system.
- To understand Indian philosophical traditions, Indian linguistic Tradition, and Indian artistic tradition.

Unit 1 **10**

Indian Tradition: Fundamental unity of India, India's heroic role in world civilization, The Indian way of life, Introduction to Indian tradition, The Scientific Outlook and Human Values.

Learning Outcomes: At the end of the unit, the student will be able to:

- Appreciate incorporated traditions in Indian culture
- Understand the value of culture and traditions in leading peaceful life
- Understand the hidden scientific outlook and imbibed human values in the Indian way of life

Unit 2 **10**

Basic structure of Indian Knowledge System: Indian Traditional Scriptures, Exposure to 4-Vedas (the Rigveda, the Yajurveda, the Samaveda and the Atharvaveda) , 4-Upvedas (Ayurveda, Dhanurveda, Gandharvaveda, Sthapatya etc.), 6-Vedangas (Shiksha, Kalp, Nirukta, Vyakaran, Jyotish), 6-Upangas (Dharmashastra, Meemansa, Puranas, Tarkashastra/Logic) etc.

Learning Outcomes: At the end of the unit, the student will be able to:

- Grasp basic structure of Indian knowledge system
- Understand the essence of Vedas and their value
- Understand the systematic classification of holy scriptures

Unit 3 **10**

Indian Knowledge System and Modern Science: Relevance of Science and Spirituality, Science and Technology in Ancient India, Superior intelligence of Indian sages and scientists.

Indian Traditional Health Care: Importance and Practice of Yoga, Pranayama and other prevailing health care techniques.

Learning Outcomes: At the end of the unit, the student will be able to:

- Establish connection between Indian knowledge system and Modern science
- Understand spirituality in relation to science
- Appreciate the superior intelligence of Indian saints and scientists

Unit 4 **8**

Indian Artistic Tradition: Introduction and overview of significant art forms in ancient India such as painting, sculpture, Civil Engineering, Architecture, Music, Dance, Literature etc.

Indian Linguistic Tradition: Ancient Indian languages and literary Heritages, Phonology, Morphology, Syntax and Semantics.

Learning Outcomes: At the end of the unit, the student will be able to:

- Get an overview of significant art forms of ancient India
- Understand pioneering efforts of ancient civil engineering technology
- Trace the basic Indian linguistic tradition

Unit 5 **10**

Indian Philosophical Tradition: (Sarvadarshan)- Nyaya, Viaisheshiika, Sankhya, Yoga, Meemansa, Brief understanding of Philosophy of Charvaka, Bhagwan Mahaveer Jain, Bhagwan Buddha, Kabeer, Guru Nanak Dev and other eminent ancient Indian Philosophers.

Activities: Activities will consist of one assignment on each module, group discussions, presentations,case study on various topics based on above curriculum

Learning Outcomes: At the end of the unit, the student will be able to:

- Find the essence of Indian philosophical tradition
- Assimilate the philosophical speculations of different sects and the preachings of eminent philosophers of ancient days

Prescribed Text Books

1. Ajwani L.H., Immortal India, Vora & Co. Publishers, 1997.
2. Swami Jitmananda, Modern Physics and Vedanta, Bharatiya Vidya Bhavan, 2004.
3. Krishnamurthy,V. Science and Spirituality- A Vedanta Perception,Bharatiya Vidya Bhavan, 2002.
4. Sharma D.S., The Upanishads- An Anthology, Bharatiya Vidya Bhavan, 1989.
5. Raman V.V.,Glimpses of Indian Heritage, Popular Prakashan,1993.

Reference Books:

1. Sivaramakrishnan, V., Cultural Heritage of India- Course Material, Bharatiya Vidya Bhavan, Mumbai, 5 th Edition, 2014.
2. Capra F., Tao of Physics, Shambhala, 2010.
3. Chaterjee S.C. and Datta D.M., An Introduction to Indian Philosophy, University of Calcutta, 1984.
4. Krishna Chaitanya, Arts of India, Abhinav Publications, 1987.
5. Jha V.N., Language, Thought and Reality.

Course Outcomes: Upon successful completion of the course, student will be able to — Bloom's Level of Learning

1. Explain basics of Indian tradition and Indian traditional knowledge systems. — L3
2. Describe basics of Indian traditional health care, technologies and its scientific perspectives. — L3
3. Explain basics of Indian artistic, linguistic and philosophical tradition. — L3
4. co-relate the Indian traditional knowledge in modern scientific perspective. — L4

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20AC63T.1	-	-	-	-	-	-	-	-	-	-	-	3	-	-
20AC63T.2	-	-	-	-	-	-	-	-	-	-	-	3	-	-
20AC63T.3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
20AC63T.4	-	-	-	-	-	-	-	-	-	-	-	3	-	-

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

Title of the Course Operations Research
Category PEC
Course Code 20A37AT

Year IV B. Tech
Semester I Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

- To enable the students to the nature and scope of various decision making situations within business contexts, understand and apply operations research techniques to industrial applications.
- To learn the fundamental techniques of Operations Research and to choose a suitable OR technique to solve problem.

Unit 1 **10**

Development – Definition– Characteristics and Phases – Types of operation and Research models– applications. Linear Programming Problem Formulation – Graphical solution – Simplex method –Artificial variables techniques - Two–phase method, Big-M method – Duality Principle.

Learning Outcomes: At the end of the unit, the student will be able to:

- Formulate practical problems given in words into a mathematical model. (L6)
- Quantify OR models to solve optimization problems. (L5)
- Formulate linear programming problems and appreciate their limitations. (L6)

Unit 2 **10**

Transportation Problem: Formulation – Optimal solution, unbalanced transportation problem –Degeneracy. Assignment Problem – Formulation – Optimal solution - Variants of Assignment Problem-Travelling Salesman problem

Learning Outcomes: At the end of the unit, the student will be able to:

- Model linear programming problems like the transportation. (L3)
- Solve the problems of transportation from origins to destinations with minimum time and cost. (L6)

Unit 3 **10**

Replacement Models: Introduction – Replacement of items that deteriorate with time – with change in money value - without change in money value – Replacement of items that fail completely, group replacement.
Theory Of Games: Introduction – Minimax - Maximin – Criterion and optimal strategy – Solution of games with saddle points – Rectangular games without saddle points – 2 X 2 games – m X 2, 2 X n & m x n games -Graphical method, Dominance principle.

Learning Outcomes: At the end of the unit, the student will be able to:

- Apply the concept of replacement model. (L3)
- Identify strategic situations and represent them as games. (L3)
- Solve simple games using various techniques. (L6)

Unit 4 **10**

Waiting Lines: Introduction – Single Channel – Poisson arrivals – exponential service times – with infinite queue length models.
Simulation: Definition – Types of simulation models – phases of simulation– applications of simulation – Queuing problems – Advantages and Disadvantages – Simulation Languages.

Learning Outcomes: At the end of the unit, the student will be able to:

- Understand and will apply the fundamentals of waiting lines in real life situations. (L3)
- Simulate queuing models. (L3)

Unit 5 **10**

Inventory: Introduction – Single item – Deterministic models – Purchase inventory models with one price break and multiple price breaks.

Dynamic Programming: Introduction – Bellman's Principle of optimality – Applications of dynamic programming-shortest path problem – linear programming problem.

Learning Outcomes: At the end of the unit, the student will be able to:

- Understand and will apply the fundamentals of inventory in real life situations. (L3)
- Have aware of applying Dynamic Programming technique to solve the complex problems by breaking them into a series of sub- problems. (L3)

Prescribed Text Books:

1. Operations Research, PS Gupta, DS Hira, S Chand Publications, 10th Edition, 2016, ISBN-13978-8121902816.
2. Operations Research, S.D. Sharma, Kedarnath and Ramnath Publications, 2012, ISBN-135551234001596.

Reference Books:

1. Introduction to Operations Research. Taha, PHI, 10 th edition, 2016, ISBN-13978-0134444017.
2. Operations Research. R. Panneerselvam, PHI Publ, 2nd edition, 2004, ISBN: 9788120319233.
3. Operations Research: Theory and Applications,Sharma J.K., 4th Edition, Laxmi Publications, 2009.

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Solve the Linear Programming Problems using Graphical, Simplex and Artificial Variable Techniques	L3
2. Solve the Transportation, Assignment and Travelling Salesmen problems	L3
3. Solve the problems of replacement and Game Theory	L3
4. Analyze the waiting lines in real life situations and Simulate the queuing models	L4
5. Apply the inventory models related to market and Dynamic Programming technique for complex problems	L3

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A37AT.1	3	2	1	2	-	-	-	1	-	-	-	-	1	2
20A37AT.2	3	2	1	2	-	-	-	1	-	-	-	-	1	2
20A37AT.3	3	2	1	2	-	-	-	1	-	-	-	-	1	2
20A37AT.4	3	3	2	2	-	-	-	1	-	-	-	-	1	1
20A37AT.5	3	2	1	2	-	-	-	1	-	-	-	-	1	1

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

Title of the Course Turbo Machinery
Category PEC
Course Code 20A37BT

Year IV B. Tech
Semester I Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To impart the basic knowledge of turbo machinery
- To familiarize various power absorbing devices and its key parameters.
- To understand the flow characteristics of Centrifugal compressors
- To make conversant with the flow characteristics of axial compressors.
- To provide preliminary design on turbo machines.

Unit 1 Principles **8**

Energy transfer between fluid and rotor, classification of fluid machinery, dimensionless parameters, specific speed, applications, stage velocity triangles, work and efficiency for compressors and turbines

Learning Outcomes: At the end of the unit, the student will be able to
- Learn Classification of fluid machinery. (L2)
- Calculate the work and efficiency for compressors and turbines. (L3)

Unit 2 Centrifugal Fans and Blowers **7**

Types, stage and design parameters, flow analysis in impeller blades, volute and diffusers, losses, characteristics curves and selection, fan drives and fan noise.

Learning Outcomes: At the end of the unit, the student will be able to
- Calculate the stage & design parameters in centrifugal fans and blowers. (L3)
- Analyze the flow in impeller blades. (L4)

Unit 3 Centrifugal Compressor **8**

Construction details, types, impeller flow losses, slip factor, diffuser analysis, losses and performance curves.

Learning Outcomes: At the end of the unit, the student will be able to
- Calculate air angle, pressure ratio and power required in centrifugal compressor. (L3)
- Understand the concept of losses and performance curves of centrifugal compressors. (L2)
- Analyze the construction details. (L4)

Unit 4 Axial Flow Compressor **7**

Stage velocity triangles, enthalpy-entropy diagrams, stage losses and efficiency, work done factor, simple stage design problems and performance characteristics.

Learning Outcomes: At the end of the unit, the student will be able to
- Calculate stage losses, stage efficiency and pressure ratio in axial flow compressor. (L3)
- Understand the concept of losses and performance curves of centrifugal compressors. (L2)

Unit 5 Axial and Radial Flow Turbines **8**

Stage velocity diagrams, reaction stages, losses and coefficients blade design principles, testing and performance characteristics.

Learning Outcomes: At the end of the unit, the student will be able to
- Able to draw velocity diagrams. (L3)
- Understands the concept of losses and coefficients blade design principles. (L2)

Prescribed Text Books:

1. Turbines, Compressors & Fans, S. M. Yahya, Tata McGraw Hill & Co. Ltd., 4th edition, 2010. ISBN 13: 9780070707023
2. V. Kadambi and Manohar Prasad, "An Introduction to Energy Conversion, Volume III, Turbo machinery", New Age International Publishers, reprint 2008. ISBN-13: 978-1781830086
3. Fundamentals of Turbo machinery: William W Perg, John Wiley & Sons, Inc. 2008. ISBN: 9780470124222

Reference Books:

1. S. L.Dixon, "Fluid Mechanics & Thermodynamics of Turbo machines", Elsevier (2005). ISBN-13: 978-0124159549
2. Fundamentals of turbo machinery, B.K. Venkanna PHI, New Delhi 2009. ISBN 13: 9788120337756
3. M. S. Govindgouda and A. M.Nagaraj, "A Text Book of Turbomachines", M. M. Publications, 10th Ed, 2014. ISBN-135551234003189
4. Earl Logan, Jr. Publisher: CRC Press; 2 editions (1 May 2003) ISBN-13: 978-0824709952.
5. D. G. Shepherd, "Principals of Turbo machines", the Macmillan Company (1964). ISBN-13: 978-0024096609

Course Outcomes:

A student will be able to — Blooms Level of Learning

1. Calculate energy transfer and efficiency of the turbines and compressors. — L3
2. Comprehend the design, performance, and selection of centrifugal fans and blowers. — L2
3. Analyze the performance of centrifugal compressor. — L4
4. Analyze the performance parameters and flow losses in axial flow compressor. — L4
5. Calculate the performance of axial and radial flow turbines. — L3

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
19A36AT.1	3	2	1	1	-	-	-	-	-	1	-	1	1	2
19A36AT.2	2	1	1	1	-	-	-	-	-	1	-	1	1	2
19A36AT.3	3	3	1	2	-	-	-	-	-	1	-	1	1	2
19A36AT.4	3	3	1	2	-	-	-	-	-	1	-	1	1	2
19A36AT.5	3	2	1	1	-	-	-	-	-	1	-	1	1	2

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

Title of the Course Tribology
Category PEC
Course Code 20A37CT

Year IV B. Tech
Semester I Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To understand the lubricant principles, types of lubricants and their properties
- To understand the mechanisms of friction and wear in materials
- To analyze the friction force and power loss in hydrodynamic and hydrostatic lubrication.
- To understand the preparation of bearing materials.

Unit 1 Introduction to Tribology: 8

Properties of oils and equation of flow: Viscosity, Newton's Law of viscosity, Hagen-Poiseuille Law, Flow between parallel stationary planes, viscosity measuring apparatus. Purpose of lubrication, properties and characteristics of lubricants, types of lubricants (oils, greases, solid lubricants), lubrication systems, Lubricant Additives.

Learning Outcomes: At the end of the unit, the student will be able to:
- Illustrate the subject "Tribology" and its technological significance. (L3)
- Interpret the type of oils and its properties. (L3)
- Write the type of lubricants and its characteristics. (L3)

Unit 2 Friction and Wear 8

Friction: Material properties influencing friction, laws of friction, causes/theories of friction, Types of friction, Elastic and Visco-elastic effects in friction, effects of friction.

Wear: Causes/sources of wear, types of wear (adhesive, abrasive, corrosive, erosive, fretting), wear of polymers, wear of ceramic materials, effects of wear, steps for wear prevention/resistance, Wear measurement. Effects of speed, temperature and pressure. Tribological measures, Material selection.

Learning Outcomes: At the end of the unit, the student will be able to:
- Identify the type of friction and wear and its effects due to visco elastic. (L2)
- Compare the effects of wear on different materials. (L4)

Unit 3 Hydrodynamic Lubrication and Mechanism of Pressure Development in an Oil Film: 7

Hydrodynamic Lubrication:: Friction forces and power loss in lightly loaded bearing, Petroff's law, Tower's experiments, idealized full journal bearings.

Mechanism of Pressure Development in an Oil Film: Reynold's investigations, Reynold's equation in two dimensions. Partial journal bearings, end leakages in journal bearing, numerical problems.

Learning Outcomes: At the end of the unit, the student will be able to:
- Use the Hydro dynamic lubrication. (L3)
- Illustrate the mechanism of pressure. (L3)

Unit 4 Slider / Pad Bearing with a Fixed and Pivoted Shoe 7

Pressure distribution, Load carrying capacity, coefficient of friction, frictional resistance in a pivoted shoe bearing, influence of end leakage, numerical examples.

Learning Outcomes: At the end of the unit, the student will be able to:
- Employ the pressure distribution. (L3)

Unit 5 Hydrostatic Lubrication and Bearing Materials 7

Hydrostatic Lubrication: Introduction to hydrostatic lubrication, hydrostatic step bearings, load carrying capacity and oil flow through the hydrostatic step bearing..

Bearing Materials: Commonly used bearings materials, properties of typical bearing materials.

Learning Outcomes: At the end of the unit, the student will be able to:

- Examine the hydrostatic lubrication. (L4)
- Appraise the different types of material used in bearings. (L4)

Prescribed Text Books:

1. Lubrication of Bearings – Theoretical Principles and Design by Redzimovskay E I., Oxford press company 2000.
2. Principles and Applications of Tribology by Moore, Pergamaon press 1998

Reference Books:

1. Fundamentals of Tribology by Basu S K., Sengupta A N., Ahuja B. B., , PHI 2006
2. Introduction to Tribology Bearings by Mujumdar B. C., S. Chand company pvt. Ltd 2008

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Describe the lubrication principles and mechanisms.	L2
2. Explain the different friction and wear mechanism in tribological components.	L2
3. Describe the friction surfaces and power losses in hydrodynamic lubrication.	L2
4. Design load carrying capacity in light and heavy loaded journal bearings	L6
5. Design load carrying capacity in hydrostatic step bearing and identify the appropriate material for bearings based on the application.	L6

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A37CT.1	3	1	2	2	-	-	-	-	-	-	-	1	2	2
20A37CT.2	3	1	2	2	-	-	-	-	-	-	-	1	1	2
20A37CT.3	3	1	2	2	-	-	-	-	-	-	-	1	2	2
20A37CT.4	1	2	3	3	-	-	-	1	-	-	-	1	1	1
20A37CT.5	1	2	3	3	-	-	-	-	-	-	-	1	1	1

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

Title of the Course Supply chain Management
Category PEC
Course Code 20A37DT

Year IV B. Tech
Semester I Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

- To get the knowledge on basic concepts of supply chain management, decision phases, process view and its strategies.
- To learn the concepts of distribution networks and supply chain network
- To acquire the skill of planning, managing safety stock in a supply chain, transportation.
- To know the concept of sourcing and pricing of products.
- To get the awareness on Bullwhip effect and Technology in the Supply Chain

Unit 1 Introduction to SCM 10

Fundamentals of supply chain, Objective of supply chain and importance, concepts and definitions, Supply chain stages and decision phases, process view of a supply chain. Supply chain flows. Competitive and supply chain strategies, strategic fit, Supply chain Drivers, Examples of supply chains

Learning Outcomes: At the end of the unit, the student will be able to:

- Discuss the goal of a supply chain and explain the impact of supply chain decisions on the Success of a firm. (L2)
- Identify the three key supply chain decision phases and explain the significance of each one, and describe the cycle and push/pull views of a supply chain. (L2)
- Describe how a company achieves strategic fit between its supply chain strategy and its competitive Strategy. (L2)

Unit 2 Designing the Supply Chain Network: 08

Distribution Networks (DN) – Role, Factors, Design of Distribution Networking, e-Business and the Distribution Network.

Supply Chain Network (SCN) – Role, Factors, Framework for Design Decisions. Models for facility location and capacity allocation.

Learning Outcomes: At the end of the unit, the student will be able to:

- Identify the key factors to be considered when designing a distribution network. (L2)
- Discuss the strengths and weaknesses of various distribution options. (L2)
- Understand how e-business has affected the design of distribution networks in different
- Industries. (L2)

Unit 3 Planning and Managing Inventory & Transportation Networks in a SCM: 10

The Role of cycle Inventory in a Supply Chain, Managing Multi-Echelon Cycle Inventory, Safety inventory determination. Optimum level of product availability, Managerial levers to improve supply chain profitability.

Transportation: Role of Transportation, Factors affecting transportation decisions. Modes of Transportation and their performance characteristics.

Learning Outcomes: At the end of the unit, the student will be able to:

- Balance the appropriate costs to choose the optimal amount of cycle inventory in a supply chain. (L2)
- Utilize managerial levers available to lower safety inventory and improve product availability. (L3)
- Understand the role of transportation in a supply chain, and evaluate the strengths and weaknesses of different modes of transportation. (L2)

Unit 4 Sourcing Decisions and Revenue Management in Supply Chain: 08

Role of sourcing, supplier – scoring & assessment, selection and contracts. Design collaboration, procurement, source planning and analysis.

Pricing and Revenue Management in SCM: Role of pricing and Revenue Management in the Supply Chain.

Learning Outcomes: At the end of the unit, the student will be able to:

- Understand the role of sourcing in a supply chain, and Discuss factors that affect the decision to outsource a supply chain function. (L2)
- Describe the impact of different contracts on supplier performance and information distortion. (L2)
- Understand the role of pricing and revenue management in a supply chain. (L2)

Unit 5 Bullwhip effect & Technology in the Supply Chain: 10

Co-ordination in a supply chain - Bullwhip effect. The Effect on performance of Lack of co-ordination, Obstacles to coordination. Managerial levers to achieve co-ordination.

Technology in the Supply Chain: The Role of IT supply Chain, The Supply Chain IT Framework, CRM, Internal SCM, SRM. The role of E-Business in a supply chain.

Learning Outcomes: At the end of the unit, the student will be able to:

- Describe supply chain coordination, the bullwhip effect, causes and obstacles to coordination in a supply chain. (L2)
- Discuss managerial levers that help achieve coordination in a supply chain. (L2)
- Understand the major applications of supply chain information technology and the processes that they enable. (L2)

Prescribed Text Books:

1. Supply Chain Management-Strategy, Planning & Operation. Sunil Chopra & Peter Meindl, Pearson Edu. Asia, 2001, ISBN: 81-7808-272-1.
2. Supply Chain Redesign – Transforming Supply Chains into Integrated Value Systems. Robert B Handfield, Ernest L Nichols, Jr., Pearson Edu. Inc, 2002, ISBN: 81-297-0113-8.

Reference Books:

1. Modelling the Supply Chain. Jeremy F Shapiro, Duxbury; Thomson Learning, 2002, ISBN 0-534-37363.
2. Designing & Managing the Supply Chain.David Simchi Levi, Philip Kaminsky& Edith Simchi Levi; McGraw Hill. 2007. ISBN-10 : 9780070666986
3. Going Backwards Reverse Logistics Trends and Practices. Dr. Dale S. Rogers, Dr. Ronald S. Tibben-Lembke, University of Nevada, Reno, Center for Logistics Management. 1999. ISBN, 0967461901, 9780967461908
4. Supply chain logistics management. Donald J.Bowersox; Tata McGraw – Hill, 2008, ISBN: 978-0-07-066703-7

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Understand the knowledge on basic concepts of supply chain management, decision phases, process view and its strategies.	L2
2. Understand the concepts of distribution networks and supply chain network	L2
3. Analyse the skill of planning, managing safety stock in a supply chain, transportation	L4
4. Analyse the concept of sourcing and pricing of products..	L4
5. Analyse the awareness on Bullwhip effect and Technology in the Supply Chain	L4

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A37DT.1	3	2	1	2	-	-	-	-	-	-	-	-	1	2
20A37DT.2	3	2	1	2	-	-	-	-	-	-	-	-	1	2
20A37DT.3	3	2	1	2	-	-	-	-	-	-	-	-	1	2
20A37DT.4	3	3	2	2	-	-	-	-	-	-	-	-	1	1
20A37DT.5	3	2	1	2	-	-	-	-	-	-	-	-	1	1

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

Title of the Course Non-Conventional Sources of Energy
Category PEC
Course Code 20A37ET

Year IV B. Tech
Semester I Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To grasp the role and potential of new and renewable source
- To recognize the principle, storage and applications of solar energy
- To understand the sources and potentials of wind energy and also to comprehend the Principles of Bio-Conversion of bio-mass and bio-gas uses.
- To explain the principle, working procedure and types of geothermal energy, ocean energy and tidal & wave energy.
- To know the knowledge on direct energy conversion.

Unit 1 Principles Of Solar Radiation 9

Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation, potential in India

Learning Outcomes: At the end of the unit, the student will be able to:
- Understand types of energy resources. (L2)
- Understand the different types of measuring instruments of solar radiation. (L2)

Unit 2 Solar Energy Collectors 9

Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors. Solar Energy Storage And Applications: Different methods, Sensible, latent heat and tratified storage, solar ponds. Solar Applications solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion, potential in India.

Learning Outcomes: At the end of the unit, the student will be able to:
- Understand different types of solar collectors. (L2)
- Understand the different types of energy storage systems and applications. (L2)

Unit 3 Wind Energy 8

Sources and potential in India, horizontal and vertical axis wind mills, performance characteristics, Betz criteria. Bio-Mass: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, and economic aspects, potential in India

Learning Outcomes: At the end of the unit, the student will be able to:
- Understand the type of winds and windmills components. (L2)
- Understand the types of biomass conversion technologies and biogas digesters. (L2)

Unit 4 Geothermal Energy 10

Resources, types of wells, methods of harnessing the energy, potential in India.

Ocean Energy: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics, potential in India.

Learning Outcomes: At the end of the unit, the student will be able to:
- Classify the Geothermal resources. (L2)
- Understand OTEC, wave and tidal energy extraction methods. (L2)

Unit 5 Direct Energy Conversion 9

Need for DEC, Carnot cycle, limitations, principles of DEC. Thermo-electric generators, Seebeck, Peltier and Joule Thomson effects, materials, applications, MHD generators, principles, dissociation and ionization, hall effect, Magnetic flux, MHD accelerator, MHD Engine, power generation systems, electron gas dynamic conversion, economic aspects. Fuel cells, principles, faraday‟s law‟s, thermodynamic aspects, selection of fuels and operating Conditions.

Learning Outcomes: At the end of the unit, the student will be able to:

- Classify the Direct energy conversion techniques. (L2)
- Understand the concept and working of MHD generator and Fuel cells. (L2)

Prescribed Text Books:

1. Tiwari and MK.Ghosal, Renewable energy resources: Basic principles and applications, Narosa publications 2005, ISBN 10: 1842651250 ISBN 13: 9781842651254
2. G.D. Rai, Non-Conventional Energy Sources, khanna publications, 2011, ISBN 10: 8174090738, ISBN 13: 9788174090737

Reference Books:

1. Twidell & Weir, Renewable Energy Sources, Routledge , 3rd Ed.2015,ISBN 9780367200756
2. Non Conventional Energy Resources, B.H.Khan, McGrawHIll, 2015, ISBN 1259081397, 9781259081392

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Summarize the basics of solar radiation and its instruments.	L2
2. Summarize the types of solar collectors, energy storage systems and their applications.	L2
3. Summarize the working of Wind Mills, Bio-Mass energy and their applications.	L2
4. Summarize the concepts of Geothermal resources, Ocean thermal energy conversion plants, wave energy and tidal energy.	L2
5. Summarize different direct energy conversion systems.	L2

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A37ET.1	2	2	1	2	-	-	-	1	-	-	-	1	2	1
20A37ET.2	2	2	1	2	-	-	-	1	-	-	-	1	1	1
20A37ET.3	2	2	1	2	-	-	-	1	-	-	-	1	2	1
20A37ET.4	2	2	1	2	-	-	-	1	-	-	-	1	1	1
20A37ET.5	2	2	1	2	-	-	-	1	-	-	-	1	2	1

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

Title of the Course Finite Element Methods
Category PEC
Course Code 20A37FT

Year IV B. Tech
Semester I Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To enable the students to understand fundamentals of finite element analysis
- To learn the principles involved in the discretization of domain with various elements, polynomial interpolation and assembly of global arrays.
- To learn the application of FEM in various structural and non structural problems by incorporating boundary conditions.

Unit 1 **12**

Introduction to finite element methods for solving field problems, Stress and equilibrium, Boundary conditions, Strain-Displacement relations, Stress- strain relations for 2D and 3D Elastic problems, Potential energy and equilibrium.

One dimensional problem: Finite element modeling coordinates and shape functions. Assembly of global stiffness matrix and load vector. Finite element equations, Treatment of boundary conditions, solution for displacements, reaction, stresses, temperature effects. Quadratic shape functions.

Learning Outcomes: At the end of the unit, the student will be able to:
- Understand the numerical methods involved in Finite Element theory. (L2)
- Understand the general steps of finite element method. (L2)
- Understand the role and significance of shape functions in finite element formulation. (L2)
- Formulate and solve axially loaded bar problems. (L3)

Unit 2 **8**

Analysis of trusses: Stiffness Matrix for plane truss element. Stress Calculations and Problems.

Analysis of beams: Element Stiffness Matrix for two noded, two degrees of freedom per node beam element and simple problems.

Learning Outcomes: At the end of the unit, the student will be able to:
- Explain the use of the basic finite elements for structural applications using truss and beam. (L2)
- Formulate and analyze truss and beam problems. (L4)

Unit 3 **8**

Two dimensional problems: Finite element modeling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions. Estimation of load Vector, Stresses. Finite element modeling of Axi-symmetric solids subjected to axi-symmetric loading with triangular elements.

Learning Outcomes: At the end of the unit, the student will be able to:
- Choose two – dimensional elements (Triangular Elements). (L3)
- Apply the formulation techniques to solve two – dimensional problems using triangle elements. (L3)
- Formulate and solve axis symmetric problems. (L3)

Unit 4 **12**

Iso-Parametric Formulation: Concepts, sub parametric, super parametric elements, 2 dimensional 4 noded iso-parametric elements, and numerical integration.

Analysis of Shafts: Analysis of a uniform shaft subjected to torsion.

Learning Outcomes: At the end of the unit, the student will be able to:

- Apply the formulation techniques to solve two – dimensional problems using quadrilateral elements. (L3)
- Formulate and solve torsion problems. (L3)

Unit 5 **7**

Dynamic analysis: Formulation of finite element model, element –mass matrices, evaluation of Eigen values and Eigen vectors for a stepped bar and Beam.

Steady state heat transfer analysis: One dimensional analysis of slab and fin, analysis of heat generated in thin plate, two dimensional analysis of thin plate.

Learning Outcomes: At the end of the unit, the student will be able to:

- Understand problems involving dynamics using Finite Element Methods. (L2)
- Analyze the Eigen values and Eigen Vectors for stepped bar. (L4)
- Apply Finite Element Methods for heat transfer problems. (L3)

Prescribed Text Books:

1. Introduction to Finite elements in Engineering- Tirupathi.R. Chandrupatla and Ashok D. Belegundu-Pearson Education India -4th Edition 2015- ISBN-978-9332551824
2. Finite Element Analysis- Dr. S Senthil, R Paneerdhass – Lakshmi Publications-5th Edition 2013-ISBN-978-9383103317
3. Finite Element Analysis in Engineering- S.Md. Jalaludeen- Anuradha Publications- 2016-ISBN-978-8184722376

Reference Books:

1. J N Reddy- An introduction to the Finite Element Method, McGraw – Hill- 4th Edition 2019-ISBN -978-9390385270.
2. R D Cook, D S Malkus and M E Plesha- Concepts and Applications of Finite Element Analysis -John Wiley-4th Edition 2001-ISBN-978-0471356059.
3. K J Bathe- Finite Element Procedures in Engineering Analysis- Prentice-Hall-1996-ISBN-978-8126529988.

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Analyze one dimensional element like bars by adopting finite element method	L4
2. Analyze the stresses induced in beams and trusses	L4
3. Analyze the two-dimensional elements like CST, Axisymmetric based on Plane strain and Plane stress conditions.	L4
4. Analyze the numerical associated with Iso-parametric elements & Heat transfer	L4
5. Analyze the dynamic behavior of structural members considering mass	L4

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A37FT.1	3	3	3	3	-	-	-	-	-	-	-	1	1	-
20A37FT.2	3	3	3	3	-	-	-	-	-	-	-	-	2	-
20A37FT.3	3	3	3	3	-	-	-	-	-	-	-	-	2	-
20A37FT.4	3	3	3	3	-	-	-	-	-	-	-	-	2	1
20A37FT.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 Modern Machining Processes
Category PEC
Course Code 20A37GT

Year IV B. Tech
Semester I Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

- To provide students with an understanding of the latest technologies being used in manufacturing industries as part of modernization of industries
- To understand and appreciate the importance of basic principles of Manufacturing Systems and also they will know about the differences between conventional and un-conventional machining process with the help of various advanced manufacturing techniques like USM, AJM, ECM, CM, EDM, PAM, EBM & LSB

Unit 1 UCMP – Introduction - Ultrasonic machining 10

Need for non-traditional machining methods- Classification of modern machining processes – considerations in process selection. Importance of smart, HSTR and Composite materials in UCMP, Applications. Ultrasonic machining – Elements of the process, mechanics of metal removal process parameters, economic considerations, applications and limitations, recent development, Hybrid technologies used in UCMP.

Learning Outcomes: At the end of the unit, the student will be able to:

- Understand the need for unconventional machining processes. (L2)
- Illustrate the working of USM can perform experiments on those processes. (L3)

Unit 2 Mechanical Processes 10

Abrasive jet machining, Water jet machining and abrasive water jet machining Basic principles, equipment's, process variables, mechanics of metal removal, MRR, application and limitations. (AJM and WJM). Working Principles – equipment used – Process parameters –MRR-Variation in techniques used – Applications.

Learning Outcomes: At the end of the unit, the student will be able to:

- Understand the need for AJM, WAJM and WJM. (L2)
- Illustrate the working of AJM, WAJM and WJM can perform experiments on those processes. (L3)

Unit 3 Electro – Chemical Processes 8

Fundamentals of electro chemical machining, electrochemical grinding, electro chemical honing and deburring process, metal removal rate in ECM, Tool design, Surface finish and accuracy economic aspects of ECM – Fundamentals of chemical machining, advantages and applications.

Learning Outcomes: At the end of the unit, the student will be able to:

- Understand the fundamental concepts of CM, ECM. (L2)
- Illustrate the working of CM, ECM can perform experiments on those processes. (L3)

Unit 4 Thermal Metal Removal Processes – I 10

General Principle and applications of Electric Discharge Machining, Electric Discharge Grinding and electric discharge wire cutting processes – Mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, methods surface finish and machining accuracy, characteristics of spark eroded surface and machine tool selection. Wire EDM, principle, applications.

Learning Outcomes: At the end of the unit, the student will be able to:

- Understand the fundamental concepts of EDM and WEDM. (L2)
- Illustrate the working of CM, ECM can perform experiments on those processes. (L3)

Unit 5 Thermal Metal Removal Processes – II 10

Generation and control of electron beam for machining, theory of electron beam machining, comparison of thermal and non-thermal processes –General Principle and application of laser beam machining – thermal features, cutting speed and accuracy of cut. Application of plasma for machining, metal removal mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries. Chemical machining principle-maskants –etchants- applications. Magnetic abrasive finishing, Abrasive flow finishing.

Learning Outcomes: At the end of the unit, the student will be able to:

- Understand the fundamental concepts of LBM, PAM and other surface finish process. (L2)
- Illustrate the working LBM, PAM and other surface finish process can perform experiments on those processes. (L3)

Prescribed Text Books:

1. Vijay.K. Jain "Advanced Machining Processes" Allied Publishers Pvt. Ltd., New Delhi(2002) ISBN 81-7764-294-4.
2. Pandey P.C. and Shan H.S. "Modern Machining Processes" Tata McGraw- Hill, New Delhi (1980). ISBN: 0070965188, 9780070965188

Reference Books:

1. Benedict. G.F. "Nontraditional Manufacturing Processes" Marcel Dekker Inc., New York (1987). ISBN, 0824773527
2. Mc Geough, "Advanced Methods of Machining" Chapman and Hall, London (1998) 42 Industrial Robotics 3.0, ISBN 978-0-412-31970-9

Course Outcomes:

At the end of the course, the student will be able to	Blooms Level of Learning
1. Explain the need for unconventional machining process and the principles of the Ultra Sonic Machining process for Metal Removal Rate (MRR)	L2
2. Describe the working processes of Abrasive Jet Machining, Water Abrasive Jet Machining and Water Jet Machining, for calculating MRR.	L2
3. Describe the fundamental concepts of Chemical Machining, Electro Chemical Machining processes for calculating MRR.	L2
4. Describe the operating processes of Electric Discharge Machining and Wire Electric Discharge Machining their process parameters, tool selections for calculating MRR.	L2
5. Describe the procedures for metal removal mechanism of Laser Beam Machining, Plasma Arc Machining and other surface finish processes.	L2

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A37GT.1	2	2	1	1	-	-	-	-	-	-	-	-	2	1
20A37GT.2	2	2	1	1	-	-	-	-	-	-	-	-	2	1
20A37GT.3	2	2	1	1	-	-	-	-	-	-	-	-	2	1
20A37GT.4	2	2	1	1	-	-	-	-	-	-	-	-	2	1
20A37GT.5	2	2	1	1	-	-	-	-	-	-	-	-	2	1

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

Title of the Course Mechatronics
Category PEC
Course Code 20A37HT

Year IV B. Tech
Semester I Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To Familiarize the technologies behind modern mechatronic systems
- To explain fundamentals for the development of fully automated system.
- To Develop a robotic or automated systems focusing on the hardware and software integration.
- To demonstrate the development of mechatronic system and MEMS.

Unit 1 INTRODUCTION 9
Definition of Mechatronics, Need for Mechatronics in Industry, Objectives of mechatronics, mechatronics design process, Mechatronics key elements, mechatronics applications–Computer numerical control(CNC) machines, Tool monitoring systems, Flexible manufacturing system(FMS), Industrial Robots, Automatic packaging systems, Automatic inspection systems.
Learning Outcomes: At the end of the unit, the student will be able to
- Explain the role of mechatronics in industry. (L2)
- Applications of mechatronics in automation industry. (L3)

Unit 2 Sensors 9
Static characteristics of sensors, Displacement, Position and Proximity sensors, Force and torque sensors, Pressure sensors, Flow sensors, Temperature sensors, Acceleration sensors, Level sensors, Light sensors, Smart material sensors, Micro and Nano sensors, Selection criteria for sensors.
Learning Outcomes: At the end of the unit, the student will be able to:
- Classify the types of sensors and can describe their working principles. (L2)

Unit 3 Actuators 9
Mechanical, Electrical, Hydraulic and Pneumatic Actuation systems, Characteristics and their limitations, Design of Hydraulic and Pneumatic circuits, Piezo electric actuators, Shape memory alloys, Selection criteria for actuators.
Learning Outcomes: At the end of the unit, the student will be able to:
- Classify the types of actuators and can explain them. (L2)
- Choose the selection criteria for different actuators. (L3)

Unit 4 Microprocessors, Micro controllers and Programmable Logic Controllers 9
Architecture of of Microprocessor, Micro controller and Programmable Logic Controller, PLC Programming using ladder diagrams, logics, latching, sequencing, timers relays and counters, data handling, Analog input/output, selection of controllers.
Learning Outcomes: At the end of the unit, the student will be able to:
- Understand the architecture of microprocessors, microcontrollers and PLC. (L2)
- Recognize the applications of microprocessors, microcontrollers and PLC in electronic appliances. (L2)

Unit 5 Micro Electro Mechanical Systems(MEMS) 9
History, Effect of scaling, Fabrication Techniques: Oxidation, Physical Vapor disposition, Chemical Vapor

Deposition, Lithography, Etching, Wafer bonding, LIGA, DRIE, and Applications: Labon chip.
Learning Outcomes: At the end of the unit, the student will be able to

- Illustrate the different working principles of processes about MEMS in industry. (L3)

Prescribed Text Books:

1. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering, W. Bolton, 3/e Pearson Education Press, 2005. ISBN-10 : 0273742868; ISBN-13 : 978-0273742869
2. Devadas Shetty and Richard A Kolk, Mechatronic System Design, 2/e, Cengage learning, 2010. ISBN-10: 1-4390-6199-8
3. Clarence W. de Silva, Mechatronics an Integrated Approach, CRC Press, 2005. ISBN 9780849312748

Reference Books:

1. James J Allen, Micro Electro Mechanical Systems Design, CRC Press Taylor & Francis group, 2005. ISBN 0-8247-5824-2
2. Ganesh S Hedge, Mechatronics, Jones & Bartlett Learning, 2010. ISBN, 1934015296, 9781934015292

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Explain About Advanced Manufacturing systems	L 2
2. Explain different types of sensor	L 2
3. Explain different types of actuators	L 2
4. Explain about microprocessor, micro controllers and Programmable logic controllers	L 2
5. Explain the different working principles of processes about MEMS in industry	L 2

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A37HT.1	2	2	1	1	-	-	-	-	-	-	-	-	1	1
20A37HT.2	2	2	1	1	-	-	-	1	-	-	-	-	1	1
20A37HT.3	2	2	1	1	-	-	-	-	-	-	-	-	1	1
20A37HT.4	2	2	1	1	-	-	-	-	-	-	-	1	1	1
20A37HT.5	2	2	1	1	-	-	-	-	-	-	-		1	1

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

Title of the Course Power Plant Engineering
Category PEC
Course Code 20A37IT

Year IV B. Tech
Semester I Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To understand the student present day energy demand.
- To understand the working and combustion phenomenon in steam power plant.
- To gain knowledge on the concept and the working of diesel power plants and gas turbines.
- To understand the function and operation of the basic components of a hydro-electric power plant & nuclear power station.
- To learn the concept of non-conventional sources and factors affecting the site selection for a power plant and concept of base load plant and peak load plant.

Unit 1 Introduction **9**

Introduction to the Sources of Energy – Resources and Development of Power in India.
Steam Power Plant: Plant Layout, Working of different Circuits, Fuel and handling equipment's, types of coals, coal handling, choice of handling equipment, coal storage, Ash handling systems.
Learning Outcomes: At the end of the unit, the student will be able to
- Discuss the various sources of energy and functions of the components of power plant. (L2)
- Identify and explains the coal handling and ash handling units. (L2)

Unit 2 Steam Power Plant -Combustion Process **9**

Properties of coal – overfeed and underfeed 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. Corrosion and feed water treatment.
Learning Outcomes: At the end of the unit, the student will be able to
- Explain the various combustion processes. (L2)
- Identify the components of water treatment process. (L2)

Unit 3 Internal Combustion Engine Plant-Diesel Power Plant **9**

Introduction – IC Engines, types, construction– Plant layout with auxiliaries – fuel supply system, air starting equipment, super charging.
Gas Turbine Plant: Introduction – classification - construction – Layout with auxiliaries – Principles of working of closed and open cycle gas turbines. Combined Cycle Power Plants and comparison.
Learning Outcomes: At the end of the unit, the student will be able to
- Describe the functions of the components of diesel power plant and concepts of fuel supply system. (L2)
- Classify and explain the functions of various gas turbine power plants. (L2)

Unit 4 Hydro Electric Power Plant **10**

Hydro Electric Power Plant: Water power – Hydrological cycle / flow measurement – drainage area characteristics – Hydrographs – storage and Pondage – classification of dams and spill ways.
Hydro Projects And Plant: Classification – Typical layouts – plant auxiliaries – plant operation pumped storage plants.
Nuclear Power Station: Nuclear fuel – breeding and fertile materials – Nuclear reactor – reactor operation-radioactive waste disposal.
Boiling water reactor - Pressurized water reactor - Gas cooled reactor - Fast breeder reactor - Liquid metal cooled reactor-reactor materials - Radiation shielding.

Learning Outcomes: At the end of the unit, the student will be able to

- Demonstrate the functioning of Hydro-electric power plants and concepts of hydro projects. (L3)
- Describe the working principles of various nuclear reactors. (L2)

Unit 5 Power From Non-Conventional Sources **6**

Power From Non-Conventional Sources: Utilization of Solar Collectors- Principle of Working, Wind Energy – types – HAWT, VAWT - Tidal Energy.

Power Plant Economics And Environmental Considerations: Capital cost, investment of fixed charges, operating costs, general arrangement of power distribution, Load curves, and load duration curve. Definitions of connected load, Maximum demand, demand factor, average load, load factor, diversity factor – related exercises. Effluents from power plants and Impact on environment – pollutants and pollution standards – Methods of Pollution control.

Learning Outcomes: At the end of the unit, the student will be able to

- Describe the concept of non-conventional sources of Solar, wind and tidal energy. (L2)
- Examine about power plant economics and the concept of pollutants and pollution standards. (L4)

Prescribed Text Books:

1. P.K.Nag, Power Plant Engineering. TMH, 4 th Ed.2014.ISBN 10: 9339204042ISBN 13: 9789339204044.
2. P.C.Sharma, Power Plant Engineering. S.K.Kataria&sons, 2014. ISBN-10 : 9350143844, ISBN-13 : 978-9350143841.

Reference Books:

1. Rajput. R.K., A Text Book of Power Plant Engineering. Laxmi Publications;, 2016, 5th Ed. ISBN-10 : 8131802558ISBN-13 : 978-8131802557.
2. Hegde R.K. Power Plant Engineering. Pearson Education India, 2015. ISBN-10 : 9332534101ISBN-13 : 978-9332534100
3. Arora and S. Domkundwar.A Course in Power Plant Engineering Dhanpat Rai& Co. (P) Limited, 6th Ed. 2016. ISBN-10 : 8177001957, ISBN-13 : 978-8177001952.

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Summarize the different energy sources, fuel and ash handling systems in steam power plant.	L2
2. Summarize the combustion process, Dust collectors, cooling towers and feed water treatment in steam power plant.	L2
3. Summarize the working of diesel engine, gas turbine power plants and its auxiliaries.	L2
4. Summarize the working of hydroelectric power plant and nuclear power plants.	L2
5. Calculate the operating costs of steam power and highlight the power production from various non-conventional sources.	L3

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A37IT.1	2	2	1	2	-	-	-	-	-	-	-	-	2	2
20A37IT.2	2	2	1	2	-	-	-	-	-	-	-	-	2	2
20A37IT.3	2	2	1	2	-	-	-	-	-	-	-	-	2	2
20A37IT.4	2	2	1	2	-	-	-	-	-	-	-	-	2	2
20A37IT.5	3	3	1	2	-	-	-	-	-	-	-	-	2	2

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

Title of the Course Mechanical Vibrations
Category PEC
Course Code 20A37JT

Year IV B. Tech.
Semester I Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To understand the un-damped and damped free vibrations to mechanical systems.
- To know the sources of forced vibrations and Also transmissibility& isolation of vibrations.
- To understand the natural frequencies and modes of forced vibrations.
- To analyze the formulation, model analysis of vibrations and critical speeds of shafts.
- To learn the various vibration transducers and its applications.

Unit 1 Single Degree Freedom Systems 9

Single Degree Freedom Systems: Un-damped free vibration - Classical method, Energy method, equivalent systems, torsional systems. Damped free vibration - Viscous damping, under damping, critical damping, over damping, Coulomb damping, equivalent damping coefficient. Simple problems.

Learning Outcomes: At the end of the unit, the student will be able to:
- Evaluate the natural frequencies of free vibrations under single degree freedom.[L6]
- Analyze the frequency and coefficient of damped vibrations. [L4]
- Solve the problems of damped and undamped free vibrations with single degree freedom.[L3]

Unit 2 Forced Vibrations of Single Degree Freedom Systems 10

Forced Vibrations of Single Degree Freedom Systems: Steady state forced vibration, sources of excitation, impressed harmonic force, resonance impressed force due to unbalance, motion excitation, transmissibility and isolation, performance of different type of isolators, power absorbed by viscous damping.

Learning Outcomes: At the end of the unit, the student will be able to:
- Judge the resonance due to forced vibrations under single degree freedom. [L6]
- Analyze the different sources of excitations in forced vibrations.[L4]
- Compare the performance of various isolators. [L4]

Unit 3 Two Degree Freedom Systems 9

Two Degree Freedom Systems: Formulation of Equation of motion, Natural frequencies and modes of vibration by classical method, coupled pendulum, forced vibration, dynamic vibration absorber.

Learning Outcomes: At the end of the unit, the student will be able to:
- Formulate the equations of motion for free vibrations under two degree freedom. [L5]
- Evaluate the natural frequencies and modes of free vibrations under two degree freedom.[L6]

Unit 4 Multi Degree Freedom Systems& Whirling of shafts 10

Multi Degree Freedom Systems: Lagrangian method for formulation of equation of motion, Influence co- efficient method, Lumped mass and distributed mass systems, Stodola method, Holzer's method, model analysis of free and forced vibrations.

Whirling of shafts: Critical speed of shafts, Rayleigh's upper bound approximation, Dunkerley's lower bound approximation, critical speed of shafts with damping.

Learning Outcomes: At the end of the unit, the student will be able to:

- Formulate the equations of motion to the forced vibrations under multi degree freedom.[L5]
- Analyze the model analysis for free and forced vibrations under multi degree freedom. [L4]
- Apply the Dunkerly's and Rayleigh method for finding the critical speeds of shafts under multi degree freedom. [L3]

Unit 5 Vibration measurement and Applications 10

Vibration measurement and Applications: Transducers - variable resistance transducers, Piezoelectric transducers, electrodynamic transducers and linear variable differential transformer transducer, Vibration pickups - vibrometer, accelerometer, velometer and phase distortion, Frequency-measuring instruments, Vibration exciters- Mechanical exciters and electrodynamic shaker.

Learning Outcomes: At the end of the unit, the student will be able to:

- Select the suitable transducer for vibrations measurement. [L4]
- Experiment the usage of vibrations pickups for measuring the frequency of vibrations. [L5]
- Consider the importance of vibrations measurement to various applications. [L6]

Prescribed Textbooks:

1. Singrasu S. Rao, Mechanical Vibrations, 6/e, Pearson Education, 2018,ISBN-13:9780132128193
2. G.K.Groover, Mechanical Vibrations, 8/e, 2009, N. Chand & Bros, ISBN-13 :9788185240565
3. Rao.V.Dukkipati&J.Srinivas,PHI 2010, ISBN-13 :9788120345249
4. V.P.Singh, Mechanical Vibrations,DhanapatRai&Co, ISBN-13:5551234002564

Reference Books:

1. William Thomson, Theory of Vibrations with Applications, CRS Press , ISBN-13:9780748743803
2. L. Meirovich, Elements of Vibrations Analysis, Tata McGraw Hill, ISBN-13:9789339204716
3. S. Graham Kelly, Mechanical Vibrations, Tata McGraw Hill, 1996, ISBN-13:9781439062128

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Analyze the natural frequencies and the behaviour of the un-damped single degree freedom systems with damping.	L4
2. Solve single degree freedom systems subjecting to Forced vibrations	L3
3. Analyze the natural frequencies and the modes of two degree freedom systems.	L4
4. Analyze the multi degree freedom systems using Stodola method, Holzer"s method and Matrix iteration method and the natural frequencies with Rayleighs method and Dunkerleys method.	L4
5. Summarize various approaches to measure the vibrations, vibration pickups and exciters.	L2

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A37JT.1	3	3	3	3	-	-	-	-	-	-	-	-	2	2
20A37JT.2	3	3	2	3	-	-	-	-	-	-	-	-	2	2
20A37JT.3	3	3	3	3	-	-	-	-	-	-	-	-	2	2
20A37JT.4	3	3	3	3	-	-	-	-	-	-	-	-	2	2
20A37JT.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 Production and Operations Management
Category PEC
Course Code 20A37KT

Year IV B. Tech
Semester I Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

- To make the students understand the functions of production planning & control, goods and services, issues in product design and to provide knowledge of determining the accurate demand forecasting.
- To provide the knowledge on facilities location, various types layouts, computerized layout planning, and assembly line balancing techniques.
- To make the students understand the concepts of capacity planning and aggregate planning and their planning strategies.
- To make the students understand the concepts of capacity planning and aggregate planning and their planning strategies,
- To make knowledge on lean management, concepts of JIT, six sigma, quality control.

Unit 1 Production and Forecasting 8

Production – Products – types – design of goods & services – Functions of Production & Operations Management – Production Vs Productivity – Productivity measurement – Product design & analysis – new product development and its concepts.

Forecasting – Importance of forecasting – Types of forecasting, their uses– Forecasting techniques – qualitative methods and quantitative methods – accuracy of forecasting methods.

Learning Outcomes: At the end of the unit, the student will be able to:

- Understand production definition and can measure productivity. (L3)
- Describe new product development concepts. (L2)
- Analyse and apply forecasting and its techniques to determine the accurate demand forecasting. (L4)

Unit 2 Plant Layout 8

Factors affecting facilities location – Single facility location model – Types of facilities layouts: product layout process layout, group technology layout – Assembly line balancing – Computerized layout planning algorithms: ALDEP, CRAFT, and CORELAP.

Learning Outcomes: At the end of the unit, the student will be able to:

- Understand the types of plant layouts and factors affecting the plant location. (L2)
- Solve assembly line balancing problems. (L3)
- Understand and demonstrate computerized layout planning algorithms. (L3)

Unit 3 : Capacity Planning and Aggregate Planning 10

Capacity Planning **–** Plant capacity – strategies of capacity planning – equipment selection.

Aggregate Planning – Strategies of aggregate planning – O.R. models in aggregate planning – chase planning – expediting – controlling aspects.

MRP– Lot sizing techniques in MRP –Introduction to ERP – LOB (Line of Balance).

Learning Outcomes: At the end of the unit, the student will be able to:

- Solve problems on capacity planning and equipment selection. (L3)
- Solve problems on aggregate planning using OR models. (L3)
- Define MRP, ERP and LOB concepts. (L1)

Unit 4 : Scheduling **8**

Job Sequencing – Johnson's rule, extension of Johnson's rule, Palmer's rule, and Graphical method. Scheduling– Techniques – flow shop and job shop Scheduling.

Learning Outcomes: At the end of the unit, the student will be able to:

- Analyze and apply Johnson's rule, palmers rule and graphical methods for scheduling jobs. (L4)
- Apply flow shop and job shop scheduling techniques. (L3)

Unit 5 : Quality Management **8**

Quality Management: Economics of quality assurance-Control charts for variables and for attributes-Acceptance sampling plans - Lean management- philosophy and creation of lean enterprise - JIT concepts - Kanban system - Total Quality Management-ISO 9000 series standards-Six sigma-concepts.

Learning Outcomes: At the end of the unit, the student will be able to:

- Define quality management, control charts for variables and for attributes. (L1)
- Describe Lean management and its philosophy for creation of lean enterprise. (L2)
- Understand and explain JIT concept, Kanban system, TQM, ISO series standards and six sigma (L2)

Prescribed Text Books:

1. S.N. Chary, *Production and Operations Management*. 5th edition McGraw Hill Edu. Pvt. Ltd, 2012. (ISBN 10: 1259005100ISBN 13: 9781259005107)
2. R. Panneerselvam, *Production and Operation Management.* PHI. 2012. (*ISBN*, 9788120345553.)
3. Operations Management: Theory and Practice: B.Mahadevan Pearson.(*ISBN*: 9788131730706)

Reference Books:

1. KanishkaBedi, Production & Operations Management. Oxford Univ. Press. (ISBN: 9780195690873)
2. Martin K. Starr and David W. Miller. Inventory Control Theory and practice. (*ISSN*: 0925-5273)
3. Buffa and Sarin . Modern Production / Operations Management 8ed **,**Wiley.. (*ISSN*: 1059-1478)

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Describe the basic concepts of production systems, productivity, and determine the future demands by using forecasting techniques.	L2
2. Apply the facility location and layout planning problems using single facility location model, Assembly line balancing, and computerized techniques.	L3
3. Apply the strategies of capacity planning and aggregate planning while solving O.R. models of production planning.	L3
4. Apply optimal job sequences, can prepare the schedules of flow shop and job shop scheduling problems.	L3
5. Summarize Quality management ,Lean philosophy, JIT, Kanban system, TQM and Six-Sigma quality control.	L2

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A37KT.1	2	1	1	1	-	-	-	-	-	-	-	-	1	1
20A37KT.2	3	2	1	2	-	-	-	-	-	-	-	-	1	1
20A37KT.3	3	2	1	2	-	-	-	-	-	-	-	-	1	1
20A37KT.4	3	2	1	2	-	-	-	-	-	-	-	-	1	1
20A37KT.5	2	1	1	1	-	-	-	-	-	-	-	-	1	1

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

Title of the Course CNC and Adaptive Control
Category PEC
Course Code 20A37LT

Year IV B. Tech
Semester I Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To acquaint new technologies in machine tools.
- To explore features of NC/CNC machine tools.
- To impart knowledge on NC/CNC part programming.
- To explain interpolation algorithms for control loops.
- To cover latest developments in CNC system.

Unit 1 CNC Technology **8**

An overview: Introduction to NC/CNC/DNC machine tools, Classification of NC /CNC machine tools, Advantage, disadvantages of NC /CNC machine tools, Application of NC/CNC.DNC systems: Classifications, Merits, Demerits and application.

Learning Outcomes: At the end of the unit, the student will be able to:
- Learn advanced technologies to control different machine. (L2)

Unit 2 Design of CNC **8**

Constructional features of NC/CNC machine tools, CNC tooling and fixturing system, Designation of axis in CNC systems.

Learning Outcomes: At the end of the unit, the student will be able to:
- Describe the design of CNC (L2)

Unit 3 Part programming **10**

CNC programming and introduction, Manual part programming: Basic (Milling, turning etc...), Special part programming, Advanced part programming, Computer aided part programming (APT).

Learning Outcomes: At the end of the unit, the student will be able to:
- Develop part programs for different diagrams. (L6)

Unit 4 System drivers and devices **8**

Hydraulic and pneumatic motors, and their features, Electrical motors AC/DC and their features.
Interpolators: Hardware Interpolators, Software Interpolators, NC/CNC controllers.

Learning Outcomes: At the end of the unit, the student will be able to:
- Identify the importance of electronics in manufacturing processes. (L2)

Unit 5 Adaptive control system **6**

Adaptive control with optimizations (ACO), Adaptive control with constraints (ACC).
Latest developments: Machining center, Turing center, Communication networking, recent developments of CNC systems, Virtual NC systems.

Learning Outcomes: At the end of the unit, the student will be able to:
- Enhance their knowledge on different control systems. (L2)

Prescribed Text Books:

1. Yoram Koren, Computer Control of Manufacturing Systems, McGraw Hill International, Singapore, 2006. ISBN 0070607435

2. John Stenerson and Kelly Curran, Computer Numerical Control: Operation and Programming, PHI, New Delhi, 2009. ISBN 0130119806
3. TC Chang, RA Wysk and HP Wang, Computer Aided Manufacturing, PHI, New Delhi, 2009. ISBN 0131429191

Reference Books:

1. P. Radhakrishnan, S. Subramanyan& V. Raju, CAD/CAM/CIM, 3/e, New Age International Publishers, 2008. ISBN 9788122427110
2. Mikell P. Groover, Emory W. Zimmers , CAD/CAM, 5/e, Pearson Prentice Hall of India, Delhi, 2008. ISBN 8120304020

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Summarize the NC, CNC and DNC systems.	L2
2. Explain CNC machine structures and system drives.	L2
3. Describe manual and APT part programs for 2D complex profiles and test the programs through simulation.	L2
4. Describe System Drives, devices and Interpolators.	L2
5. Explain types of Adaptive control systems and latest developments of CNC systems.	L2

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A37LT.1	2	1	1	1	-	-	-	-	-	-	-	-	1	1
20A37LT.2	2	1	1	1	-	-	-	-	-	-	-	-	1	1
20A37LT.3	2	1	1	1	-	-	-	-	-	-	-	-	1	1
20A37LT.4	2	1	1	1	-	-	-	-	-	-	-	-	1	1
20A37LT.5	2	1	1	1	-	-	-	-	-	-	-	-	1	1

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

Title of the Course Additive Manufacturing
Category OEC
Course Code 20A37MT

Year IV B. Tech
Semester I Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To familiarize techniques for processing of CAD models for rapid prototyping
- To explain fundamentals of rapid prototyping techniques
- To demonstrate appropriate tooling for rapid prototyping process
- To focus Rapid prototyping techniques for reverse engineering
- To train Various Pre – Processing, Processing and Post Processing errors in RP Processes

Unit 1 Introduction to rapid prototyping 8

Introduction: Introduction to Prototyping, Traditional Prototyping Vs. Rapid Prototyping (RP), Need for time compression in product development, Usage of RP parts, Generic RP process, Distinction between RP and CNC, other related technologies, Classification of RP.

Learning Outcomes: At the end of the unit, the student will be able to:
- Recognize rapid prototyping process. (L2)
- Classify different rapid prototyping processes. (L2)

Unit 2 Solid and Liquid Based RP Systems 8

Stereolithography (SLA): Principle, Process, Materials, Advantages, Limitations and Applications.
Solid Ground Curing (SGC): Principle, Process, Materials, Advantages, Limitations, Applications.
Fusion Deposition Modeling (FDM): Principle, Process, Materials, Advantages, Limitations, Applications.
Laminated Object Manufacturing (LOM): Principle, Process, Materials, Advantages, Limitations, Applications.

Learning Outcomes: At the end of the unit, the student will be able to
- Explain the principles, advantages, limitations and applications of Solid and Liquid based AM systems. (L2)
- Identify the materials for Solid and Liquid based AM systems. (L2)

Unit 3 Powder Based RP Systems 8

Principle and Process of Selective Laser Sintering (SLS), Advantages, Limitations and Applications of SLS, Principle and Process of Laser Engineered Net Shaping (LENS), Advantages, Limitations and Applications of LENS, Principle and Process of Electron Beam Melting (EBM), Advantages, Limitations and Applications of EBM.

Other RP Systems: Three-Dimensional Printing (3DP): Principle, Process, Advantages, Limitations and Applications. Ballastic Particle Manufacturing (BPM): Principle, Process, Advantages, Limitations, Applications. Shape Deposition Manufacturing (SDM): Principle, Process, Advantages, Limitations, Applications.

Learning Outcomes: At the end of the unit, the student will be able to:
- Explain the principles, advantages, limitations and applications of powder-based and other RP systems. (L2)

Unit 4 Rapid tooling and Reverse engineering 8

Rapid Tooling: Conventional Tooling Vs. Rapid Tooling, Classification of Rapid Tooling, Direct and Indirect Tooling Methods, Soft and Hard Tooling methods.

Reverse Engineering (RE): Meaning, Use, RE – The Generic Process, Phases of RE Scanning, Contact Scanners and Noncontact Scanners, Point Processing, Application Geometric Model, Development.

Learning Outcomes: At the end of the unit, the student will be able to:
- Classify rapid Tooling methods. (L2)
- Explain the concepts of reverse engineering and scanning tools. (L2)

Unit 5 Errors in RP processes and RP applications 8

Errors in RP Processes: Pre-processing, processing, post-processing errors, Part building errors in SLA, SLS, etc. RP Applications: Design, Engineering Analysis and planning applications, Rapid Tooling, Reverse Engineering, Medical Applications of RP.

Learning Outcomes: At the end of the unit, the student will be able to:

- Describe various Pre – Processing, Processing and Post – Processing errors in RP processes. (L2)
- Select suitable RP technique for engineering design analysis and medical applications. (L2)

Prescribed Text Books:

1. Chua C.K., Leong K.F. and Lim C.S., Rapid Prototyping: Principles and Applications, 2/e, Edition, World Scientific Publishers, 2003.
2. Ian Gibson, David W. Rosen, Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, 1st Edition, Springer, 2010.
3. Rafiq Noorani, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley & Sons, 2006.

Reference Books:

1. Liou W. Liou, Frank W., Liou, Rapid Prototyping and Engineering Applications: A Tool Box for Prototype Development, CRC Press, 2007.
2. Pham D.T. and Dimov S.S., Rapid Manufacturing; The Technologies and Application of RPT and Rapid tooling, Springer, London 2001.
3. Gebhardt A., Rapid prototyping, Hanser Gardener Publications, 2003.
4. Hilton P.D. and Jacobs P.F., Rapid Tooling: Technologies and Industrial Applications, CRC Press, 2005.

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Summarize the fundamentals of Additive Manufacturing Technologies for engineering applications.	L2
2. Summarize the methodology to manufacture the products using SLA and SGC technologies and study their applications, advantages and case studies	L2
3. Summarize the methodology to manufacture the products using LOM and FDM technologies and study their applications, advantages and case studies	L2
4. Summarize the methodology to manufacture the products using SLS technologies and study their applications, advantages and case studies	L2
5. Summarize the 3D Printing technologies and study their applications, advantages and case studies	L2

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A37MT.1	2	2	1	1	-	-	-	-	-	-	-	-	3	2
20A37MT.2	2	2	1	1	-	-	-	-	-	-	-	-	3	2
20A37MT.3	2	2	1	1	-	-	-	-	-	-	-	-	3	2
20A37MT.4	2	2	1	1	-	-	-	-	-	-	-	-	3	2
20A37MT.5	2	2	1	1	-	-	-	-	-	-	-	-	3	2

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

Title of the Course Entrepreneurship Development
Category OEC
Course Code 20A37NT

Year IV B. Tech
Semester I Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To impart conceptual and managerial skills to students.
- To create awareness among the students about the various institutions, which supports entrepreneurship.
- To impart knowledge on the basics of entrepreneurial skills and competencies to provide the participants with necessary inputs for creation of new ventures.
- To explore new vistas of entrepreneurship in 21st century environment to generate innovative business ideas.
- To impart conceptual and managerial skills to students.

Unit 1 Entrepreneurship **9**

Entrepreneur–Meaning and concept of entrepreneurship, role of entrepreneurship in economic development, Myths about entrepreneurs, agencies in entrepreneurship management and future of entrepreneurship types of entrepreneurs.

Learning Outcomes: At the end of the unit, the student will be able to:
- Develop awareness about entrepreneurship and successful entrepreneurs. (L6)
- Develop an entrepreneurial mind-set by learning key skills such as design, personal selling, and communication. (L6)

Unit 2 Motivation **9**

Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self - Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.

Learning Outcomes: At the end of the unit, the student will be able to:
- Develop awareness about Entrepreneur – Achievement Motivation Training. (L6)
- Explain business games, stress management and Entrepreneurship Development Programs. (L2)

Unit 3 Business **9**

Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – Identification of business opportunities; Steps involved in starting a small Enterprise-Financial, technical, social, legal and managerial feasibilities of the project

Learning Outcomes: At the end of the unit, the student will be able to:
- Create innovative and establish a foundation of confidence in the skills necessary to establish an enterprise. (L6)
- Explain the importance of business networking and the strategies in overcoming the business challenges. (L2)

Unit 4 Financing and Accounting **9**

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Taxation – Income Tax, Excise Duty – Sales Tax.

Learning Outcomes: At the end of the unit, the student will be able to:
- Create innovative and establish a foundation of confidence in the skills necessary to establish an enterprise and its financial aspects. (L6)

Unit 5 Support to Entrepreneurs 11

Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures – Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Women Entrepreneurship Development, Entrepreneurship Development in rural areas,

Learning Outcomes: At the end of the unit, the student will be able to:

- Describe an insight on how to make business proposal and also analysis of the same. (L2)

Prescribed Text Books:

1. Khanka.S.S., "Entrepreneurial Development" S.Chand&Co.Ltd.,RamNagar,NewDelhi,2013.ISBN:81-219-1801-4
2. Donald F Kuratko, "Entrepreneurship– Theory, Process and Practice", 9th Edition, Cengage Learning, 2014. ISBN-10:1285051750

Reference Books:

1. HisrichRD,PetersMP,"Entrepreneurship"8thEdition,TataMcGraw-Hill,2013.ISBN1843769964
2. MathewJManimala,"Enterprenuershiptheoryatcrossroads:paradigmsandpraxis"2ndEditionDreamtech,2005.ISBN81-297-0260-6
3. RajeevRoy,"Entrepreneurship"2ndEdition,OxfordUniversityPress,2011.ISBN10:0198072635
4. EDII"FaultyandExternalExperts–AHandBookforNewEntrepreneursPublishers:Entrepreneurship

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Develop awareness and create entrepreneurial mind-set by learning key skills such as design, personal selling, and communication.	L6
2. Develop awareness about Entrepreneur – Achievement Motivation Training and Explain business games, stress management with Entrepreneurship Development Programs.	L6
3. Summarise basic concepts of organization structure, and evaluate the skills needed to run a business.	L5
4. Create innovative and establish a foundation of confidence in the skills necessary to establish an enterprise and its financial aspects.	L6
5. Describe an insight on how to make business proposal and also analysis of the same.	L2

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A37NT.1	3	2	2	-	-	-	-	-	-	-	-	-	3	-
20A37NT.2	2	2	2	-	-	-	-	-	-	-	-	-	3	-
20A37NT.3	3	2	2	-	-	-	-	-	-	-	-	-	3	-
20A37NT.4	2	1	2	2	-	-	-	-	-	-	-	-	3	2
20A37NT.5	3	3	2	-	-	-	-	-	-	-	-	-	3	2

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

Title of the Course Total Quality Management
Category OEC
Course Code 20A37OT

Year IV B. Tech.
Semester I Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To introduce the students, the basic concepts of Total Quality Management.
- To expose with various quality issues in Inspection.
- To gain Knowledge on quality control and its applications to real time.
- To know the extent of customer satisfaction by the application of various quality concepts.
- To understand the importance of Quality standards in Production.

Unit 1 Introduction to TQM **10**

Definition of Quality, Dimensions of Quality, Definition of Total quality management, Quality Planning, Quality costs – Analysis, Techniques for Quality costs, and Basic concepts of Total Quality Management.

Learning Outcomes: At the end of the unit, the student will be able to:
- Define quality; explain the principles of Quality Planning and techniques of quality costs. (L2)
- Interpret the concepts of TQM and contrast the present quality issues with the past. (L2)

Unit 2 Historical Review of TQM **9**

Quality council, Quality statements, Strategic Planning, Deming Philosophy, Barriers of TQM Implementation, Benefits of TQM, Characteristics of successful quality leader, Contributions of Gurus of TQM, Case studies.

Learning Outcomes: At the end of the unit, the student will be able to:
- Apply Deming philosophy and strategic planning to achieve quality in production. (L3)
- Explain the characteristics of quality leader with case studies. (L2)
- Outline the contributions of TQM Gurus. (L2)

Unit 3 TQM Principles **8**

Customer Satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment teams, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure Case studies

Learning Outcomes: At the end of the unit, the student will be able to:
- Identify customer perception of quality and explain customer satisfaction for retention. (L4)
- Apply the principles of motivation and Empowerment. (L3)
- Examine and measure performance using quality principles. (L4)

Unit 4 TQM Tools **9**

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function.

Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA, The seven tools of quality, Process capability, Concept of Six Sigma, New Seven management tools, Case studies.

Learning Outcomes: At the end of the unit, the student will be able to:
- Solve problems on Taguchi loss function and quality function deployment. (L3)
- Illustrate TPM seven tools, Concept of Six Sigma and new seven management tools of TQM. (L3)

Unit 5 Quality Systems 8

Need for ISO 9000 and Other Quality Systems, ISO 9000: 2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, QS 9000, ISO 14000 – Concept, Requirements and Benefits, Case Studies

Learning Outcomes: At the end of the unit, the student will be able to:

- Describe the quality systems concepts and their elements. (L2)
- Discuss the need of ISO9000 and Other Quality systems. (L2)

Prescribed Textbooks:

1. Dale H Besterfield, Total Quality Management, Fourth Edition, Pearson Education, 2018, ISBN: 9789332534452
2. Subburaj Ramaswamy, Total Quality Management, Tata Mcgraw Hill Education., 2012, ISBN: 1259001415, 9781259001413
3. Joel E.Ross , Total Quality Management, Third Eition, CRC Press, 2017, ISBN: 9781351407786

Reference Books:

1. Narayana V and Sreenivasan N.S, Quality Management – Concepts and Tasks, NewAge International, 1996, ISBN-10: 8122416802.
2. Robert L.Flood, Beyond TQM, First Edition, John Wiley & Sons Ltd, 1993, ISBN: 9780471939672.
3. Richard S. Leavenworth & Eugene Lodewick Grant, Statistical Quality Control, Seventh Edition, Tata Mcgraw Hill, 2015, ISBN, 0070241147, 9780070241145.
4. Samuel Ho , TQM – An Integrated Approach, Kogan Page Ltd, USA, 1995, ISBN: 9780749415617.

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Explain definition of quality, TQM, quality planning, quality costs and techniques of quality cost	L2
2. Explain quality council, quality statements, characteristics of a quality leader and can apply the knowledge of Deming's 14 principle of philosophy	L2
3. Describe customer satisfaction and his perception of quality, TQM principles like Juran Trilogy, PDSA cycle, Kaizen principles for achieving continuous process improvement.	L2
4. Explain the concept of bench marking for organizational processes, the quality function deployment, Taguchi quality loss functions, TPM concepts, seven tools of quality and the concepts of six sigma in production processes	L2
5. Summarize the ISO 9000, ISO 14000 quality systems concept, requirements and benefits and can apply the documentation procedures of quality systems	L2

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A37OT.1	2	2	1	1	-	-	-	-	-	-	-	-	1	2
20A37OT.2	2	2	1	1	-	-	-	-	-	-	-	-	1	2
20A37OT.3	2	2	1	1	-	-	-	-	-	-	-	-	1	2
20A37OT.4	2	2	1	1	-	-	-	-	-	-	-	-	1	2
20A37OT.5	2	2	1	1	-	-	-	-	-	-	-	-	1	2

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

Title of the Course Product Design and Development
Category OEC
Course Code 20A37PT

Year IV B. Tech
Semester I Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

- To apply the principles of generic development process; conduct customer need analysis; and set product specification for new product design and development.
- To generate, select, screen, and test concepts for new product design and development.
- To apply the principles of product architecture and industrial design to design and develop new products.
- To apply the principles of DFMA and Prototyping to design and develop new product.
- To apply the concepts of economics principles sustainable product development and life cycle assessment.

Unit 1 Introduction & Product Specifications 9

Introduction – A Generic Development Process – Adapting the Generic Product Development Process - Product Development Process Flows- Digital tools for product design– Identifying Customer Needs.
Product Specifications: Establishing Target Specifications; Setting the Final Specifications.
Learning Outcomes: At the end of the unit, the student will be able to,

- Apply the principles of generic development process. (L3)
- Conduct customer need analysis. (L3)
- Set product specification for new product design and development. (L3)

Unit 2 Concept Generation 9

Concept Generation: The Activity of Concept Generation - Concept Selection: Concept Screening; Concept Scoring – Concept Testing – Concept innovation using TRI.
Learning Outcomes: At the end of the unit, the student will be able to,

- Select, screen, and test concepts for new product design and development. (L3)

Unit 3 Product Architecture 9

Implications of the Architecture: Establishing the Architecture; Delayed Differentiation; Platform Planning; Related System-Level Design Issues – Industrial Design: Assessing the Need for Industrial Design; Impact of Industrial Design; The Industrial Design Process; Management of the Industrial Design Process; Assessing the Quality of Industrial Design.
Learning Outcomes: At the end of the unit, the student will be able to,

- Apply the principles of product architecture. (L3)
- Apply industrial design to design and develop new products. (L3)

Unit 4 DFM and Prototyping 9

Design for Manufacturing: Estimate the Manufacturing Costs; Reduce the Costs of Components; Reduce the Costs of Assembly; Reduce the Costs of Supporting Production; Consider the Impact of DFMA
Prototyping: Type; Uses; Principles; Technologies; Planning for Prototypes.
Learning Outcomes: At the end of the unit, the student will be able to:

- Apply the principles of DFMA. (L3)
- Apply Prototyping to design and develop new product. (L3)

Unit 5 Product Development Economics 9

Elements of Economic Analysis; Economic Analysis Process – sustainable product development: framework and metrics – life cycle assessment of a product: stages and impact.

Learning Outcomes: At the end of the unit, the student will be able to:

- Apply the concepts of economics principles sustainable product development. (L3)
- Apply life cycle assessment of a product. (L3)

Prescribed Text Books:

1. Introduction to Product Design and Development for Engineers, Jamnia, A., , CRC Press, 2018.
2. Product Design and Development, Karl, T. Ulrich and Steven, D. Eppinger,", McGraw Hill, 2003.

Reference Books:

1. Belz A., 36-Hour Course: "Product Development" McGraw-Hill, 2010.
2. Chitale, A. K. and Gupta, R. C., Product Design and Manufacturing, PHI Learning, 2013
3. Pugh S., "Total Design – Integrated Methods for successful Product Engineering", Addison Wesley Publishing, 1991.

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Summarize the principles of generic development process; conduct customer need analysis; and set product specification for new product design and development	L3
2. Summarize the test concepts for new product design and development.	L3
3. Apply the principles of product architecture and industrial design to design and develop new products	L3
4. Summarize the principles of DFMA and Prototyping to design and develop new product	L3
5. Apply the concepts of economics principles sustainable product development and life cycle assessment	L3

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A37PT .1	3	3	3	3	-	-	-	-	-	-	-	-	2	1
20A37PT .2	3	3	3	3	-	-	-	-	-	-	-	-	2	1
20A37PT .3	3	3	3	3	-	-	-	-	-	-	-	-	2	1
20A37PT .4	3	3	3	3	-	-	-	-	-	-	-	-	2	1
20A37PT .5	3	3	3	3	-	-	-	-	-	-	-	-	2	1

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering
(Can also be handled by the faculty members of other departments who underwent FDP on UHV conducted by AICTE, New Delhi)

Title of the Course	Universal Human Values - II
Category	HSMC
Course Code	20AC71T
Year	IV B. Tech
Semester	I Semester
Branch	Common to all

Lecture Hours	Tutorial Hours	Practical	Credits
3	0	0	3

Course Objectives:
- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
- Strengthening of self-reflection
- Development of commitment and courage to act

Unit 1 Course Introduction - Need, Basic Guidelines, Content and Process for Value Education 6
- Purpose and motivation for the course, recapitulation from Universal Human Values-I
- Self-Exploration–what is it? - Its content and process;
- 'Natural Acceptance' and Experiential Validation- as the process for self-exploration
- Continuous Happiness and Prosperity- A look at basic Human Aspirations
- Right understanding, Relationship and Physical Facility- the basic requirements for fulfillment of aspirations of every human being with their correct priority
- Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
- Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

Un it 2 Understanding Harmony in the Human Being - Harmony in Myself! 6
- Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
- Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
- Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
- Understanding the characteristics and activities of 'I' and harmony in 'I'
- Understanding the harmony of I with the Body
- Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
- Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss programs for ensuring health vs dealing with disease.

Unit 3 Understanding Harmony in the Family and Society- Harmony in Human – Human Relation ship 6
- Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the

foundational values of relationship
- Understanding the meaning of Trust; Difference between intention and competence
- Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
- Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
- Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education, etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

Unit 4 Understanding Harmony in the Nature and Existence -Whole existence as Coexistence 6

- Understanding the harmony in the Nature
- Interconnectedness and mutual fulfillment among the four orders of nature recyclability and self-regulation in nature
- Understanding Existence as Co-existence of mutually interacting units in all pervasive space
- Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology, etc.

Unit 5 Implications of the above Holistic Understanding of Harmony on Professional Ethics 6

- Natural acceptance of human values
- Definitiveness of Ethical Human Conduct
- Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
- Competence in professional ethics: a). Ability to utilize the professional competence for augmenting universal human order b). Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c). Ability to identify and develop appropriate technologies and management patterns for the above production systems.
- Case studies of typical holistic technologies, management models and production systems
- Strategy for transition from the present state to Universal Human Order: a). At the level of individual: as socially and ecologically responsible engineers, technologists and managers b). At the level of society: as mutually enriching institutions and organizations
- Summing up.

Include practice Exercises and Case Studies (tutorial) Sessions e.g., to discuss the conduct of an engineer or a scientist, etc.

Prescribed Textbooks

1. 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. 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: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar Kantak, 1999.
2. N. Tripathi, Human Values", New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. Mohandas Karamchand Gandhi. The Story of My Experiments with Truth
5. E. FSchumacher. Small is Beautiful
6. Cecile Andrews, Slow is Beautiful
7. J C Kumarappa. Economy of Permanence
8. Pandit Sunderlal. Bharat Mein AngrejiRaj
9. Dharampal, Rediscovering India.

10. Mohandas K. Gandhi, “Hind Swaraj or Indian Home Rule”
11. Maulana Abdul Kalam Azad. India Wins Freedom
12. Romain Rolland. Vivekananda (English)
13. Romain Rolland. Gandhi (English)
14. Jawaharlal Nehru. Rediscovery of India

Course Outcomes:

Upon successful completion of the course, student will be able to	Blooms Level of Learning
1. demonstrate themselves, and their surroundings (family, society, nature)	L2
2. Comprehend more responsibilities in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.	L2
3. Use better critical ability practically.	L3
4. Analyze their commitment towards what they have understood (human values, human relationship and human society).	L4
5. Apply what they have learnt to their own self in different day- to-day settings in real life, at least a beginning would be made in this direction.	L3

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
20AC71T.1	-	-	-	-	-	-	-	-	-	-	-	3
20AC71T.2	-	-	-	-	-	-	-	-	-	-	-	3
20AC71T.3	-	-	-	-	-	-	-	-	-	-	-	3
20AC71T.4	-	-	-	-	-	-	-	-	-	-	-	3
20AC71T.5	-	-	-	-	-	-	-	-	-	-	-	3

Assessment pattern for UHV-2

The Assessment Pattern for Universal Human Values-II course is described hereunder.

UHV-2 course carries two credits. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self-assessment, peer assessment etc. will be used in evaluation.

A student has to secure 40% marks out of 100 in the CIE and SEE together to qualify for the award of the degree. The distribution shall be 50 marks for continuous internal assessment and 50 marks for semester end examination.

Internal evaluation shall be conducted for the course during semester and shall be evaluated for 50 marks and distributions of marks as follows:

- Assessment by faculty mentor: 10 marks
- Self-assessment: 10 marks
- Assessment by peers: 10 marks
- Socially relevant project/Group Activities/Assignments: 20 marks

Semester End examination is conducted for 50 marks and is of 2 hours duration. The question paper shall be of subjective type with 5 questions, one question from each unit, with internal choice. All the questions carry equal marks of 10 each.

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

Title of the Course Refrigeration and Air Conditioning
Category SC
Course Code 20A371L

Year IV B. Tech.
Semester I Semester
Branch ME

Lecture Hours	Tutorial Hours	Practice Hours	Credits
1	0	2	2

Course Objectives:

- To understand the principles of vapor compression refrigeration system.
- To understand the various components of vapor compression refrigeration system and its thermodynamic cycle.
- To understand the properties of various refrigerants used in the commercial refrigeration and air conditioning units and their effect on environment.
- To understand the principle of Air-conditioning system andusage of Psychometric Chart.
- To understand human comfort conditions and estimate the effect ofvarious cooling and heating loads in an air-conditioning system.

Module – 1 **Theory Sessions – 1** **Lab Sessions – 1**

Introduction to Refrigeration: - Necessity and applications–Unit of refrigeration and C.O.P.– Vapor Compression Refrigeration system.
Experiment-1: Study of various components of Vapor compression refrigeration system cut models.
Learning Outcomes: At the end of the unit, the student will be able to:

- Learn about units of refrigeration and basic refrigeration cycle principle. (L1)

Module – 2 **Theory Sessions – 2** **Lab Sessions – 2**

Description of various components of Simple Vapour compression refrigeration cycle –Representation of cycle on T-S and p-h charts.
Experiment-2: Study of various components of Domestic Refrigerator in working condition.
Experiment-3: Trouble shooting of the Domestic refrigerator like leakage of refrigerant, failure of thermostat, failure of compressor motor, failure of insulation, etc.,
Learning Outcomes: At the end of the unit, the student will be able to:

- Learns about various components of refrigeration cycle. (L1)

Module – 3 **Theory Sessions – 3** **Lab Sessions – 3**

Refrigerants–Desirable properties –common refrigerants used –Nomenclature–Ozone Depletion–Global Warming
Experiment-4: Study of various refrigerants used in the various refrigeration and air conditioning units.
Experiment-5: Study of refrigerant filling procedure in various refrigeration and air conditioning units used commercially.
Experiment-6: Knowing the quantity of refrigerants filled in the domestic refrigeration and air conditioning units. Knowing the price of refrigerants and their suppliers details
Learning Outcomes: At the end of the unit, the student will be able to:

- Learns about the various refrigerants properties and their effect on Ozone depletion. (L1, L2 & L3)

Module – 4 **Theory Sessions – 2**
Lab Sessions – 2

Introduction to Air-Conditioning, Basic Definition, Applications of Air-Conditioning, Psychometric - Air-water vapor mixtures, Psychometric Properties, Psychometric or Air-Conditioning processes, Psychometric Chart.

Experiment-7: Study of various components of Domestic Split Air-conditioner in working condition.

Experiment-8: Trouble shooting of the Domestic Split Air-conditioner like leakage of refrigerant, failure of thermostat, failure of compressor motor, failure of condenser fan, failure of evaporator blower, failure of air filtering element, etc.,

Learning Outcomes: At the end of the unit, the student will be able to:

- Know about the Air Conditioning process, Psychometric properties and their use in comfort air conditioning process. (L1,L2 &L3)

Module – 5 **Theory Sessions – 2**
Lab Sessions – 2

ConceptofhumancomfortandeffectivetemperatureComfortAirconditioning–
IndustrialairconditioningandRequirementsAirconditioningLoadCalculations.

Experiment-9: Estimation of cooling loads for a room based on the area of room, no. of occupants in the room and no. of electrical Gadgets present in the room.

Experiment-10: Determining the tonnage of air conditioner.

Learning Outcomes: At the end of the unit, the student will be able to:

- Estimate the cooling loads of the air conditioning systems. L1,L2 &L3

Prescribed Textbooks:

1. Refrigeration and Airconditioning/CPArora/McGrawHill
2. Basic Refrigeration and Air-Conditioning/Ananthanarayanan/McGrawHill

Course Outcomes:

A student will be able to	Blooms Level of Learning
1. Use and apply the principles of vapor compression refrigeration system.	L3
2. Demonstrate and fix the various components of vapor compression refrigeration system and its thermodynamic cycle.	L3
3. Explain and apply the proper ties of various refrigerants used in the commercial refrigeration and air conditioning units and their effect on environment.	L3
4. Explain and apply the principle of Air-conditioning system and usage of Psychometric Chart.	L3
5. Estimate and apply human comfort conditions and estimate the effect of various cooling and heating loads in an air-conditioning system.	L3

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20A371L.1	3	3	3	2	-	1	1	-	-	-	-	1	1	1
20A371L.2	3	3	3	3	-	1	1	-	-	-	-	1	1	1
20A371L.3	2	2	2	2	-	1	1	-	-	-	-	1	1	1
20A371L.4	3	3	2	3	-	1	1	-	-	-	-	1	1	1
20A371L.5	3	3	3	3	-	1	1	-	-	-	-	1	1	1