JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003 Andhra Pradesh, India
(Established by Andhra Pradesh Act No.22 of 2021)
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Academic Regulations (R23) for B. Tech (Regular-Full time)

AUTOMOBILE ENGINEERING

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

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

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

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

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

1. **Award of the Degree**
   (a) Award of the B.Tech. Degree / B.Tech. Degree with a Minor if he/she fulfils the following:
      (i) Pursues a course of study for not less than four academic years and not more than eight academic years. However, for the students availing Gap year facility this period shall be extended by two years at the most and these two years would in addition to the maximum period permitted for graduation (Eight years).
      (ii) Registers for 160 credits and secures all 160 credits.

   (b) **Award of B.Tech. degree with Honors** if he/she fulfils the following:
      (i) Student secures additional 15 credits fulfilling all the requisites of a B.Tech. program i.e., 160 credits.
      (ii) Registering for Honors is optional.
      (iii) Honors are to be completed simultaneously with B.Tech. Programme.

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

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

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

   Credit Definition:

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

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

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

5. Semester/Credits:

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

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

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

6. Structure of the Undergraduate Programme

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

S.No.	Category	Breakup of Credits (Total 160)	Percentage of total credits	AICTE Recommendation (%)
1.	Humanities and Social Science including Management (HM)	13	8 %	8 – 9%
2.	Basic Sciences (BS)	20	13 %	12 - 16%
3.	Engineering Sciences (ES)	23.5	14%	10 – 18%
4.	Professional Core (PC)	54.5	34 %	30 – 36%
5.	Electives – Professional (PE) & Open (OE); Domain Specific Skill Enhancement Courses (SEC)	33	21 %	19 - 23%
6.	Internships & Project work (PR)	16	10 %	8 – 11%
7.	Mandatory Courses (MC)	Non-credit	Non-credit	-

7. Course Classification:

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

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

8. Programme Pattern

i. Total duration of the of B. Tech (Regular) Programme is four academic years.
ii. Each academic year of study is divided into two semesters.
iii. Minimum number of instruction days in each semester is 90 days.
iv. There shall be mandatory student induction program for freshers, with a three-week duration before the commencement of first semester. Physical activity, Creative Arts, Universal Human Values, Literary, Proficiency Modules, Lectures by Eminent People, Visits to local Areas, Familiarization to Dept./Branch & Innovations etc., are included as per the guidelines issued by AICTE.
v. Health/wellness/yoga/sports and NSS /NSS /Scouts & Guides / Community service activities are made mandatory as credit courses for all the undergraduate students.
vi. Courses like Environmental Sciences, Indian Constitution, Technical Paper Writing & IPR are offered as non-credit mandatory courses for all the undergraduate students.
vii. Design Thinking for Innovation & Tinkering Labs are made mandatory as credit courses for all the undergraduate students.
viii. Increased flexibility for students through an increase in the elective component of the curriculum, with 05 Professional Elective courses and 04 Open Elective courses.

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

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

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

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

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

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

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

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

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

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

9. Evaluation Process

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

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

Theory Courses

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

i) For theory subject, the distribution shall be 30 marks for Internal Evaluation and 70 marks for the End-Examination.
ii) For practical subject, the distribution shall be 30 marks for Internal Evaluation and 70 marks for the End- Examination.
iii) If any course contains two different branch subjects, the syllabus shall be written in two parts with 3 units each (Part-A and Part-B) and external examination question paper shall be set with two parts each for 35 marks.
iv) If any subject is having both theory and practical components, they will be evaluated separately as theory subject and practical subject. However, they will be given same subject code with an extension of „T" for theory subject and „P" for practical subject.

a) Continuous Internal Evaluation

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

Note:

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

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

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

units. The second midterm examination shall be conducted for III, IV and V units with one either or type question from each unit.

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

For Example:

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

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

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

b) End Examination Evaluation:

End examination of theory subjects shall have the following pattern:

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

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

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

Practical Courses

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

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

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

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

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

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

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

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

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

f) There shall be no external examination for mandatory courses with zero credits. However, attendance shall be considered while calculating aggregate attendance and student shall be declared to have passed the mandatory course only when he/she secures 40% or more in the internal examinations. In case, the student fails, a re-

examination shall be conducted for failed candidates for 30 marks satisfying the conditions mentioned in item 1 & 2 of the regulations.

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

10. Skill oriented Courses

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

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

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

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

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

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

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

11. Massive Open Online Courses (MOOCs):

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

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

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

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

12. Credit Transfer Policy

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

i) The University shall offer credit mobility for MOOCs and give the equivalent credit weightage to the students for the credits earned through online learning courses.
ii) Student registration for the MOOCs shall be only through the respective department of the institution; it is mandatory for the student to share necessary information with the department.
iii) Credit transfer policy will be applicable to the Professional & Open Elective courses only.
iv) The concerned department shall identify the courses permitted for credit transfer.
v) The University/institution shall notify at the beginning of semester the list of the online learning courses eligible for credit transfer.
vi) The institution shall designate a faculty member as a Mentor for each course to guide the students from registration till completion of the credit course.
vii) The university shall ensure no overlap of MOOC exams with that of the university examination schedule. In case of delay in results, the university will re-issue the marks sheet for such students.
viii) Student pursuing courses under MOOCs shall acquire the required credits only

after successful completion of the course and submitting a certificate issued by the competent authority along with the percentage of marks and grades.

ix) The institution shall submit the following to the examination section of the university:
   a) List of students who have passed MOOC courses in the current semester along with the certificate of completion.
   b) Undertaking form filled by the students for credit transfer.

x) The universities shall resolve any issues that may arise in the implementation of this policy from time to time and shall review its credit transfer policy in the light of periodic changes brought by UGC, SWAYAM, NPTEL and state government.

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

13. Academic Bank of Credits (ABC)

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

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

14. Mandatory Internships

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

Evaluation of the summer internships shall be through the departmental committee. A student will be required to submit a summer internship report to the concerned department and appear for an oral presentation before the departmental committee comprising of Head of the Department, supervisor of the internship and a senior faculty member of the department. A certificate of successful completion from industry shall be included in the report. The report and the oral presentation shall carry 50% weightage

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

Full Semester Internship and Project work: In the final semester, the student should mandatorily register and undergo internship (onsite/virtual) and in parallel he/she should work on a project with well-defined objectives. At the end of the semester the candidate shall submit an internship completion certificate and a project report. A student shall also be permitted to submit project report on the work carried out during the internship.

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

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

15. Guidelines for offering a Minor

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

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

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

16. Guidelines for offering Honors

The objective of introducing B.Tech. (Hons.) is to facilitate the students to choose additionally the specialized courses of their choice and build their competence in a

specialized area in the UG level. The Programme is a best choice for academically excellent students having good academic record and interest towards higher studies and research.

i) Honors are introduced in the curriculum of all B. Tech. programs offering a major degree and is applicable to all B. Tech (Regular and Lateral Entry) students admitted in Engineering & Technology.
ii) A student shall earn additional 15 credits for award of B.Tech.(Honors) degree from same branch/department/discipline registered for major degree. This is in addition to the credits essential for obtaining the Undergraduate degree in Major Discipline (i.e., 160 credits).
iii) A student is permitted to register for Honors in IV semester after the results of III Semester are declared and students may be allowed to take maximum two subjects per semester pertaining to the Honors from V Semester onwards.
iv) The concerned Principal of the college shall arrange separate class work and timetable of the courses offered under Honors program.
v) Courses that are used to fulfil the student's primary major may not be double counted towards the Honors. Courses with content substantially equivalent to courses in the student's primary Major may not be counted towards the Honors.
vi) Students can complete the courses offered under Honors either in the college or in online platforms like SWAYAM with a minimum duration of 12 weeks for a 3-credit course and 8 weeks duration for a 2-credit course satisfying the criteria for credit mobility. If the courses under Honors are offered in conventional mode, then the teaching and evaluation procedure shall be similar to regular B. Tech courses.
vii) The attendance for the registered courses under Honors and regular courses offered for Major degree in a semester are to be considered separately.
viii) A student shall maintain an attendance of 75% in all registered courses under Honors to be eligible for attending semester end examinations.
ix) A student registered for Honors shall pass in all subjects that constitute the requirement for the Honors degree program. No class/division (i.e., second class, first class and distinction, etc.) shall be awarded for Honors degree Programme.
x) If a student drops or is terminated from the Honors program, the additional credits so far earned cannot be converted into open or core electives; they will remain extra. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.
xi) The Honors will be mentioned in the degree certificate as Bachelor of Technology (Honors) in XYZ. For example, B.Tech. (Honors) in Mechanical Engineering

Enrolment into Honors:

i) Students of a Department/Discipline are eligible to opt for Honors program offered by the same Department/Discipline
ii) The enrolment of student into Honors is based on the CGPA obtained in the major degree program. CGPA shall be taken up to III semester in case of regular entry students and only III semester in case of lateral entry students. Students having 7 CGPA without any backlog subjects will be permitted to register for Honors.
iii) If a student is detained due to lack of attendance either in Major or in Honors, registration shall be cancelled.

iv) Transfer of credits from Honors to regular B. Tech degree and vice-versa shall not be permitted.
v) Honors are to be completed simultaneously with a Major degree program.

Registration for Honors:

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

17. Attendance Requirements:

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

18. For induction Programme attendance shall be maintained as per AICTE norms.
Promotion Rules:

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

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

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

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

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

19. Grading:

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

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

Structure of Grading of Academic Performance

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

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

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

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

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

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

where, C_i is the number of credits of the i^{th} subject and G_i is the grade point scored by the student in the i^{th} course.

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

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

where "S_i" is the SGPA of the i^{th} semester and C_i is the total number of credits up to that semester.

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

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

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

Award of Class:

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

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

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

20. With–holding of Results

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

21. Multiple Entry / Exit Option

(a) Exit Policy:

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

i) **UG Certificate in (Field of study/discipline)** - Programme duration: First year (first two semesters) of the undergraduate Programme, 40 credits followed by an additional exit 10-credit bridge course(s) lasting two months, including at least 6-credit job-specific internship/ apprenticeship that would help the candidates acquire job-ready competencies required to enter the workforce.

ii) **UG Diploma (in Field of study/discipline)** - Programme duration: First two years (first four semesters) of the undergraduate Programme, 80 credits followed by an additional exit 10-credit bridge course(s) lasting two months, including at least 6-credit job-specific internship/ apprenticeship that would help the candidates acquire job-ready competencies required to enter the workforce.

iii) **Bachelor of Science (in Field of study/discipline)** i.e., **B.Sc. Engineering in (Field of study/discipline)**- Programme duration: First three years (first six semesters) of the undergraduate Programme, 120 credits.

(b) Entry Policy:

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

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

22. Gap Year Concept:

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

23. 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.

24. Minimum Instruction Days for a Semester:

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

25. Medium of Instruction:

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

26. Student Transfers:

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

27. General Instructions:

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

*** *** ***

ACADEMIC REGULATIONS (R23)

FOR B. TECH. (LATERAL ENTRY SCHEME)

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

1. Award of the Degree

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

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

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

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

(i) Student secures additional 15 credits fulfilling all the requisites of a B.Tech. program i.e., 120 credits.

(ii) Registering for Honors is optional.

(iii) Honors are to be completed simultaneously with B.Tech. Programme.

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

3. Minimum Academic Requirements

The following academic requirements have to be satisfied in addition to the requirements mentioned in item no.**2**

i. A student shall be deemed to have satisfied the minimum academic requirements and earned the credits allotted to each theory, practical, design, drawing subject or project if he secures not less than 35% of marks in the end examination and a minimum of 40% of marks in the sum total of the mid semester evaluation and end examination taken together.

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

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

4. Course Pattern

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

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

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

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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

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B. Tech (Regular-Full time)

(Mechanical & Automobile Engineering)

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

&

B.Tech.(Lateral Entry Scheme)

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

B.TECH. - COURSE STRUCTURE – R23
(Applicable from the academic year 2023-24 onwards)

INDUCTION PROGRAMME

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

JAWAHARLALNEHRUTECHNOLOGICALUNIVERSITY-GURAJADA-VIZIANAGARAM
VIZIANAGARAM–535003Andhra Pradesh (India)
(Established by Andhra Pradesh ActNo.22of2021)

Group-B

B. TECH- Mechanical & Automobile Engineering

I Year I Semester						
S. No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1.	R23BS01	Linear Algebra & Calculus	3	0	0	3
2.	R23BS04	Engineering Chemistry	3	0	0	3
3.	R23ES07	Introduction to Programming	3	0	0	3
4.	R23ES03	Engineering Graphics	1	0	4	3
5.	R23ES04	Basic Electrical & Electronics Engineering	3	0	0	3
6.	R23BS04	Engineering Chemistry Lab	0	0	2	1
7.	R23ES07	Computer Programming Lab	0	0	3	1.5
8.	R23ES05	Electrical &Electronics Engineering Workshop	0	0	3	1.5
9.	R23MC02	NSS/NCC/Scouts &Guides/Community Service	0	0	1	0.5
		Total				**19.5**

I Year II Semester						
S. No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1.	R23BS02	Differential Equations and Vector Calculus	3	0	0	3
2.	R23BS03	Engineering Physics	3	0	0	3
3.	R23HS01	Communicative English	2	0	0	2
4.	R23ES01	Basic Civil & Mechanical Engineering	3	0	0	3
5.	R23PC01	Engineering Mechanics	3	0	0	3
6.	R23HS01	Communicative English Lab	0	0	2	1
7.	R23BS03	Engineering Physics Lab	0	0	2	1
8.	R23ES06	IT workshop	0	0	2	1
9.	R23ES02	Engineering Workshop	0	0	3	1.5
10.	R23PC01	Engineering Mechanics Lab	0	0	3	1.5
11.	R23MC01	Health and Wellness, Yoga and Sports	0	0	1	0.5
		Total				**20.5**

AUTOMOBILE ENGINEERING

B. Tech – II Year I Semester

S. No	Category	Title	L	T	P	Credits
1	BS	Numerical Techniques and Statistical Methods	3	0	0	3
2	HSMC	Universal human values – understanding harmony and Ethical human conduct	2	1	0	3
3	Engineering Science	Thermodynamics & Thermal Engineering	3	0	0	3
4	Professional Core	Fluid Mechanics & Hydraulic Machines	3	0	0	3
5	Professional Core	Components of Automotive Chassis	3	0	0	3
6	Professional Core	Fluid Mechanics & Hydraulic Machines Lab	0	0	3	1.5
7	Professional Core	Automotive Chassis Lab	0	0	3	1.5
8	Skill Enhancement Course	Computer Aided drafting and Automobile Assembly Drawing	0	1	2	2
9	Audit Course	Environmental Science	2	0	0	-
Total			**16**	**2**	**8**	**20**

B. Tech – II Year II Semester

S.No.	Category	Title	L	T	P	Credits
1	Management Course- I	Product Life Cycle Management	2	0	0	2
2	Engineering Science/Basic Science	Mechanics of Solids	3	0	0	3
3	Professional Core	Automobile Engines	3	0	0	3
4	Professional Core	Automobile Electrical and Electronics	3	0	0	3
5	Professional Core	Metallurgy and Material Science	3	0	0	3
6	Professional Core	Automobile Engines & Fuels Lab	0	0	3	1.5
7	Professional Core	Automobile Electrical and Electronics Lab	0	0	3	1.5
8	Skill Enhancement Course	Machine Tools and Metrology Lab	0	1	2	2
9	Engineering Science	Design Thinking & Innovation	1	0	2	2
		Total	**15**	**1**	**10**	**21**
Mandatory Community Service Project Internship of 08 weeks duration during Summer Vacation						

III YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	PC	Theory of Machines	3	0	0	3
2	PC	Production Technology	3	0	0	3
3	PC	Vehicle Dynamics	3	0	0	3
4	OE-1	**OPEN ELECTIVE**	3	0	0	3
5	PE	1. Alternative Fuels for engines 2. Two and Three Wheelers 3. Heat Transfer 4. Industrial Hydraulics and Pneumatics (OR) MOOC'S/NPTEL	3	0	0	3
6	PC	Production Technology Lab	0	0	3	1.5
7	PC	Theory of Machines Lab	0	0	3	1.5
8	SEC	Vehicle Design & Analysis Lab	0	0	4	2
9	MC	Indian Traditional Knowledge	2	0	0	0
10	Evaluation of Community Service Project	Community Service Internship				2
	Total Credits					**22**
Honors/Minor courses			**4**	0	**0**	**4**

III YEAR II SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits
1	PC	Automobile Components and Chassis Design	3	0	0	3
2	PC	Automobile Transmission systems	3	0	0	3
3	PC	Vehicle Body Engineering	3	0	0	3
4	OE-2	**OPEN ELECTIVE**	3	0	0	3
5	PE-2	1. CFD for Automobile Applications 2. Condition Monitoring 3. Noise Vibrations and Harshness 4. Measurements and Control systems (OR) MOOC'S/NPTEL	3	0	0	3
6	PC	Auto Scanning & Vehicle Testing Lab	0	0	3	1.5
7	PC	Vehicle Maintenance Lab	0	0	3	1.5
8	PC	Vehicle Evaluation Lab	0	0	4	2
9	SEC	Soft Skills	0	0	4	2
10	MC	Technical Paper Writing & IPR	2	--		0
	Total Credits					**22**
Mandatory industry Internship of 08 Weeks duration during summer vacation						
Honors/Minor courses			**4**	**0**	**0**	**4**

IV B. TECH I SEMESTER

S. No	Code	Course Title	L	T	P	Credits
1	PE-3	1. Automobile Safety 2. Automobile HVAC 3. Special Purpose Vehicles 4. Engine Management Systems (OR) MOOC'S/NPTEL	3	0	0	3
2	PE-4	1. Automobile Certification and Homologation 2. Electric Vehicles and Hybrid Technology 3. Facilities Planning and Material Handling 4. Rapid Prototyping (OR) MOOC'S/NPTEL	3	0	0	3
3	PE-5	1. Lean Manufacturing 2. Vehicle Design Data Characteristics 3. Reliability Engineering 4. Smart, Autonomous and Connected Vehicles (OR) MOOC'S/NPTEL	3	0	0	3
4	OE-3	**OPEN ELECTIVE**	3	0	0	3
5	OE-4	**OPEN ELECTIVE**	3	0	0	3
6	HS	Professional Ethics	3	0	0	3
7	SOC	Artificial Intelligence and Machine Learning Lab	1	0	2	2
Evaluation of Summer Internship completed after III B. Tech II Semester						3
Total Credits						**23**
Honors/Minor courses			**4**	**0**	**0**	**4**

IV B. TECH II SEMESTER

S. No.	Category	Course Title	L	T	P	Credits
1	Internship &Project Work	Full semester Internship &Project Work	0	0	24	12
Total Credits						**12**

***Students can complete Project work @ Industries/ Higher Learning Institutions/ APSSDC.**

OPEN ELECTIVES:

OPEN ELECTIVE-I:	1. Basic Automobile Engineering 2. Automobile Maintenance and Safety 3. Automobile Emissions and Effects
OPEN ELECTIVE-II:	1. Alternative Fuels for Automobiles 2. Vehicle Stability and Control 3. Electric Vehicles and Hybrid Technology
OPEN ELECTIVE-III:	1. Automobile Safety 2. Automobile Power train 3. IC Engines
OPEN ELECTIVE-IV:	1. Automobile Materials and Manufacturing Techniques 2. Engine Management Systems 3. Automobile Electrical and Electronics

MINOR in AUTOMOBILE ENGINEERING:

S. No	Subject	Prerequisites
1	Basic Automobile Engineering	NIL
2	IC Engines	NIL
3	Vehicle Body Engineering	Basic AE
4	Vehicle Dynamics	Basic AE, VBE
5	Automobile Electrical and Electronics	Basic AE
6	Electric Vehicles and Hybrid Technology	Basic AE, AEE
7	Automobile Materials and Manufacturing	Basic AE
8	Automobile Pollution and its Effects	Basic AE, ICE

PROPOSED SUBJECTS FOR B. Tech (HONORS) IN AUTOMOBILE ENGINEERING

HONORS IN AUTOMOBILE ENGINEERING		Pre-requisites
POOL – 1 (in II-II)		
1.	Engine Tribology	Automobile Engines
2.	Micro Electrical Mechanical Systems	Nil
3.	Standards And Test Procedures of Fuel and Vehicle Emissions	Components of Automotive Chassis
4.	Engine Modeling	Automobile Engines
POOL-2 (in III-I)		
1.	Metal Forming Processes	Production Technology
2.	Statistical Design in Quality Control	Nil
3.	Design for Manufacturing & Assembly	Production Technology
4.	Robotics & Automation	Kinematics of Machinery
POOL-3 (in III-II)		
1.	Advanced Microcontroller for Automobile Systems	Basic Electrical & Electronics
2.	Automobile Sensors Actuators & Data Acquisition System	Automotive Electrical & Electronics
3.	Automobile Instrumentation and Embedded System	Automotive Electrical & Electronics
4.	Automobile Accident Investigation	Nil
POOL-4 (in IV-I)		
1.	Automobile Product Design and Development	Nil
2.	Analysis and Synthesis of Mechanisms	Kinematics of Machinery
3.	Gas Dynamics	Dynamics of Machinery
4.	Gear Engineering	Kinematics of Machinery

I Year-I Semester

L	T	P	C
3	0	0	3

LINEAR ALGEBRA & CALCULUS

(Common to All Branches of Engineering)

Course Objectives:

To equip the students with standard concepts and tools of mathematics to handle various real-world problems and their applications.

Course Outcomes:

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

- develop matrix algebra techniques that is needed by engineers for practical applications.
- to find the eigen values and eigen vectors and solve the problems by using linear transformation
- learn important tools of calculus in higher dimensions.
- familiarize with functions of several variables which is useful in optimization.
- familiarize with double and triple integrals of functions of several variables in two and three dimensions.

UNIT - I: Matrices

Rank of a matrix by echelon form, normal form. Cauchy –Binet formulae (without proof). Inverse of non-singular matrices by Gauss-Jordan method

System of linear equations: Solving system of Homogeneous and Non-Homogeneous equations by Gauss elimination method, Gauss Seidel Iteration Method.

UNIT- II: Linear Transformation and Orthogonal Transformation:

Eigen values, Eigen vectors and their properties (without Proof), Diagonalization of a matrix, Cayley-Hamilton Theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton Theorem, Quadratic forms and Nature of the Quadratic Forms, Reduction of Quadratic form to canonical forms by Orthogonal Transformation

UNIT- III: Calculus

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

UNIT- IV: Partial differentiation and Applications (Multi variable calculus)

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

UNIT – V: Multiple Integrals (Multi variable Calculus)

Double integrals - change of variables (Cartesian and Polar coordinates), Change of order of integration, cylindrical and spherical coordinates. Finding areas (by double integrals) and volumes (by double integrals and triple integrals).

Text books:

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

Reference Books:

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

I Year-I Semester

L	T	P	C
3	0	0	3

ENGINEERING CHEMISTRY

Course Objectives:

- To familiarize engineering chemistry and its applications
- To impart the concept of soft and hard waters, softening methods of hard water
- To train the students on the principles and applications of astrochemistry, polymers, surface chemistry, and cement

.

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

CO1: Demonstrate the corrosion prevention methods and factors affecting corrosion.

CO2: Explain the preparation, properties, and applications of thermoplastics & thermosetting, elastomers & conducting polymers.

CO3: Explain calorific values, octane number, refining of petroleum and cracking of oils.

CO4: Explain the setting and hardening of cement.

CO5: Summarize the concepts of colloids, micelle and nanomaterials.

UNIT I Water Technology

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

UNIT II Electrochemistry and Applications

Electrodes –electrochemical cell, Nernst equation, cell potential calculations.

Primary cells – Zinc-air battery, Secondary cells – Nickel-Cadmium (NiCad), and lithium-ion batteries- working principle of the batteries including cell reactions; Fuel Cells-Basic Concepts, the principle and working of hydrogen-oxygen Fuel cell.

Corrosion: Introduction to corrosion, electrochemical theory of corrosion, differential aeration cell corrosion, galvanic corrosion, metal oxide formation by dry electrochemical corrosion, Pilling Bedworth ratios and uses, Factors affecting the corrosion**,** cathodic and anodic protection, electroplating and electro less plating (Nickel and Copper).

UNIT III Polymers and Fuel Chemistry

Introduction to polymers, functionality of monomers, Mechanism of chain growth, step growth polymerization.

Thermoplastics and Thermo-setting plastics-: Preparation, properties and applications of poly styrene. PVC Nylon 6,6 and Bakelite.

Elastomers – Preparation, properties and applications of Buna S, Buna N, Thiokol rubbers.

Fuels – Types of fuels, calorific value of fuels, numerical problems based on calorific value; Analysis of coal (Proximate and Ultimate analysis), Liquid Fuels, refining of petroleum, Octane and Cetane number- alternative fuels- propane, methanol, ethanol and bio fuel-bio diesel.

UNIT IV Modern Engineering Materials

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

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

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

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

UNIT V Surface Chemistry and Nanomaterials

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

Textbooks:

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

Reference Books:

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

L	T	P	C
3	0	0	3

I Year-I Semester

INTRODUCTION TO PROGRAMMING
(Common to All branches of Engineering)

Course Objectives:

The objectives of this course are to acquire knowledge on the
i. To impart adequate knowledge on the need of programming languages and problem-solving techniques and develop programming skills.
ii. To enable effective usage of Control Structures and Implement different operations on arrays.
iii. To demonstrate the use of Strings and Functions.
iv. To impart the knowledge of pointers and understand the principles of dynamic memory allocation.
v. To understand structures and unions and illustrate the file concepts and its operations.
vi. To impart the Knowledge Searching and Sorting Techniques

UNIT-I Introduction to Computer Problem Solving:
Programs and Algorithms, Computer Problem Solving Requirements, Phases of Problem Solving, Problem. Solving Strategies, Top-Down Approach, Algorithm Designing, Program Verification, Improving Efficiency, Algorithm Analysis and Notations.

UNIT-II Introduction to C Programming:
Introduction, Structure of a C Program. Comments, Keywords, Identifiers, Data Types, Variables, Constants, Input/output Statements. Operators, Type Conversion. Control Flow, Relational Expressions: Conditional Branching Statements: if, if-else, if-else—if, switch. Basic Loop Structures: while, do-while loops, for loop, nested loops, The Break and Continue Statements, goto statement**.**

UNIT-III Arrays:
Introduction, Operations on Arrays, Arrays as Function Arguments, Two Dimensional Arrays, Multidimensional Arrays. Pointers: Concept of a Pointer, Declaring and Initializing Pointer Variables, Pointer Expressions and Address Arithmetic, Null Pointers, Generic Pointers, Pointers as Function Arguments, Pointers and Arrays, Pointer to Pointer, Dynamic Memory Allocation, Dangling Pointer, Command Line Arguments.

UNIT-IV Functions:
Introduction Function: Declaration, Function Definition, Function Call, Categories of Functions, Passing Parameters to Functions, Scope of Variables, Variable Storage Classes. Recursion. Strings: String Fundamentals, String Processing with and without Library Functions, Pointers and Strings.

UNIT-V
Structures, Unions, Bit Fields: Introduction, Nested Structures, Arrays of Structures, Structures

and Functions, Self-Referential Structures, Unions, Enumerated Data Type —Enum variables, Using Typedef keyword, Bit Fields. Data Files: Introduction to Files, Using Files in C, Reading from Text Files, Writing to Text Files, Random File Access.

Note: The syllabus is designed with C Language as the fundamental language of implementation.

Course Outcomes:
At the end of the Course, Student should be able to:
i. Illustrate the Fundamental concepts of Computers and basics of computer programming and problem-solving approach
ii. Understand the Control Structures, branching and looping statements
iii. Use of Arrays and Pointers in solving complex problems.
iv. Develop Modular program aspects and Strings fundamentals.
v. Demonstrate the ideas of User Defined Data types, files. Solve real world problems using the concept of Structures, Unions and File operations.

Text Books:
1. A Structured Programming Approach Using C, Forouzan, Gilberg, Cengage.
2. How to solve it by Computer, R. G. Dromey, and Pearson Education.
3. Programming In C A-Practia1 Approach. Ajay Mittal, Pearson

References:
1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill.
2. Computer Programming. Reema Thareja, Oxford University Press
3. The C Programming Language, Dennis Richie And Brian Kernighan, Pearson Education.
4. Programming In C, Ashok Kamthane, Second Edition, Pearson Publication.
5. Let us C ,YaswanthKanetkar, 16th Edition,BPB Publication.
6. Computing fundamentals and C Programming, Balagurusamy, E., McGraw-Hill Education, 2008

Web References:
1. http://www.c4learn.com/
2. http://www.geeksforgeeks.org/c/
3. http://nptel.ac.in/courses/122104019/
4. http://www.learn-c.org/
5. https://www.tutorialspoint.com/cprogramming/

I Year-I Semester

L	T	P	C
1	0	4	3

ENGINEERING GRAPHICS
(Common to All branches of Engineering)

Course Objectives:

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

Course Outcomes:

CO1: Understand the principles of engineering drawing, including engineering curves, scales, orthographic and isometric projections.
CO2: Draw and interpret orthographic projections of points, lines, planes and solids in front, top and side views.
CO3: Understand and draw projection of solids in various positions in first quadrant.
CO4: Explain principles behind development of surfaces.
CO5: Prepare isometric and perspective sections of simple solids.

UNIT I

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

Curves: construction of ellipse, parabola and hyperbola by general, Cycloids, Involutes, Normal and tangent to Curves.

Scales: Plain scales, diagonal scales and vernier scales.

UNIT II

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

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

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

UNIT III

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

UNIT IV

Sections of Solids: Perpendicular and inclined section planes, Sectional views and True shape of section, Sections of solids in simple position only.

Development of Surfaces: Methods of Development: Parallel line development and radial line development. Development of a cube, prism, cylinder, pyramid and cone.

UNIT V

Conversion of Views: Conversion of isometric views to orthographic views; Conversion of orthographic views to isometric views.

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

Textbook:

1. N. D. Bhatt, Engineering Drawing, Charotar Publishing House, 2016.

Reference Books:

1. Engineering Drawing, K.L. Narayana and P. Kannaiah, Tata McGraw Hill, 2013.
2. Engineering Drawing, M.B.Shah and B.C. Rana, Pearson Education Inc,2009.
3. Engineering Drawing with an Introduction to AutoCAD, Dhananjay Jolhe, Tata McGraw Hill, 2017.

I Year-I Semester

L	T	P	C
3	0	0	3

BASIC ELECTRICAL & ELECTRONICS ENGINEERING
(Common to All branches of Engineering)

Course Objectives

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

Course Outcomes: After the completion of the course students will be able to

Course Outcomes:
CO1: Remember the fundamental laws, operating principles of motors, generators, MC and MI instruments.
CO2: Understand the problem-solving concepts associated to AC and DC circuits, construction and operation of AC and DC machines, measuring instruments; different power generation mechanisms, Electricity billing concept and important safety measures related to electrical operations.
CO3: Apply mathematical tools and fundamental concepts to derive various equations related to machines, circuits and measuring instruments; electricity bill calculations and layout representation of electrical power systems.
CO4: Analyze different electrical circuits, performance of machines and measuring instruments.
CO5: Evaluate different circuit configurations, Machine performance and Power systems operation.

PART A: BASIC ELECTRICAL ENGINEERING

UNIT I DC & AC Circuits

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

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

UNIT II Machines and Measuring Instruments

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

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

UNIT III Energy Resources, Electricity Bill & Safety Measures

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

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

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

Textbooks:

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

Reference Books:

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

Web Resources:

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

PART B: BASIC ELECTRONICS ENGINEERING

Course Objectives:

- To teach the fundamentals of semiconductor devices and its applications, principles of digital electronics.

UNIT I SEMICONDUCTOR DEVICES

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

UNIT II BASIC ELECTRONIC CIRCUITS AND INSTRUMENTTAION

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

UNIT III DIGITAL ELECTRONICS

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

Textbooks:

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

Reference Books:

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

L	T	P	C
0	0	2	1

I Year-I Semester

ENGINEERING CHEMISTRY LAB

Course Objectives:

- To verify the fundamental concepts with experiments

Course Outcomes: At the end of the course, the students will be able to
CO1: Determine the cell constant and conductance of solutions.
CO2: Prepare advanced polymer materials.
CO3: Determine the physical properties like surface tension, adsorption and viscosity.
CO4: Estimate the Iron and Calcium in cement.
CO5: Calculate the hardness of water.

List of Experiments:

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

Reference:

- "Vogel's Quantitative Chemical Analysis 6th Edition 6th Edition" Pearson Publications by J. Mendham, R.C. Denney, J.D. Barnes and B. Sivasankar

I Year-I Semester

L	T	P	C
0	0	3	1.5

COMPUTER PROGRAMMING LAB
(Common to All branches of Engineering)

Course Objectives:

The course aims to give students hands – on experience and train them on the concepts of the C- programming language.

Course Outcomes:
CO1: Read, understand, and trace the execution of programs written in C language.
CO2: Select the right control structure for solving the problem.
CO3: Develop C programs which utilize memory efficiently using programming constructs like pointers.
CO4: Develop, Debug and Execute programs to demonstrate the applications of arrays, functions, basic concepts of pointers in C.

UNIT I

WEEK 1
Objective: Getting familiar with the programming environment on the computer and writing the first program.

Suggested Experiments/Activities:
Tutorial 1: Problem-solving using Computers.
Lab1: Familiarization with programming environment
i) Basic Linux environment and its editors like Vi, Vim & Emacs etc.
ii) Exposure to Turbo C, gcc
iii) Writing simple programs using printf(), scanf()

WEEK 2
Objective: Getting familiar with how to formally describe a solution to a problem in a series of finite steps both using textual notation and graphic notation.

Suggested Experiments /Activities:
Tutorial 2: Problem-solving using Algorithms and Flow charts.
Lab 1: Converting algorithms/flow charts into C Source code.
Developing the algorithms/flowcharts for the following sample programs
i) Sum and average of 3 numbers
ii) Conversion of Fahrenheit to Celsius and vice versa
iii) Simple interest calculation

WEEK 3
Objective: Learn how to define variables with the desired data-type, initialize them with appropriate values and how arithmetic operators can be used with variables and constants.

Suggested Experiments/Activities:
Tutorial 3: Variable types and type conversions:

Lab 3: Simple computational problems using arithmetic expressions.
i) Finding the square root of a given number
ii) Finding compound interest
iii) Area of a triangle using heron's formulae
iv) Distance travelled by an object

UNIT II

WEEK 4
Objective: Explore the full scope of expressions, type-compatibility of variables & constants and operators used in the expression and how operator precedence works.

Suggested Experiments/Activities:

Tutorial4: Operators and the precedence and as associativity:
Lab4: Simple computational problems using the operator' precedence and associativity
i) Evaluate the following expressions.
   a. A+B*C+(D*E) + F*G
   b. A/B*C-B+A*D/3
   c. A+++B---A
   d. J= (i++) + (++i)
ii) Find the maximum of three numbers using conditional operator
iii) Take marks of 5 subjects in integers, and find the total, average in float

WEEK 5
Objective: Explore the full scope of different variants of ―if construct‖ namely if-else, null-else, if-else if*-else, switch and nested-if including in what scenario each one of them can be used and how to use them. Explore all relational and logical operators while writing conditionals for ―if construct‖.

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

WEEK 6
Objective: Explore the full scope of iterative constructs namely while loop, do-while loop and

for loop in addition to structured jump constructs like break and continue including when each of these statements is more appropriate to use.

Suggested Experiments/Activities:
Tutorial 6: Loops, while and for loops
Lab 6: Iterative problems e.g., the sum of series

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

UNIT III

WEEK 7:
Objective: Explore the full scope of Arrays construct namely defining and initializing 1-D and 2-D and more generically n-D arrays and referencing individual array elements from the defined array. Using integer 1-D arrays, explore search solution linear search.

Suggested Experiments/Activities:
Tutorial 7: 1 D Arrays: searching.
Lab 7:1D Array manipulation, linear search

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

WEEK 8:
Objective: Explore the difference between other arrays and character arrays that can be used as Strings by using null character and get comfortable with string by doing experiments that will reverse a string and concatenate two strings. Explore sorting solution bubble sort using integer arrays.

Suggested Experiments/Activities:
Tutorial 8: 2 D arrays, sorting and Strings.
Lab 8: Matrix problems, String operations, Bubble sort

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

UNIT IV

WEEK 9:
Objective: Explore pointers to manage a dynamic array of integers, including memory allocation & value initialization, resizing changing and reordering the contents of an array

and memory de-allocation using malloc (), calloc (), realloc () and free () functions. Gain experience processing command-line arguments received by C

Suggested Experiments/Activities:
Tutorial 9: Pointers, structures and dynamic memory allocation
Lab 9: Pointers and structures, memory dereference.

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

WEEK 10:
Objective: Experiment with C Structures, Unions, bit fields and self-referential structures (Singly linked lists) and nested structures

Suggested Experiments/Activities:
Tutorial 10: Bitfields, Self-Referential Structures, Linked lists
Lab10: Bitfields, linked lists
Read and print a date using dd/mm/yyyy format using bit-fields and differentiate the same without using bit- fields

i) Create and display a singly linked list using self-referential structure.
ii) Demonstrate the differences between structures and unions using a C program.
iii) Write a C program to shift/rotate using bitfields.
iv) Write a C program to copy one structure variable to another structure of the same type.

UNIT V

WEEK 11:
Objective: Explore the Functions, sub-routines, scope and extent of variables, doing some experiments by parameter passing using call by value. Basic methods of numerical integration

Suggested Experiments/Activities:
Tutorial 11: Functions, call by value, scope and extent,
Lab 11: Simple functions using call by value, solving differential equations using Eulers theorem.

i) Write a C function to calculate NCR value.
ii) Write a C function to find the length of a string.
iii) Write a C function to transpose of a matrix.
iv) Write a C function to demonstrate numerical integration of differential equations using Euler's method

WEEK 12:
Objective: Explore how recursive solutions can be programmed by writing recursive functions that can be invoked from the main by programming at-least five distinct problems that have naturally recursive solutions.

Suggested Experiments/Activities:
Tutorial 12: Recursion, the structure of recursive calls
Lab 12: Recursive functions

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

WEEK 13:
Objective: Explore the basic difference between normal and pointer variables, Arithmetic operations using pointers and passing variables to functions using pointers

Suggested Experiments/Activities:
Tutorial 13: Call by reference, dangling pointers
Lab 13: Simple functions using Call by reference, Dangling pointers.

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

WEEK14:
Objective: To understand data files and file handling with various file I/O functions. Explore the differences between text and binary files.

Suggested Experiments/Activities:
Tutorial 14: File handling
Lab 14: File operations

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

Textbooks:

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

Reference Books:

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

I Year-I Semester

L	T	P	C
0	0	3	1.5

ELECTRICAL & ELECTRONICS ENGINEERING WORKSHOP
(Common to All branches of Engineering)

Course Objectives:

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

Course Outcomes:

CO1: Understand the Electrical circuit design concept; measurement of resistance, power, power factor; concept of wiring and operation of Electrical Machines and Transformer.
CO2: Apply the theoretical concepts and operating principles to derive mathematical models for circuits, Electrical machines and measuring instruments; calculations for the measurement of resistance, power and power factor.
CO3: Apply the theoretical concepts to obtain calculations for the measurement of resistance, power and power factor.
CO4: Analyze various characteristics of electrical circuits, electrical machines and measuring instruments.
CO5: Design suitable circuits and methodologies for the measurement of various electrical parameters; Household and commercial wiring.

Activities:

1. Familiarization of commonly used Electrical & Electronic Workshop Tools: Bread board, Solder, cables, relays, switches, connectors, fuses, Cutter, plier, screwdriver set, wire stripper, flux, knife/blade, soldering iron, de-soldering pump etc.
   - Provide some exercises so that hardware tools and instruments are learned to be used by the students.

2. Familiarization of Measuring Instruments like Voltmeters, Ammeters, multimeter, LCR-Q meter, Power Supplies, CRO, DSO, Function Generator, Frequency counter.
   - Provide some exercises so that measuring instruments are learned to be used by the students.

3. Components:
   - Familiarization/Identification of components (Resistors, Capacitors, Inductors, Diodes, transistors, IC's etc.) – Functionality, type, size, color coding package, symbol, cost etc.

- Testing of components like Resistor, Capacitor, Diode, Transistor, ICs etc. - Compare values of components like resistors, inductors, capacitors etc with the measured values by using instruments

PART A: ELECTRICAL ENGINEERING LAB

List of experiments:

1. Verification of KCL and KVL
2. Verification of Superposition theorem
3. Measurement of Resistance using Wheat stone bridge
4. Magnetization Characteristics of DC shunt Generator
5. Measurement of Power and Power factor using Single-phase wattmeter
6. Measurement of Earth Resistance using Megger
7. Calculation of Electrical Energy for Domestic Premises

Reference Books:

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

Note: Minimum Six Experiments to be performed.

PART B: ELECTRONICS ENGINEERING LAB

Course Objectives:

- To impart knowledge on the principles of digital electronics and fundamentals of electron devices & its applications.

Course Outcomes: At the end of the course, the student will be able to
CO1: Identify & testing of various electronic components.
CO2: Understand the usage of electronic measuring instruments.
CO3: Plot and discuss the characteristics of various electron devices.
CO4: Explain the operation of a digital circuit.

List of Experiments:

1. Plot V-I characteristics of PN Junction diode A) Forward bias B) Reverse bias.
2. Plot V – I characteristics of Zener Diode and its application as voltage Regulator.
3. Implementation of half wave and full wave rectifiers

4. Plot Input & Output characteristics of BJT in CE and CB configurations
5. Frequency response of CE amplifier.
6. Simulation of RC coupled amplifier with the design supplied
7. Verification of Truth Table of AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gates using ICs.
8. Verification of Truth Tables of S-R, J-K& D flip flops using respective ICs.

Tools / Equipment Required: DC Power supplies, Multi meters, DC Ammeters, DC Voltmeters, AC Voltmeters, CROs, all the required active devices.

References:

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

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

I Year-I Semester

L	T	P	C
0	0	1	0.5

NSS/NCC/SCOUTS & GUIDES/COMMUNITY SERVICE

(Common to All branches of Engineering)

Course Objectives:

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

Course Outcomes: After completion of the course the students will be able to

CO1: Understand the importance of discipline, character and service motto.
CO2: Solve some societal issues by applying acquired knowledge, facts, and techniques.
CO3: Explore human relationships by analyzing social problems.
CO4: Determine to extend their help for the fellow beings and downtrodden people.
CO5: Develop leadership skills and civic responsibilities.

UNIT I Orientation

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

Activities:

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

UNIT II Nature & Care

Activities:

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

UNIT III Community Service

Activities:

i) Conducting One Day Special Camp in a village contacting village-area leaders- Survey in the village, identification of problems- helping them to solve via media- authorities-experts-etc.

ii) Conducting awareness programs on Health-related issues such as General Health, Mental health, Spiritual Health, HIV/AIDS,
iii) Conducting consumer Awareness. Explaining various legal provisions etc.
iv) Women Empowerment Programmes- Sexual Abuse, Adolescent Health and Population Education.
v) Any other programmes in collaboration with local charities, NGOs etc.

Reference Books:

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

General Guidelines:

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

Evaluation Guidelines:

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

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I Year-II Semester

L	T	P	C
3	0	0	3

DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS
(Common to All Branches of Engineering)

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 in to advanced level by handling various real-world applications.

Course Outcomes:

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

- solve the differential equations related to various engineering fields.
- model engineering problems as higher order differential equations and solve analytically.
- identify solution methods for partial differential equations that model physical processes.
- interpret the physical meaning of different operators such as gradient, curl and divergence.
- estimate the work done against a field, circulation and flux using vector calculus.

UNIT- I: Differential equations of first order and first degree

Linear differential equations – Bernoulli's equations- Exact equations and equations reducible to exact form. Applications: Newton's Law of cooling – Law of natural growth and decay- Electrical circuits

UNIT – II: Linear differential equations of higher order (Constant Coefficients)

Definitions, homogenous and non-homogenous, complimentary function, general particular integral, Wronskian, method of variation of parameters. Simultaneous linear equations, Applications to L-C-R Circuit problems and Simple Harmonic motion.

UNIT – III: Partial Differential Equations

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

UNIT - IV: Vector differentiation

Scalar and vector point functions, vector operator del, del applies to scalar point functions-Gradient, del applied to vector point functions - Divergence and Curl, vector identities

UNIT –V: Vector integration

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

Textbooks:

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

Reference Books:

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

L	T	P	C
3	0	0	3

I Year-II Semester

ENGINEERING PHYSICS

(Common for all branches of Engineering)

Course Objectives:

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

Course Outcomes:

CO1: Analyze the intensity variation of light due to polarization, interference and diffraction.
CO2: Familiarize with the basics of crystals and their structures.
CO3: Explain fundamentals of quantum mechanics and apply it to one dimensional motion of particles.
CO4: Summarize various types of polarization of dielectrics and classify the magnetic materials.
CO5: Explain the basic concepts of Quantum Mechanics and the band theory of solids.
CO6: Identify the type of semiconductor using Hall effect.

UNIT I Wave Optics

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

UNIT II Crystallography and X-ray diffraction

Crystallography: Space lattice, Basis, Unit Cell and lattice parameters – Bravais Lattices – crystal systems (3D) – coordination number - packing fraction of SC, BCC & FCC - Miller indices – separation between successive (hkl) planes.

X- ray diffraction: Bragg's law - X-ray Diffractometer – crystal structure determination by Laue's and powder methods

UNIT III Dielectric and Magnetic Materials

Dielectric Materials: Introduction - Dielectric polarization - Dielectric polarizability, Susceptibility, Dielectric constant and Displacement Vector – Relation between the electric vectors - Types of polarizations- Electronic (Quantitative), Ionic (Quantitative) and Orientation

polarizations (Qualitative) - Lorentz internal field - Clausius- Mossotti equation - complex dielectric constant – Frequency dependence of polarization – dielectric loss

Magnetic Materials: Introduction - Magnetic dipole moment - Magnetization-Magnetic susceptibility and permeability – Atomic origin of magnetism - Classification of magnetic materials: Dia, para, Ferro, anti-ferro & Ferri magnetic materials - Domain concept for Ferromagnetism & Domain walls (Qualitative) - Hysteresis - soft and hard magnetic materials.

UNIT IV Quantum Mechanics and Free electron Theory

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

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

UNIT V Semiconductors

Semiconductors: Formation of energy bands – classification of crystalline solids - Intrinsic semiconductors: Density of charge carriers – Electrical conductivity – Fermi level – Extrinsic semiconductors: density of charge carriers – dependence of Fermi energy on carrier concentration and temperature - Drift and diffusion currents – Einstein's equation – Hall effect and its applications.

Textbooks:

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

Reference Books:

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

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

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I Year-II Semester

COMMUNICATIVE ENGLISH

(Common to All Branches of Engineering)

Course Objectives:

The main objective of introducing this course, *Communicative English,* is to facilitate using Listening, Reading, Speaking and Writing skills effectively by the students. It should result in their better comprehending abilities, oral presentations, reporting useful information and with enhanced knowledge of grammatical structures and vocabulary. This course helps the students in using speaking and writing (productive) skills more efficiently and to make them industry- ready

Course Outcomes

- **By the end of the course the students will have** Learned how to understand the context, topic, and specific information from social or transactional dialogues.
- Remedially learn applying grammatical structures to formulate sentence sand use appropriate words and correct word forms.
- Using discourse markers to speak clearly on a specific topic in formal as well as informal discussions. (not required)
- Improved communicative competence in formal and informal contexts and for social and academic purposes.
- Critically comprehending and appreciating ding /listening texts and to write summaries based on global comprehension of these texts.
- Writing coherent paragraphs essays, letters/e-mails and resume.

Instructions:

1. The reading texts can be given as podcasts to the students so that their listening skills can be enhanced
2. While listening and reading to the text can be given as homework, the classwork for the students can be to discuss and critically evaluate the texts based on the context, purpose or writing the text and understanding it from the author's as well as reader's point of view.
3. Reading as habit for both academic and non-academic (pleasure) purposes has to be inculcated in the students. So training has to be given in intensive and extensive reading strategies.
4. Writing for both academic (assignments, examinations, reports, e-mails/letters etc)
5. The writing tasks given in the class are to be self and peer evaluated by the students before they are finally graded by the faculty.

   Note: Please note that the texts given here are just contexts for teaching various language skills and sub skills. The students' ability to use language cannot be confined to comprehending or using the language related to the given texts (textbooks). The given texts can be used only for practice.
6. All the activities to develop language skills have to be integrated and interconnected, within each unit and across the units.

7. Use as many supplementary materials as possible in various modes (Audio, visual and printed versions) in the classroom so that the students get multimode input and will how to use language skills in the absence of the teacher.

UNIT I
Lesson: HUMAN VALUES: A Power of a Plate of Rice by Ifeoma Okoye (Short Story)

Listening: Identifying the topic, the context and specific pieces of information by listening to short audio texts and answering a series of questions.
Speaking: Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others.
Reading: Skimming to get the main idea of a text; scanning to look for specific pieces of information.
Writing: Mechanics of Writing-Capitalization, Spellings, Punctuation-Parts of Sentences. (That has to be part of the bridge course- 2 weeks before the actual academic Programme starts)
Grammar: Parts of Speech, Basic Sentence Structures-forming questions
Vocabulary: Synonyms, Antonyms, Affixes (Prefixes/Suffixes), Root words.

UNITII
Lesson: NATURE: Night of the Scorpion by Nissim Ezekiel (Indian and contemporary)

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

UNITIII
Lesson: BIOGRAPHY Steve Jobs

Listening: Listening for global comprehension and summarizing what is listened.
Speaking: Discussing specific topics in pairs or small groups and reporting what is discussed
Reading: Readingatextindetailbymakingbasicinferences-recognizingandinterpretingspecific context clues; strategies to use text clues for comprehension.
Writing: Summarizing, Note-making, paraphrasing
Grammar: Verbs - tenses; subject-verb agreement; Compound words, Collocations
Vocabulary: Compound words, Collocations

UNIT IV
Lesson: INSPIRATION: The Toys of Peace by Saki

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

UNIT V
Lesson: MOTIVATION: The Power of Intrapersonal Communication (An Essay)

Listening: Identifying key terms, understanding concepts and answering a series of relevant questions that test comprehension.
Speaking: Formal oral presentations on topics from academic on texts
Reading: Reading comprehension.
Writing: Writings structured essays on specific topics.
Grammar: Editing short texts –identifying and correcting common errors in grammar and usage (articles, prepositions, tenses, subject-verb agreement)
Vocabulary: Technical Jargons

Textbooks:

1. Pathfinder: Communicative English for Undergraduate Students, 1st Edition, Orient BlackSwan, 2023 (Units 1,2 & 3)
2. Empowering English by Cengage Publications, 2023 (Units 4 & 5)

Suggestion: Instead of giving the syllabus in the form of textbooks it would be better procreate soft copies of individual texts (stories or poems or biographies and non-fiction texts) by the university and make them available on the university website for registered students to access and download

Reference Books:

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

Web Resources:
GRAMMAR:

1. www.bbc.co.uk/learningenglish
2. https://dictionary.cambridge.org/grammar/british-grammar/
3. www.eslpod.com/index.html
4. https://www.learngrammar.net/

5. https://english4today.com/english-grammar-online-with-quizzes/
6. https://www.talkenglish.com/grammar/grammar.aspx

VOCABULARY

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

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I Year-II Semester

BASIC CIVIL & MECHANICAL ENGINEERING

(Common to All branches of Engineering)

Course Objectives:

- Get familiarized with the scope and importance of Civil Engineering sub-divisions.
- Introduce the preliminary concepts of surveying.
- Acquire preliminary knowledge on Transportation and its importance in nation's economy.
- Get familiarized with the importance of quality, conveyance and storage of water.
- Introduction to basic civil engineering materials and construction techniques.

Course Outcomes: On completion of the course, the student should be able to:

CO1: Understand various sub-divisions of Civil Engineering and to appreciate their role in ensuring better society.

CO2: Know the concepts of surveying and to understand the measurement of distances, angles and levels through surveying.

CO3: Realize the importance of Transportation in nation's economy and the engineering measures related to Transportation.

CO4: Understand the importance of Water Storage and Conveyance Structures so that the social responsibilities of water conservation will be appreciated.

CO5: Understand the basic characteristics of Civil Engineering Materials and attain knowledge on prefabricated technology.

UNIT I

Basics of Civil Engineering: Role of Civil Engineers in Society- Various Disciplines of Civil Engineering- Structural Engineering- Geo-technical Engineering- Transportation Engineering - Hydraulics and Water Resources Engineering - Environmental Engineering-Scope of each discipline - Building Construction and Planning- Construction Materials-Cement - Aggregate - Bricks- Cement concrete- Steel. Introduction to Prefabricated construction Techniques.

UNIT II

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

UNIT III

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

Water Resources and Environmental Engineering: Introduction, Sources of water- Quality of water- Specifications- Introduction to Hydrology–Rainwater Harvesting-Water Storage and

Conveyance Structures (Simple introduction to Dams and Reservoirs).

Textbooks:

1. Basic Civil Engineering, M.S.Palanisamy, , Tata Mcgraw Hill publications (India) Pvt. Ltd. Fourth Edition.
2. Introduction to Civil Engineering, S.S. Bhavikatti, New Age International Publishers. 2022. First Edition.
3. Basic Civil Engineering, Satheesh Gopi, Pearson Publications, 2009, First Edition.

Reference Books:

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

PART B: BASIC MECHANICAL ENGINEERING

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

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

Course Outcomes: On completion of the course, the student should be able to

CO1: Understand the different manufacturing processes.
CO2: Explain the basics of thermal engineering and its applications.
CO3: Describe the working of different mechanical power transmission systems and power plants.
CO4: Describe the basics of robotics and its applications.

UNIT I

Introduction to Mechanical Engineering: Role of Mechanical Engineering in Industries and Society- Technologies in different sectors such as Energy, Manufacturing, Automotive, Aerospace, and Marine sectors.
Engineering Materials - Metals-Ferrous and Non-ferrous, Ceramics, Composites, Smart materials.

UNIT II

Manufacturing Processes: Principles of Casting**,** Forming, joining processes, Machining, Introduction to CNC machines, 3D printing, and Smart manufacturing.
Thermal Engineering – working principle of Boilers, Otto cycle, Diesel cycle, Refrigeration and air-conditioning cycles, IC engines, 2-Stroke and 4-Stroke engines, SI/CI Engines, Components of Electric and Hybrid Vehicles.

UNIT III

Power plants – working principle of Steam, Diesel, Hydro, Nuclear power plants.
Mechanical Power Transmission - Belt Drives, Chain, Rope drives, Gear Drives and their applications.
Introduction to Robotics - Joints & links, configurations, and applications of robotics.

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

Textbooks:

1. Internal Combustion Engines by V.Ganesan, By Tata McGraw Hill publications (India)Pvt. Ltd.
2. A Tear book of Theory of Machines by S.S. Rattan, Tata McGraw Hill Publications, (India) Pvt. Ltd.
3. An introduction to Mechanical Engg by Jonathan Wicker and Kemper Lewis, Cengagelearning India Pvt. Ltd.

Reference Books:

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

I Year-II Semester

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ENGINEERING MECHANICS

Course Objectives:

- To get familiarized with different types of force systems.
- To draw accurate free body diagrams representing forces and moments acting on a body to analyze the equilibrium of system of forces.
- To teach the basic principles of center of gravity, centroid and moment of inertia and determine them for different simple and composite bodies.
- To apply the Work-Energy method to particle motion.
- To understand the kinematics and kinetics of translational and rotational motion of rigid bodies.

Course Outcomes: On Completion of the course, the student should be able to
CO1: Understand the fundamental concepts in mechanics and determine the frictional forces for bodies in contact.
CO2: Analyze different force systems such as concurrent, coplanar and spatial systems and calculate their resultant forces and moments.
CO3: Calculate the centroids, center of gravity and moment of inertia of different geometrical shapes.
CO4: Apply the principles of work-energy and impulse-momentum to solve the problems of rectilinear and curvilinear motion of a particle.
CO5: Solve the problems involving the translational and rotational motion of rigid bodies.

UNIT I

Introduction to Engineering Mechanics– Basic Concepts. Scope and Applications
Systems of Forces: Coplanar Concurrent Forces– Components in Space–Resultant– Moment of Force and its Application –Couples and Resultant of Force Systems.
Friction: Introduction**,** limiting friction and impending motion, Coulomb'slaws of dry friction, coefficient of friction, Cone of Static friction.

UNIT II

Equilibrium of Systems of Forces: Free Body Diagrams, Lami's Theorm, Equations of Equilibrium of Coplanar Systems, Graphical method for the equilibrium, Triangle law of forces, converse of the law of polygon of forces condition of equilibrium, Equations of Equilibrium for Spatial System of forces, Numerical examples on spatial system of forces using vector approach, Analysis of plane trusses.
Principle of virtual work with simple examples

UNIT III

Centroid: Centroids of simple figures (from basic principles)–Centroids of Composite Figures. **Centre of Gravity:** Centre of gravity of simple body (from basic principles), Centre of gravity of composite bodies, Pappus theorems.

Area Moments of Inertia: Definition– Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of Composite Figures, Products of Inertia, Transfer Formula for Product of Inertia.
Mass Moment of Inertia: Moment of Inertia of Masses, Transfer Formula for Mass Moments of Inertia, Mass Moment of Inertia of composite bodies.

UNIT IV

Rectilinear and Curvilinear motion of a particle: Kinematics and Kinetics –D'Alembert's Principle - Work Energy method and applications to particle motion-Impulse Momentum method.

UNIT V

Rigid body Motion: Kinematics and Kinetics of translation, Rotation about fixed axis and plane motion, Work Energy method and Impulse Momentum method.

Textbooks:

1. Engineering Mechanics, S. Timoshenko, D. H. Young, J.V. Rao, S. Pati., , McGraw Hill Education 2017. 5th Edition.
2. Engineering Mechanics, P.C.Dumir- S.Sengupta and Srinivas V veeravalli , University press. 2020. First Edition.
3. A Textbook of Engineering Mechanics, S.S Bhavikatti. New age international publications 2018. 4th Edition.

Reference Books:

1. Engineering Mechanics, Statics and Dynamics, Rogers and M A. Nelson., McGraw Hill Education. 2017. First Edition.
2. Engineering Mechanics, Statics and Dynamics, I.H. Shames., PHI, 2002. 4th Edition.
3. Engineering Mechanics, Volume-I: Statics, Volume-II: Dynamics, J. L. Meriam and L. G. Kraige., John Wiley, 2008. 6th Edition.
4. Introduction to Statics and Dynamics, Basudev Battachatia, Oxford University Press, 2014. Second Edition
5. Engineering Mechanics: Statics and Dynamics, Hibbeler R.C., Pearson Education, Inc., New Delhi, 2022, 14th Edition

I Year-II Semester

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COMMUNICATIVE ENGLISH LAB

(Common to All Branches of Engineering)

Course Objectives:

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

Course Outcomes:

CO1: Understand the different aspects of the English language proficiency with emphasis on LSRW skills.
CO2: Apply communication skills through various language learning activities.
CO3: Analyze the English speech sounds, stress, rhythm, intonation and syllable division for better listening and speaking comprehension.
CO4: Evaluate and exhibit professionalism in participating in debates and group discussions.
CO5: Create effective Course Objectives:

List of Topics:

1. Vowels & Consonants
2. Neutralization/Accent Rules
3. Communication Skills & JAM
4. Role Play or Conversational Practice
5. E-mail Writing
6. Resume Writing, Cover letter, SOP
7. Group Discussions-methods & practice
8. Debates - Methods & Practice
9. PPT Presentations/ Poster Presentation
10. Interviews Skills

Suggested Software:

- Walden Infotech
- Young India Films

Reference Books:

1. Raman Meenakshi, Sangeeta-Sharma. *Technical Communication*. Oxford Press.2018.
2. Taylor Grant: *English Conversation Practice*, Tata McGraw-Hill Education India, 2016
3. Hewing's, Martin. Cambridge *Academic English* (B2). CUP, 2012.
4. J. Sethi & P.V. Dhamija. *A Course in Phonetics and Spoken English*, (2nd Ed), Kindle, 2013

Web Resources:

Spoken English:

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

Voice & Accent:

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

I Year-II Semester

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ENGINEERING PHYSICS LAB
(Common to All Branches of Engineering)

Course Objectives:

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

Course Outcomes: The students will be able to
CO1: Operate optical instruments like travelling microscope and spectrometer.
CO2: Estimate the wavelengths of different colors using diffraction grating.
CO3: Plot the intensity of the magnetic field of circular coil carrying current with distance.
CO4: Evaluate dielectric constant and magnetic susceptibility for dielectric and magnetic materials respectively.
CO5: Calculate the band gap of a given semiconductor.
CO6: Identify the type of semiconductor using Hall effect.

List of Experiments:

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

experiment.

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

References:

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

Web Resources

- www.vlab.co.inhttps://phet.colorado.edu/en/simulations/filter?subjects=physics&type=html,prototype

I Year-II Semester

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IT WORKSHOP

(Common to all branches of Engineering)

Course Objectives:

- To introduce the internal parts of a computer, peripherals, I/O ports, connecting cables
- To demonstrate configuring the system as Dual boot both Windows and other Operating Systems Viz. Linux, BOSS
- To teach basic command line interface commands on Linux.
- To teach the usage of Internet for productivity and self-paced life-long learning
- To introduce Compression, Multimedia and Antivirus tools and Office Tools such as Word processors, Spread sheets and Presentation tools.

Course Outcomes:

CO1: Perform Hardware troubleshooting.
CO2: Understand Hardware components and inter dependencies.
CO3: Safeguard computer systems from viruses/worms.
CO4: Document/ Presentation preparation.
CO5: Perform calculations using spreadsheets.

PC Hardware & Software Installation

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

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

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

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

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

Internet & World Wide Web

Task1: Orientation & Connectivity Boot Camp: Students should get connected to their Local Area Network and access the Internet. In the process they configure the TCP/IP setting. Finally, students should demonstrate, to the instructor, how to access the websites and email. If there is

no internet connectivity preparations need to be made by the instructors to simulate the WWW on the LAN.

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

Task 3: Search Engines & Netiquette: Students should know what search engines are and how to use the search engines. A few topics would be given to the students for which they need to search on Google. This should be demonstrated to the instructors by the student.

Task 4: Cyber Hygiene: Students would be exposed to the various threats on the internet and would be asked to configure their computer to be safe on the internet. They need to customize their browsers to block pop ups, block active x downloads to avoid viruses and/or worms.

LaTeX and WORD

Task 1 – Word Orientation: The mentor needs to give an overview of La TeX and Microsoft (MS) office or equivalent (FOSS) tool word: Importance of La TeX and MS office or equivalent (FOSS) tool Word as word Processors, Details of the four tasks and features that would be covered in each, Using La TeXand word – Accessing, overview of toolbars, saving files, Using help and resources, rulers, format painter in word.

Task 2: Using La TeX and Word to create a project certificate. Features to be covered: -Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing, Borders and Colors, Inserting Header and Footer, Using Date and Time option in both La TeX and Word.

Task 3: Creating project abstract Features to be covered: -Formatting Styles, inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes.

Task 4: Creating a Newsletter: Features to be covered: - Table of Content, Newspaper columns, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes, Paragraphs and Mail Merge in word.

EXCEL

Excel Orientation: The mentor needs to tell the importance of MS office or equivalent (FOSS) tool Excel as a Spreadsheet tool, give the details of the four tasks and features that would be covered in each. Using Excel – Accessing, overview of toolbars, saving excel files, Using help and resources.

Task 1: Creating a Scheduler - Features to be covered: Gridlines, Format Cells, Summation, auto fill, Formatting Text

Task 2: Calculating GPA -. Features to be covered: - Cell Referencing, Formulae in excel – average, std. deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function,

LOOKUP/VLOOKUP

Task 3: Split cells, freeze panes, group and outline, Sorting, Boolean and logical operators, Conditional formatting

POWER POINT

Task 1: Students will be working on basic power point utilities and tools which help them create basic power point presentations. PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows in PowerPoint.

Task 2: Interactive presentations - Hyperlinks, Inserting –Images, Clip Art, Audio, Video, Objects, Tables and Charts.

Task 3: Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide slotter, notes etc), and Inserting – Background, textures, Design Templates, Hidden slides.

AI TOOLS – ChatGPT

Task 1: Prompt Engineering: Experiment with different types of prompts to see how the model responds. Try asking questions, starting conversations, or even providing incomplete sentences to see how the model completes them.

- Ex: Prompt: "You are a knowledgeable AI. Please answer the following question: What is the capital of France?"

Task 2: Creative Writing: Use the model as a writing assistant. Provide the beginning of a story or a description of a scene, and let the model generate the rest of the content. This can be a fun way to brainstorm creative ideas

- Ex: Prompt: "In a world where gravity suddenly stopped working, people started floating upwards. Write a story about how society adapted to this new reality."

Task 3: Language Translation: Experiment with translation tasks by providing a sentence in one language and asking the model to translate it into another language. Compare the output to see how accurate and fluent the translations are.

- Ex:Prompt: "Translate the following English sentence to French: 'Hello, how are you doing today?'"

Reference Books:

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

I Year-II Semester

L	T	P	C
0	0	3	1.5

ENGINEERING WORKSHOP
(Common to All branches of Engineering)

Course Objectives:

To familiarize students with wood working, sheet metal operations, fitting and electrical house wiring skills

Course Outcomes:

CO1: Identify workshop tools and their operational capabilities.
CO2: Practice on manufacturing of components using workshop trades including fitting, carpentry, foundry and welding.
CO3: Apply fitting operations in various applications.
CO4: Apply basic electrical engineering knowledge for House Wiring Practice

SYLLABUS

1. **Demonstration**: Safety practices and precautions to be observed in workshop.
2. **Wood Working:** Familiarity with different types of woods and tools used in wood working and make following joints.
   a) Half – Lap joint b) Mortise and Tenon joint c) Corner Dovetail joint or Bridle joint
3. **Sheet Metal Working**: Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from GI sheets.
   a) Tapered tray b) Conical funnel c) Elbow pipe d) Brazing
4. **Fitting:** Familiarity with different types of tools used in fitting and do the following fitting exercises.
   a) V-fit b) Dovetail fit c) Semi-circular fit d) Bicycle tire puncture and change of two-wheeler tyre
5. **Electrical Wiring**: Familiarity with different types of basic electrical circuits and make the following connections.
   a) Parallel and series b) Two-way switch c) Godown lighting
   d) Tube light e) Three phase motor f) Soldering of wires
6. **Foundry Trade:** Demonstration and practice on Moulding tools and processes, Preparation of Green Sand Moulds for given Patterns.
7. **Welding Shop**: Demonstration and practice on Arc Welding and Gas welding. Preparation of Lap joint and Butt joint.
8. **Plumbing:** Demonstration and practice of Plumbing tools, Preparation of Pipe joints with coupling for same diameter and with reducer for different diameters.

Textbooks:

1. Basic Workshop Technology: Manufacturing Process, Felix W.; Independently Published,2019. Workshop Processes, Practices and Materials; Bruce J. Black, Routledge publishers, 5th Edn. 2015.
2. A Course in Workshop Technology Vol I. & II, B.S. Raghuwanshi, Dhanpath Rai & Co., 2015 & 2017.

Reference Books:

1. Elements of Workshop Technology, Vol. I by S. K. Hajra Choudhury & Others, Media Promoters and Publishers, Mumbai. 2007, 14th edition
2. Workshop Practice by H. S. Bawa, Tata-McGraw Hill, 2004.
3. Wiring Estimating, Costing and Contracting; Soni P.M. & Upadhyay P.A.; Atul Prakashan, 2021-22.

I Year-II Semester

L	T	P	C
0	0	3	1.5

ENGINEERING MECHANICS LAB
(Mechanical Engineering & allied branches)

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

- Verify the Law of Parallelogram and Triangle of Forces.
- Determine the coefficients of friction of Static and Rolling friction and centre of gravity of different plane Lamina.
- Analyze the system of Pulleys and Moment of Inertia of Compound Pendulum and Flywheel.

Course Outcomes:

CO1: Evaluate the coefficient of friction between two different surfaces and between the inclined plane and the roller.
CO2: Verify Law of Polygon of forces and Law of Moment using force polygon and bell crank lever.
CO3: Determine the Centre of gravity and Moment of Inertia of different configurations.
CO4: Verify the equilibrium conditions of a rigid body under the action of different force systems.

Students have to perform any 10 of the following Experiments:

List of Experiments:

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

References:

1. S. Timoshenko, D. H. Young, J.V. Rao, S. Pati., Engineering Mechanics, 5th Edition, McGraw Hill Education.
2. Hibbeler R.C., Engineering Mechanics: Statics and Dynamics, 14th Edition, Pearson Education,

I Year-II Semester

L	T	P	C
0	0	1	0.5

HEALTH AND WELLNESS, YOGA AND SPORTS
(Common to All branches of Engineering)

Course Objectives:

The main objective of introducing this course is to make the students maintain their mental and physical wellness by balancing emotions in their life. It mainly enhances the essential traits required for the development of the personality.

Course Outcomes: After completion of the course the student will be able to

CO1: Understand the importance of yoga and sports for Physical fitness and sound health.
CO2: Demonstrate an understanding of health-related fitness components.
CO3: Compare and contrast various activities that help enhance their health.
CO4: Assess current personal fitness levels.
CO5: Develop Positive Personality

UNIT I

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

Activities:

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

UNIT II

Concept of yoga, need for and importance of yoga, origin and history of yoga in Indian context, classification of yoga, Physiological effects of Asanas- Pranayama and meditation, stress management and yoga, Mental health and yoga practice.

Activities:

Yoga practices – Asana, Kriya, Mudra, Bandha, Dhyana, Surya Namaskar

UNIT III

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

Activities:

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

Reference Books:

1. Gordon Edlin, Eric Golanty. Health and Wellness, 14th Edn. Jones & Bartlett Learning, 2022
2. T.K.V.Desikachar. The Heart of Yoga: Developing a Personal Practice
3. Archie J.Bahm. Yoga Sutras of Patanjali, Jain Publishing Company, 1993
4. Wiseman, John Lofty, SAS Survival Handbook: The Ultimate Guide to Surviving Anywhere Third Edition, William Morrow Paperbacks, 2014
5. The Sports Rules Book/ Human Kinetics with Thomas Hanlon. -- 3rd ed. Human Kinetics, Inc.2014

General Guidelines:

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

Evaluation Guidelines:

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

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA -
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

L	T	P	C
3	0	0	3

II Year - I Semester

NUMERICAL TECHNIQUES AND STATISTICAL METHODS

Course Objectives:

- To elucidate the different numerical methods to solve nonlinear algebraic equations
- To disseminate the use of different numerical techniques for carrying out numerical integration.
- To familiarize the students with the foundations of probability and statistical methods.
- To equip the students to solve application problems in their disciplines.

UNIT – I: Iterative Methods:

Introduction – Solutions of algebraic and transcendental equations: Bisection method – Secant method – Method of false position – Iteration method – Newton-Raphson method (One variable and simultaneous Equations)

Interpolation: Newton's forward and backward formulae for interpolation – Interpolation with unequal intervals – Lagrange's interpolation formula

UNIT – II: Numerical integration, Solution of ordinary differential equations with initial conditions:

Trapezoidal rule– Simpson's $1/3^{rd}$ and $3/8^{th}$ rule– Solution of initial value problems by Taylor's series– Picard's method of successive approximations– Euler's method –Runge- Kutta method (second and fourth order) – Milne's Predictor and Corrector Method.

UNIT – III: Probability and Distributions:

Baye's theorem – Random variables – Discrete and Continuous random variables – Distribution functions – Probability mass function, Probability density function and Cumulative distribution functions – Mathematical Expectation and Variance – Binomial, Poisson, Uniform and Normal distributions.

UNIT – IV: Sampling Theory:

Introduction – Population and Samples – Sampling distribution of Means and Variance (definition only) –Point and Interval estimations – Maximum error of estimate – Central limit theorem (without proof) – Estimation using t, χ^2 and F-distributions.

UNIT – V: Tests of Hypothesis:

Introduction – Hypothesis – Null and Alternative Hypothesis – Type I and Type II errors – Level of significance– One tail and two-tail tests – Test of significance for large samples and Small Samples: Single and difference means – Single and two proportions – Student's t- test, F-test, χ^2-test.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA -
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

Textbooks:

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

Reference Books:

1. Steven C. Chapra, Applied Numerical Methods with MATLAB for Engineering and Science,Tata Mc. Graw Hill Education.
2. M. K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International Publications.
3. Lawrence Turyn,Advanced Engineering Mathematics, CRC Press.
4. S. C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Publications, 2012.
5. Shron L. Myers, Keying Ye, Ronald E Walpole, Probability and Statistics Engineers and the Scientists,8th Edition, Pearson 2007.
6. Jay l. Devore, Probability and Statistics for Engineering and the Sciences, 8th Edition, Cengage.

Course Outcomes:

COs	Statements	Blooms Level
CO1	Evaluate the approximate roots of polynomial and transcendental equations by different algorithms. Apply Newton's forward & backward interpolation and Lagrange's formulae for equal and unequal intervals	L3
CO2	Apply numerical integral techniques to different Engineering problems. Apply different algorithms for approximating the solutions of ordinary differential equations with initial conditions to its analytical computations	L3
CO3	Apply discrete and continuous probability distributions	L3
CO4	Design the components of a classical hypothesis test	L6
CO5	Infer the statistical inferential methods based on small and large sampling tests	L4

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA -
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

II B. Tech I Semester

L	T	P	C
2	1	0	3

UNIVERSAL HUMAN VALUES – UNDERSTANDING HARMONY AND ETHICAL HUMAN CONDUCT

Course Objectives:

- To help the students appreciate the essential complementary between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
- To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such holistic perspective forms the basis of Universal Human Values and movement towards value- based living in a natural way.
- To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

Course Outcomes:

- Define the terms like Natural Acceptance, Happiness and Prosperity (L1, L2)
- Identify one's self, and one's surroundings (family, society nature) (L1, L2)
- Apply what they have learnt to their own self in different day-to-day settings in real life (L3)
- Relate human values with human relationship and human society. (L4)
- Justify the need for universal human values and harmonious existence (L5)
- Develop as socially and ecologically responsible engineers (L3, L6)

Course Topics

The course has 28 lectures and 14 tutorials in 5 modules. The lectures and tutorials are of 1- hour duration. Tutorial sessions are to be used to explore and practice what has been proposed during the lecture sessions.

The Teacher's Manual provides the outline for lectures as well as practice sessions. The teacher is expected to present the issues to be discussed as propositions and encourage the students to have a dialogue.

UNIT I: Introduction to Value Education (6 lectures and 3 tutorials for practice session)

Lecture 1: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)
Lecture 2: Understanding Value Education
Tutorial 1: Practice Session PS1 Sharing about Oneself Lecture 3: self-exploration as the Process for Value Education
Lecture4: Continuous Happiness and Prosperity – the Basic Human Aspirations
Tutorial 2: Practice Session PS2 Exploring Human Consciousness Lecture 5: Happiness and Prosperity – Current Scenario
Lecture 6: Method to Fulfill the Basic Human Aspirations Tutorial 3: Practice Session PS3 Exploring Natural Acceptance

UNIT II Harmony in the Human Being (6 lectures and 3 tutorials for practice session)

Lecture 7: Understanding Human being as the Co-existence of the self and the body.
Lecture 8: Distinguishing between the Needs of the self and the body
Tutorial 4: Practice Session PS4 Exploring the difference of Needs of self and body.
Lecture 9: The body as an Instrument of the self-Lecture 10:
Understanding Harmony in the self
Tutorial 5: Practice Session PS5 Exploring Sources of Imagination in the self-Lecture 11:
Harmony of the self with the body
Lecture 12: Programme to ensure self-regulation and Health
Tutorial 6: Practice Session PS6 Exploring Harmony of self with the body

UNIT III Harmony in the Family and Society (6 lectures and 3 tutorials for practice session)
Lecture 13: Harmony in the Family – the Basic Unit of Human Interaction Lecture 14:
'Trust' – the Foundational Value in Relationship
Tutorial 7: Practice Session PS7 Exploring the Feeling of Trust Lecture 15:
'Respect' – as the Right Evaluation
Tutorial 8: Practice Session PS8 Exploring the Feeling of Respect Lecture 16:
Other Feelings, Justice in Human-to-Human Relationship Lecture 17:
Understanding Harmony in the Society
Lecture 18: Vision for the Universal Human Order
Tutorial 9: Practice Session PS9 Exploring Systems to fulfil Human Goal

UNIT IV Harmony in the Nature/Existence (4 lectures and 2 tutorials for practice session)
Lecture 19: Understanding Harmony in the Nature
Lecture 20: Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature
Tutorial 10: Practice Session PS10 Exploring the Four Orders of Nature Lecture
21: Realizing Existence as Co-existence at All Levels
Lecture 22: The Holistic Perception of Harmony in Existence
Tutorial 11: Practice Session PS11 Exploring Co-existence in Existence.

UNIT V Implications of the Holistic Understanding – a Look at Professional Ethics (6 lectures and 3 tutorials for practice session)
Lecture 23: Natural Acceptance of Human Values Lecture 24:
Definitiveness of (Ethical) Human Conduct
Tutorial 12: Practice Session PS12 Exploring Ethical Human Conduct Lecture 25: A
Basis for Humanistic Education, Humanistic Constitution and Universal Human Order
Lecture 26: Competence in Professional Ethics
Tutorial 13: Practice Session PS13 Exploring Humanistic Models in Education Lecture 27:
Holistic Technologies, Production Systems and Management Models-Typical Case Studies
Lecture 28: Strategies for Transition towards Value-based Life and Profession Tutorial 14:
Practice Session PS14 Exploring Steps of Transition towards Universal Human Order

Practice Sessions for UNIT I – Introduction to Value Education
PS1 Sharing about Oneself

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA -
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

PS2 Exploring Human ConsciousnessPS3 Exploring Natural Acceptance

Practice Sessions for UNIT II – Harmony in the Human Being PS4 Exploring the difference of Needs of self and body
PS5 Exploring Sources of Imagination in the self PS6 Exploring Harmony of self with the body

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

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

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

READINGS:
Textbook and Teachers Manual
a. The Textbook
R R Gaur, R Asthana, G P Bagaria, A Foundation Course in Human Values and Professional Ethics, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
b. The Teacher's Manual
R R Gaur, R Asthana, G P Bagaria,Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

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

Mode of Conduct:
Lecture hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them.
Tutorial hours are to be used for practice sessions.
While analyzing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students

explore the important or critical elements.
In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self-exploration. Scenarios may be used to initiate discussion. The student is encouraged to take up" ordinary" situations rather than" extra-ordinary" situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignment and/or activity are included. The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.
It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses. This course is to be taught by faculty from every teaching department, not exclusively by any one department.
Teacher preparation with a minimum exposure to at least one 8-day Faculty Development Program on Universal Human Values is deemed essential.

Online Resources:

1. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%201- Introduction%20to%20Value%20Education.pdf
2. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%202- Harmony%20in%20the%20Human%20Being.pdf
3. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%203- Harmony%20in%20the%20Family.pdf
4. https://fdp-si.aicte-india.org/UHV%201%20Teaching%20Material/D3-S2%20Respect%20July%2023.pdf
5. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%205-Harmony%20in%20the%20Nature%20and%20Existence.pdf
6. https://fdp-si.aicte-india.org/download/FDPTeachingMaterial/3-days%20FDP-SI%20UHV%20Teaching%20Material/Day%203%20Handouts/UHV%203D%20D3- S2A%20Und%20Nature-Existence.pdf
7. https://fdp-si.aicte-india.org/UHV%20II%20Teaching%20Material/UHV%20II%20Lecture%2023- 25%20Ethics%20v1.pdf
8. https://www.studocu.com/in/document/kiet-group-of-institutions/universal-human- values/chapter-5-holistic-understanding-of-harmony-on-professional-ethics/62490385
9. https://onlinecourses.swayam2.ac.in/aic22_ge23/preview

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA -
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

L	T	P	C
3	0	0	3

II B. Tech I Semester

THERMODYNAMICS & THERMAL ENGINEERING

Course Objectives:

1. To impart knowledge of basic principles of thermodynamics via real world engineering examples.
2. To analyses and evaluate cardinal air standard cycles.
3. To analyse and evaluate cardinal Steam power cycles.
4. Summarize the governing concepts of Refrigeration and Air conditioning.
5. To introduce various modes of heat and mass transfer, related to real time scenarios of thermodynamics applied in engineering practice

UNIT – I: BASIC THERMODYNAMICS

Systems, closed, open and isolated. Property, state, path and process, quasi-static process, Zeroth low, First law. Steady flow energy equation. Engineering Applications of Steady flow energy equation Heat and work transfer in flow and non-flow processes. Second law, Kelvin- Planck statement – Clausius statement - Concept of Entropy, Clausius inequality, Entropy change in nonflow processes. Availability and Un Availability. Properties of gases and vapours

UNIT – IIAIR STANDARD CYCLES AND COMPRESSORS

Cycle, Carnot cycle, Otto, Diesel, Dual combustion and Brayton cycles. Air standard efficiency. Mean effective pressure. Comparison of cycles, Efficiency versus compression ratio, For the same compression ratio and the same heat input.

Compressors, Classifications of compressors, Single stage and multi stage, Effect of intercooler in multi stage compressor, Perfect and imperfect intercooler, work done by the compressor, Reciprocating, Rotary, Axial, Vane compressors.

UNIT – III: STEAM

Formation of steam and its thermodynamic properties, p-v, p-T, T-v, T-s, h-s diagrams. p-v-T surface Properties of steam, Dryness fraction, Quality of steam-by-steam tables and Mollier chart – Rankine cycle, Work done, Steam rate – Steam Nozzles, Types of nozzles, Friction in nozzles.

UNIT – IV: REFRIGERATION AND AIR-CONDITIONING

Principles of refrigeration, Vapour compression – Types of VCR system with respect to condition of vapor, Problems, Vapour absorption types, comparison - Co-efficient of performance (COP), Properties of refrigerants – Basic Principle, Summer, winter and Year-round Air conditioning.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA -
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

UNIT – V: HEAT AND MASS TRANSFER

Heat Transfer: Modes of heat transfer, Heat conduction in parallel, radial and composite wall – Heat conduction through hollow and composite cylinders, spheres. Basics of Convective heat transfer. Fundamentals of Radiative heat transfer – Flow through heat- exchangers, Logarithmic Mean Temperature Difference (LMTD) for parallel flow and counter flow heat exchangers.

Mass Transfer: Concepts of mass transfer, diffusion & convective mass transfer, Fick's Law of diffusion, Significance of non-dimensional numbers.

Text Books:

1. Chattopadhyay. P Engineering Thermodynamics", oxford University Press, New Delhi, 2010.
2. Nag.P.K., "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi, 2007.
3. Rathakrishnan E., "Fundamentals of Engineering Thermodynamics" Prentice-Hall India, 2005.

Reference Books:

1. Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.
2. Holman.J.P., "Thermodynamics", 3rd Ed. McGraw-Hill, 2007.
3. Mathur& Sharma Steam Tables, Jain Publishers, New Delhi.
4. Merala C, Pother, Craig W, Somerton, "Thermodynamics for Engineers", Schaum Outline Series, Tata McGraw-Hill, New Delhi, 2004.
5. Ramalingam K.K. "Thermodynamics", Sci-Tech Publications, 2006.

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

CO's	Statements	Bloom's Level
CO1	demonstrate understanding of the nature of the thermodynamic processes for pure substances of ideal gases.	L2
CO2	interpret First Law of Thermodynamics and its application to systems and control volumes.	L2
CO3	solve any flow specific problem in an engineering approach based on basic concepts and logic sequences.	L5
CO4	compare and contrast between various types of refrigeration cycles	L2
CO5	Get exposed to the basics and modes of heat transfer	L1

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA -
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

L	T	P	C
3	0	0	3

II B. Tech – I Semester

FLUID MECHANICS & HYDRAULIC MACHINES

Course Objectives: The students completing this course are expected to understand the properties of fluids, its kinematic and dynamic behavior through various laws of fluids like continuity, Euler's, Bernoulli's equations, energy and momentum equations. Further, the student shall be able to understand the theory of boundary layer, working and performance characteristics of various hydraulic machines like pumps and turbines.

UNIT – I:

Fluid statics: Dimensions and units: physical properties of fluids - specific gravity, viscosity and its significance, surface tension, capillarity, vapor pressure. Atmospheric, gauge and vacuum pressure, Measurement of pressure – Manometers - Piezometer, U-tube, inverted and differential manometers. Pascal's & hydrostatic laws.

Buoyancy and floatation: Meta center, stability of floating body. Submerged bodies. Calculation of metacenter height. Stability analysis and applications.

UNIT – II:

Fluid kinematics: Introduction, flow types. Equation of continuity for one dimensional flow, circulation and vorticity, Stream line, path line and streak lines and stream tube. Stream function and velocity potential function, differences and relation between them. Condition for irrotational flow, flow net, source and sink, doublet and vortex flow.

Fluid dynamics: surface and body forces –Euler's and Bernoulli's equations for flow along a stream line, momentum equation and its applications, force on pipe bend.

Closed conduit flow: Reynold's experiment- Darcy Weisbach equation- Minor losses in pipes- pipes in series and pipes in parallel- total energy line-hydraulic gradient line.

UNIT – III:

Boundary Layer Theory: Introduction, momentum integral equation, displacement, momentum and energy thickness, separation of boundary layer, control of flow separation, Stream lined body, Bluff body and its applications, basic concepts of velocity profiles.

Dimensional Analysis: Dimensions and Units, Dimensional Homogeneity, non dimensionalization of equations, Method of repeating variables and Buckingham Pi Theorem.

UNIT – IV:

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

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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA -
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

UNIT – V:

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

Centrifugal pumps: classification, working, work done – manometric head- losses and efficiencies- specific speed- pumps in series and parallel-performance characteristic curves, cavitation & NPSH.

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

Text Books:

1. Fluid Mechanics- Fundementals and Applications by Y.A. Cengel, J.M.Cimbala, 6thEdn, McGrawHill
2. Fluid Mechanics - Dixon, 7th Edn, Elesvier

Reference Books:

1. Hydraulics, fluid mechanics and Hydraulic machinery- Modi and Seth
2. Fluid Mechanics and Hydraulic Machines - RK Bansal- Laxmi Publications (P)Ltd.
3. Fluid Mechanics and Hydraulic Machines -Rajput
4. Fluid Mechanics and Fluid Power Engineering - D.S. Kumar, Kotaria&Sons.
5. Fluid Mechanics and Machinery - D. Rama Durgaiah, New Age International.

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

CO's	Statements	Bloom's Level
CO1	Understand the basic concepts of fluid properties.	L2
CO2	Demonstrate the concepts of mechanics of fluids in static and dynamic conditions.	L2
CO3	Illustrate the Boundary layer theory, flow separation and dimensional analysis.	L2
CO4	Calculate the hydrodynamic forces of jet on vanes in different positions.	L3
CO5	Understand the working Principles and performance evaluation of hydraulic pump and turbines.	L2

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA -
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

L	T	P	C
3	0	0	3

II B. Tech – I Semester

COMPONENTS OF AUTOMOTIVE CHASSIS

COURSE OBJECTIVES:

i. To understand the basic knowledge about various vehicle frames, front axles, steering systems and understand the conditions for true rolling motion of wheels during steering.
ii. To recognize the construction and working principle of drive line, final drive and differential systems
iii. To review the knowledge about the constructional feature of rear axle, wheels and tyres.
iv. To evaluate the working principles of both conventional and independent suspension system.
v. To demonstrate working principle of braking system used in automobile.

UNIT – I: INTRODUCTION, FRAME, CLUTCHES & GEAR BOX

Types of Chassis layout, with reference to Power Plant location and drive, various types of frames, Loads acting on vehicle frame, Constructional details and materials for frames, Testing of frames. Importance of Clutch, types and Applications. Requirement of Gear Box, Manual types of Gear Boxes including Synchromesh and its Applications

UNIT – II: PROPELLER SHAFT AND FINAL DRIVE

Effect of Driving Thrust, torque reactions and side thrust, Hotchkiss drive, torque tube drive, radius rods and stabilizers, Propeller Shaft, Universal Joints, Constant Velocity Universal Joints, Front Wheel drive, Final drive, different types, Double reduction and twin speed final drives, Multi–axled vehicles, Differential principle and types, Differential housings, limited speed differential, Differential locks.

UNIT – III: AXLES AND TYRES

Construction and Design of Drive Axles, Types of Loads acting on drive axles, Full – Floating, Three– Quarter Floating and Semi–Floating Axles, Axle Housings and Types – Lift axle, Dead axle, Types and Constructional Details of Different Types of Wheels and Rims, Different Types of Tyres and their constructional details.

UNIT – IV: STEERING & SUSPENSION SYSTEM

Steering System: Types of Front Axles and Stub Axles, Front Wheel Geometry, Condition for True Rolling Motion of Wheels during Steering, Ackerman's and Davis Steering Mechanisms, Steering Error Curve, Steering Linkages, Different Types of Steering Gears, Slip Angle, over–Steer and Under–Steer, Reversible and Irreversible Steering, EPAS.

Suspension System: Types of Suspension Springs, Constructional details and characteristics of Single Leaf, Multi–Leaf, Coil, Torsion bar, Rubber, Pneumatic and Hydro – elastic Suspension Spring Systems, Independent Suspension System, Shock Absorbers, Types and Constructional details.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA -
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

UNIT – V: BRAKING SYSTEM

Theory of Automobile Braking, Stopping Distance Time and Braking Efficiency, Effect of Weight Transfer during Braking, Theory of Drum Brakes, Loading and Trailing Shoes, Braking Torque, Constructional Details of Drum Brake and its Activators, Disc Brake Theory, Types and Construction, Hydraulic Braking System, Mechanical Braking System, Pneumatic Braking System, Power–Assisted Braking System, Anti–Lock Braking System, Constructional Details.

Text Books:

1. Kirpal Singh, Vol- I, Automobile Engineering, Standard Publisher, New Delhi ,2017
2. K.K.Ramalingam, "Automobile Engineering", scitech publication (India),2011.
3. R.K. Rajput, A Text–Book of Automobile Engineering, Laxmi Publications Private Limited,2015

Reference Books:

1. Heinz Hazler, Modern Vehicle Technology, Butterworth, London,2005.
2. HeldtP.M., Automotive Chassis, Chilton Co., New York,1990
3. Newton Steeds and Garret, Motor Vehicles, 13th Edition, Butterworth, London, 2005.
4. N.K. Giri, Automotive Mechanics, Kanna Publishers,2007
5. William. H. Crows – Work shop Manuel –2005

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

CO's	Statements	Bloom's Level
CO1	Identify the different types of frame and chassis used in Automotive.	L2
CO2	Relate different types of drive lines and drives used in Automotive.	L2
CO3	Acquire knowledge about different types of front axle and rear axles used in motor vehicles.	L2
CO4	Examine the working principle of conventional and independent suspension systems.	L4
CO5	Apply knowledge on working principles of brake and its subsystems.	L3

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA -
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

L	T	P	C
0	0	3	1.5

II B. Tech – I Semester

FLUID MECHANICS & HYDRAULIC MACHINES LAB

COURSE OBJECTIVES:

To impart practical exposure on the performance evaluation methods of various flow measuring equipment and hydraulic turbines and pumps.

LIST OF EXPERIMENTS:

1. Impact of jets on Vanes.
2. Performance Test on Pelton Wheel.
3. Performance Test on Francis Turbine.
4. Performance Test on Kaplan Turbine.
5. Performance Test on Single Stage Centrifugal Pump.
6. Performance Test on Multi Stage Centrifugal Pump.
7. Performance Test on Reciprocating Pump.
8. Calibration of Venturi meter.
9. Calibration of Orifice meter.
10. Determination of friction factor for a given pipeline.
11. Determination of loss of head due to sudden contraction in a pipeline.
12. Turbine flowmeter.

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

CO's	Statements	Bloom's Level
CO1	Understand calibration of flow measuring devices.	L2
CO2	Evaluate the losses in pipe flows.	L5
CO3	Apply the practical aspects of Bernoulli's principle	L3
CO4	Analyze the characteristics of different types of hydraulic turbines.	L4
CO5	Analyse the characteristics of different types of hydraulic pumps	L4

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA -
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

II B. Tech – I Semester

L	T	P	C
0	0	3	1.5

AUTOMOTIVE CHASSIS LAB

COURSE OBJECTIVES:

i. To assemble and disassemble the parts of an IC engine.
ii. To identify the various component of an IC engine.
iii. To identify the various components in transmission systems of an automobile.
iv. To assemble and disassemble the various components of transmission system.
v. To study all the functions of automobile components

LIST OF EXPERIMENTS:

1. To study constructional and working principle of clutch.
2. Assembly & Disassembly of Gear Box.
3. Assembly & Disassembly of Transfer case.
4. Assembly & Disassembly of Differential & rear axle.
5. Assembly & Disassembly of Stub Axle Assembly.
6. To assemble and disassemble Front axle.
7. To Study different chassis layouts
8. To Study braking system
9. To Study Steering system.
10. To Study Suspension system
11. To study Continuous Variable Transmission System
12. Study of different types of Wheels & Tyres

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

CO's	Statements	Bloom's Level
CO1	Understand working of braking, steering, clutch, transmission, Suspension systems.	L2
CO2	Differentiate various subsystems of two, three & Four-wheeler vehicles	L2
CO3	Develop skills in Dismantling and assembling of chassis components.	L3

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA -
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

II B. Tech I Semester

L	T	P	C
0	1	2	2

COMPUTER AIDED DRAFTING AND AUTOMOBILE ASSEMBLY DRAWING

COURSE OBJECTIVES:

i. Introduce conventional representations of material and machine components.
ii. Train to use software for 2D and 3D modeling.
iii. Familiarize with thread profiles, riveted, welded and key joints.
iv. Teach solid modeling of machine parts and their sections.
v. Explain creation of 2D and 3D assembly drawings.
vi. Familiarize with limits, fits and tolerances in mating components.

The following contents are to be done by any 2D software package

Conventional representation of materials and components:
Detachable joints: Drawing of thread profiles, hexagonal and square-headed bolts and nuts, bolted joint with washer and locknut, stud joint, screw joint and foundation bolts.
Riveted joints: Drawing of rivet, lap joint, butt joint with single strap, single riveted, double riveted double strap joints.
Welded joints: Lap joint and T joint with fillet, butt joint with conventions.
Keys: Taper key, sunk taper key, round key, saddle key, feather key, woodruff key.
Couplings: rigid – Muff, flange; flexible – bushed pin-type flange coupling, universal coupling, Oldham's' coupling.
The following contents to be done by any 3D software package Sectional views:
Creating solid models of complex machine parts and create sectional views.
Assembly drawings:(Any six of the following using solid model software)
Connecting Rod, Multi-plate Friction Clutch, Automobile Gear Box, Stub Axle, Tandem Master Cylinder, Fuel Injector, Piston, Radial Engine Sub Assembly.
Manufacturing drawing:
Representation of limits, fits and tolerances for mating parts. Use any four parts of above assembly drawings and prepare manufacturing drawing with dimensional and geometric tolerances.

Textbooks:

1. K.L.Narayana, P.Kannaiah and K.Venkat Reddy, Production Drawing, New Age International Publishers, 3/e, 2014
2. Software tools/packages- Auto CAD, Solid works or equivalent.

Reference Books:

1. Cecil Jensen, Jay Helsel and Donald D.Voisinet, Computer Aided Engineering Drawing, Tata Mcgraw-Hill, NY, 2000.
2. James Barclay, Brain Griffiths, Engineering Drawing for Manufacture, Kogan Page Science, 2003.
3. N.D.Bhatt, Machine Drawing, Charotar, 50/e, 2014

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA -
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

Online Learning Resources:

https://eeedocs.wordpress.com/wp-content/uploads/2014/02/machinedrawing.pdf,

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

CO's	Statements	Bloom's Level
CO1	Interpret and analyse the national and international standards of various machine components.	L4
CO2	Apply and illustrate various machine elements through computer aided drawings.	L3
CO3	Apply limits and tolerances to assemblies and interpret the appropriate fits.	L3
CO4	Recognize the machining surface finish parameters through appropriate symbols.	L2

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA -
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

II Year I Semester

L	T	P	C
2	0	0	-

ENVIRONMENTAL SCIENCE

Course Objectives:

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

UNIT – I

Multidisciplinary Nature of Environmental Studies: – Definition, Scope and Importance – Need for Public Awareness.

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

UNIT – II

Ecosystems: Concept of an ecosystem. – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem:

a. Forest ecosystem.
b. Grassland ecosystem
c. Desert ecosystem
d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity and Its Conservation : Introduction and Definition: genetic, species and ecosystem diversity – Bio-geographical classification of India – Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-sports of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT – III

Environmental Pollution: Definition, Cause, effects and control measures of:

a. Air Pollution.

b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution
f. Thermal pollution
g. Nuclear hazards

Solid Waste Management: Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides.

UNIT – IV

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

UNIT – V

Human Population and The Environment: Population growth, variation among nations. Population explosion – Family Welfare Programmes. – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of information Technology in Environment and human health – Case studies.

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

Textbooks:

1. Erach Bharucha, Text book of Environmental Studies for Undergraduate Courses,Universities Press (India) Private Limited, 2019.
2. Palaniswamy, Environmental Studies, 2/e, Pearson education, 2014.
3. S.Azeem Unnisa, Environmental Studies, Academic Publishing Company, 2021.
4. K.Raghavan Nambiar, “Text book of Environmental Studies for Undergraduate Courses as per UGC model syllabus”, SciTech Publications (India), Pvt. Ltd, 2010.

Reference Books:

1. Deeksha Dave and E.Sai Baba Reddy, Textbook of Environmental Science, 2/e, Cengage Publications, 2012.
2. M.Anji Reddy, “Textbook of Environmental Sciences and Technology”, BS Publication, 2014.
3. J.P. Sharma, Comprehensive Environmental studies, Laxmi publications, 2006.

4. J. Glynn Henry and Gary W. Heinke, Environmental Sciences and Engineering, Prentice Hall of India Private limited, 1988.
5. G.R. Chatwal, A Text Book of Environmental Studies, Himalaya Publishing House, 2018.
6. Gilbert M. Masters and Wendell P. Ela, Introduction to Environmental Engineering and Science, 1/e, Prentice Hall of India Private limited, 1991.

Online Learning Resources:

- https://onlinecourses.nptel.ac.in/noc23_hs155/preview
- https://www.edx.org/learn/environmental-science/rice-university-ap-r-environmental-science-part-3-pollution-and-resources?index=product&objectID=course-3a6da9f2-d84c-4773-8388-1b2f8f6a75f2&webview=false&campaign=AP%C2%AE+Environmental+Science++Part+3%3A+Pollution+and+Resources&source=edX&product_category=course&placement_url=https%3A%2F%2Fwww.edx.org%2Flearn%2Fenvironmental-science
- http://ecoursesonline.iasri.res.in/Courses/Environmental%20Science-I/Data%20Files/pdf/lec07.pdf
- https://www.youtube.com/watch?v=5QxxaVfgQ3k

Course Outcomes:

COs	Statements	Blooms Level
CO1	Grasp multi-disciplinary nature of environmental studies and various renewable and non-renewable resources.	L2
CO2	Understand flow and bio-geo- chemical cycles and ecological pyramids.	L2
CO3	Understand various causes of pollution and solid waste management and related preventive measures.	L2
CO4	Understand the rainwater harvesting, watershed management, ozone layer depletion and waste land reclamation.	L2
CO5	Illustrate the causes of population explosion, value education and welfare programmes.	L3

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA -
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

II B. Tech – II Semester

L	T	P	C
2	0	0	2

PRODUCT LIFE CYCLE MANAGEMENT

Course objectives: This course enables students to

1. Familiarize with various strategies of PLM
2. Understand the concept of product design and simulation.
3. Develop New product development, product structure and supporting systems
4. Interpret the technology forecasting and product innovation and development in business processes.
5. Understand product building and Product Configuration.

UNIT-I: PLM AND PDM

Introduction to PLM, Need for PLM, opportunities and benefits of PLM, different views of PLM, components of PLM, phases of PLM, PLM feasibility study. PLM Strategies, strategy elements, its identification, selection and implementation. Product Data Management, implementation of PDM systems.

UNIT-II: PRODUCT DESIGN

Engineering design, organization and decomposition in product design, product design process, methodical evolution in product design, concurrent engineering, design for 'X' and design central development model. Strategies for recovery at end of life, recycling, human factors in product design. Modelling and simulation in product.

UNIT-III: PRODUCT DEVELOPMENT

New Product Development, structuring new product development, building decision support system, estimating market opportunities for new product, new product financial control, implementing new product development, market entry decision, launching and tracking new product program. Concept of redesign of product.

UNIT-IV: TECHNOLOGY FORECASTING

Technological change, methods of technology forecasting, relevance trees, morphological methods, flow diagram and combining forecast of technologies Integration of technological product innovation and product development in business processes within enterprises, methods and tools in the innovation process according to the situation, methods and tools in the innovation process according to the situation.

UNIT-V: PRODUCT BUILDING AND STRUCTURES

Virtual product development tools for components, machines, and manufacturing plants: 3D CAD systems, digital mock-up, model building, model analysis, production (process) planning, and product data technology, Product structures: Variant management, product configuration, material master data, product description data, Data models, Life cycles of individual items, status of items.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA -
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

Text Books:

1. Stark, John. Product Lifecycle Management: Paradigm for 21st Century Product Realisation, Springer-Verlag, 2004. ISBN 1852338105
2. Fabio Giudice, Guido La Rosa, Product Design for the environment-A life cycle approach, Taylor & Francis 2006

Reference Books:

1. Saaksvuori Antti / ImmonenAnselmie, product Life Cycle Management Springer, Dreamtech, 3-540-25731-4
2. Product Lifecycle Management, Michael Grieves, Tata McGraw Hill

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

CO's	Statements	Bloom's Level
CO1	Explain the various strategies of PLM and Product Data Management	L2
CO2	Describe decomposition of product design and model simulation	L2
CO3	Apply the concept of New Product Development and its structuring.	L3
CO4	Analyze the technological forecasting and the tools in the innovation.	L4
CO5	Apply the virtual product development and model analysis	L3

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA -
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

II B. Tech – II Semester

L	T	P	C
3	0	0	3

MECHANICS OF SOLIDS

COURSE OBJECTIVE: The students completing this course are expected to understand the basic terms like stress, strain, poison's ratio…etc. and different stresses and deflections induced in beams, thin cylinders, thick cylinders, and columns. Further, the student shall be able to understand the shear stresses due to torsion in circular shafts.

UNIT-I

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

UNIT – II

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

UNIT – III

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

SHEAR STRESSES: Derivation of formula – Shear stress distribution across various beams sections like rectangular, circular, triangular, I, T angle sections.

UNIT-IV

DEFLECTION OF BEAMS: Bending into a circular arc – slope, deflection and radius of curvature – Differential equation for the elastic line of a beam – Double integration and Macaulay's methods – Determination of slope and deflection for cantilever and simply supported beams subjected to point loads, U.D.L uniformly varying load. Mohr's theorems – Moment area method – application to simple cases including overhanging beams, statically indeterminate Beams and solution methods.

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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA -
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

UNIT – V

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

COLUMNS:

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

TEXT BOOKS:

1. Strength of materials /GH Ryder/ Mc Millan publishers IndiaLtd.
2. Strength of materials by B.C. Punmia-lakshmi publications pvt.Ltd, New Delhi.

REFERENCE BOOKS:

1. Mechanics of Materials by Gere &Timeshenko
2. Strength of Materials -By Jindal, UmeshPublications.
3. Strength of Materials by S.Timshenko- D. VAN NOSTRAND Company-PHIPublishers
4. Strength of Materials by Andrew Pytel and Ferdinond L. Singer Longman-HarpercollinsCollege Division
5. Solid Mechanics, byPopov-
6. Mechanics of Materials/Gere and Timoshenko, CBS Publishers

Course Outcomes: On the completion of the course the student will able to

CO's	Statements	Bloom's Level
CO1	Model &analyze the behavior of basic structural members subjected to various loading and support conditions based on principles of equilibrium.	L4
CO2	Understand the apply the concept of stress and strain to analyze and design structural members and machine parts under axial, shear and bending loads, moment and torsional moment.	L3
CO3	Students will learn all the methods to analyze beams, columns, frames for normal, shear, and torsion stresses and to solve deflection problems in preparation for the design of such structural components. Students are able to analyse beams and draw correct and complete shear and bending moment diagrams for beams.	L4
CO4	Students attain a deeper understanding of the loads, stresses, and strains acting on a structure and their relations in the elastic behavior	L2
CO5	Design and analysis of Industrial components like pressure vessels.	L6

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA -
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

II B. Tech – II Semester

L	T	P	C
3	0	0	3

AUTOMOBILE ENGINES

COURSE OBJECTIVES:

1. To impart knowledge on basics of automotive SI and CI engines consisting of types, construction and working.
2. To Understand the actual engine working principle and its thermochemistry of fuel-air mixtures.
3. To learn the properties of gasoline and diesel fuel and combustion process involved in diesel engines.
4. To solve basic design problems of various operating parameters of the engines.
5. To analyze the performance and pollution characteristics of SAI and CI engine and learn modern developments in IC engine

UNIT-I:

ACTUAL CYCLES AND ENGINE CONSTRUCTION:

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; Constructional Details of Four Stroke SI and CI Engines, Working Principle, Actual Indicator Diagram, Two Stroke Engine Construction and Operation, Comparison of Four Stroke and Two Stroke Engine Operation, Firing Order and Its Significance. Basics of Lubrication and Cooling systems, Introduction to Supercharging and turbocharging.

UNIT-II:

SI ENGINE FUELING & COMBUSTION

Fuel Systems: Ulti point Injection system- Gasoline Direct Injection – GDI Pumps and Fuel Injectors - Pre-mixed charge combustion, Thermodynamic Analysis of Combustion, Cycle-to-Cycle Combustion variations and Knocking Combustion

UNIT-III:

CI ENGINE FUELING & COMBUSTION

Fuel Injection and Spray Structure: Fuel Atomization and Droplet size distribution, Sauter Mean Diameter, Spray Penetration. Fuel Injection Pumps, Injector. Types of Combustion Chambers, Diesel Combustion Process Characterization: Ignition Delay, Effect of Engine and Operational Parameters on Delay, Pre-mixed Combustion, Mixing Controlled Combustion. Thermodynamic Analysis. Multi Pulse Injections, Dual fuel technologies - Introduction to Low Temperature Combustion - Homogeneous Charge Compression Ignition (HCCI), Fuel Stratified Charge combustion/ Reactivity Controlled Compression Ignition (RCCI) Technologies, Pre-mixed Charge Compression (PCCI).

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA -
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

UNIT-IV:

FORMATION OF ENGINE EMISSIONS & CONTROL TECHNOLOGIES (SI & CI)

Emission Effects on Health & Environment: Sources of Engine emissions: Formation of CO, NO, UBHC, Soot and Particulate Matter. Diesel NOx-Particulate Trade off: Effect of SI Design and operating variables: Effect of Diesel Engine Design and operating Variables. SI Engine Emission Control Technology: CI Engine Emission Control Technology: Exhaust Gas Recirculation, Diesel Particulate Filter, Selective Catalyst Reduction and Diesel Oxidation Converter, Lean NOx Trap (LNT).

UNIT-V:

ENGINE TESTING & PERFORMANCE

Engine Performance Testing & Characteristics - Testing and measurement equipment-dynamometers, Air & Fuel, temperature, in-cylinder Pressure and Crank angle. Emission Measurement- CLA, FID, NDIR, Analyzers and Smoke meters. Variables Affecting Engine Performance, Performance Maps.

TEXT BOOKS:

1. IC Engines, M.L. Mathur & R.P. Sharma, DhanpatRai& Sons
2. Engine Emissions, Pollutant Formation and Advances in Control Technology, B.P. Pundir, Narosa Publishing House

Reference Books:

1. IC Engines Fundamentals, John B. Heywood, Mc Graw Hill Publications
2. Engineering Fundamentals of I C Engines, WiliardW.Pulkrabek, Prentice Hall Publications
3. Mixture Formation in Internal Combustion Engines, CarstenBaumgaten, Springer Pub
4. Thermal Engineering, PL Ballaney, Khanna Publishers, 25th Edition.

Course Outcomes: On the completion of the course the student will able to

CO's	Statements	Bloom's Level
CO1	Define engine glossaries, identify various components of SI and CI engines and its sub-systems	L1
CO2	Understand the actual engine working principle and its different induction and ignition systems.	L2
CO3	Exposed to gain knowledge on developments in cooling, lubrication, supercharging and turbocharging.	L2
CO4	Understand basic knowledge on SI and CI engine combustion and its related parameters	L2
CO5	Apply their knowledge in analyzing the engine performance and pollution characteristics.	L3

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA - VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

II B. Tech – II Semester

L	T	P	C
3	0	0	3

AUTOMOBILE ELECTRICAL AND ELECTRONICS

Course Objectives:

1. To define the glossary related to vehicle electrical and electronic system.
2. To understand the need for starter batteries, starter motor and alternator in the vehicle.
3. To differentiate the conventional and modern vehicle architecture and the data transfer among the different electronic control unit using different communication protocols.
4. To list common types of sensor and actuators used in vehicles.
5. To understand networking in vehicles

UNIT-I:

Batteries and Accessories: Principle and Construction of Lead Acid Battery, Characteristics of battery, rating capacity and Efficiency of Batteries, Various Tests on Batteries, Maintenance and Charging. Lighting System: Insulated and Earth Return System, Details of Head Light and Side Light, LED Lighting System, Head Light Dazzling and Preventive Methods – Horn, Wiper System and Trafficator.

UNIT-II:

Starting System: Requirements of a Starting system, Behavior of Starter during Starting, Series Motor – Working Principle, construction and its Characteristics, Principle and Construction of Starter Motor, Working of Different Starter Drive Units, Care and Maintenance of Starter Motor, Starter Switches.

UNIT-III:

Charging System: Requirements of a Charging system – Alternators – Generation of electrical energy in vehicle- physical principles- Alternator and voltage regulations versions – power losses – characteristics curve- Alternator operation in the vehicle- Alternator circuitry.

UNIT-IV:

Fundamentals of Automotive Electronics: Engine Management System – PFI, GDI, CRDI and UI systems. Electro Magnetic Interference Suppression, Electromagnetic Compatibility, Electronic Dashboard Instruments, Onboard Diagnostic System, Security and Warning System.

UNIT-V:

Sensors & Actuators: Engine Sensors: Speed, Throttle Position, Exhaust Oxygen, knock, Manifold Pressure, Crankshaft Position, Temperature, Air Mass Flow.
Automotive Sensors: Impact Sensor, Rain Sensor, GPS Sensor, Speed Sensor.
Actuators: Solenoids, Stepper Motors, Relay.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA -
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

Text Books

1. Young A.P. & Griffiths. L. "Automotive Electrical Equipment", ELBS & NewPress-1999.
2. William B.Ribbens "Understanding Automotive Electronics", 5th edition -Butter worth Heinemann Woburn,1998.

References

1. Bechtold "Understanding Automotive Electronics", SAE,1998.
2. Crouse, W.H "Automobile Electrical Equipment", McGraw-Hill Book Co., Inc., New York, 3rd edition, 1986.
3. Judge A.W "Modern Electrical Equipment of Automobiles", Chapman & Hall, London,1992.
4. Kholi.P.L "Automotive Electrical Equipment", Tata McGraw-Hill Co., Ltd., New Delhi,1975.
5. Robert Bosch "Automotive Hand Book", SAE (5th Edition),2000.

Course Outcomes: On the completion of the course the student will able to

CO's	Statements	Bloom's Level
CO1	Define the glossary related to vehicle electrical and electronic system	L1
CO2	Understand the need for starter batteries, starter motor and alternator in the vehicle.	L2
CO3	Differentiate the conventional and modern vehicle architecture and the data transfer among the different electronic control unit using different communication protocols.	L2
CO4	List common types of sensor and actuators used in vehicles.	L1
CO5	Understand networking in vehicles.	L2

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA -
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

II B. Tech – II Semester

L	T	P	C
3	0	0	3

METALLURGY & MATERIALS SCIENCE

COURSE OBJECTIVES:

To understand the basic fundamentals of Material science and

Physical metallurgy. The basic concepts to be taught will help for the improvement, proper selection and effective utilization of materials which is essential to satisfy the ever-increasing demands of the society.

UNIT – I:

Structure of Metals and Constitution of alloys: Bonds in Solids, Metallic bond, crystallization of metals, Packing Factor-SC, BCC, FCC & HCP-line density, plane density. Grain and grain boundaries, effect of grain boundaries on the Properties of metal / alloys – determination of grain size. Imperfections– point, line, surface and volume-Slip and Twinning. Necessity of alloying, types of solid solutions, Hume Rothery's rules, intermediate alloy phases, and electron compounds.

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

UNIT – II:

Ferrous metals and alloys: Structure and properties of White Cast iron, Malleable Cast iron, geriaction, Spheroidal graphitization, Allocations. Classification of steels, structure and properties of plain carbon steels, Low alloy steels, had field manganese steels, tool and die steels.
Non-ferrous Metals and Alloys: Structure and properties of copper and its alloys, Aluminum and its alloys, Titanium and its alloys, Magnesium and its alloys, Super alloys.

UNIT – III:

Heat treatment of Alloys: Effect of alloying elements on Fe-Fe3C system, Annealing, normalizing, hardening, TTT diagrams, tempering, harden ability, surface-hardening methods, Age hardening treatment, Cryogenic treatment of alloys.

UNIT – IV:

Powder Metallurgy: Basic processes- Methods of producing metal powders- milling atomization-Granulation-Reduction-Electrolytic Deposition. Compacting methods – Sintering - Methods of manufacturing sintered parts. Sintering Secondary Operations-Sizing, coining, machining –Factors determining the use of powder metallurgy-Application of this process.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA -
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

UNIT – V:

Ceramic and composite materials: Crystalline ceramics, glasses, cermet's, abrasive materials, Classification of composites, various methods of component manufacture of composites, particle –reinforced materials, fiber reinforced materials, metal ceramic mixtures, metal – matrix composites and C-Composites. Nanomaterials –definition, properties and applications.

Text Books:

1. Introduction to Physical Metallurgy-Sidney H. Avener-McGraw Hill
2. Essential of Materials science and engineering-Donald R.Askeland-Cengage.

Reference Books:

1. Material Science and Metallurgy–Dr. V.D.kodgire-Everest Publishing House
2. Materials Science and engineering-Callister & Baala subrahmanyam-Wiley Publications
3. Materia lScience for Engineering students –Fischer– Elsevier Publishers
4. Material science nd Engineering-V.Rahghavan-PHI Publishers
5. Introduction to Material Science and Engineering–Yip-Wah Chung CRC Press
6. Material Science and Metallurgy–A V KSuryanarayana –BS Publications
7. Material Science and Metallurgy–U. C.Jindal –Pearson Publications

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

CO's	Statements	Bloom's Level
CO1	Understand the crystal line structure of different metals and study the stability of phases in different alloy systems.	L2
CO2	Study the behavior of ferrous and nonferrous metals and alloys and their application indifferent domains	L1
CO3	understand the effect of heat treatment, addition of alloying elements on properties of ferrous metals	L2
CO4	Grasp the methods of making of metal powders and applications of powder metallurgy	L2
CO5	Comprehend the properties and applications of ceramic, composites and other advanced methods.	L3

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA - VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

II B. Tech – II Semester

L	T	P	C
0	0	3	1.5

AUTOMOBILE ENGINES AND FUELS LAB

Course Objectives: To study the characteristics of the fuels and lubricants used in automobile and get practical knowledge in assembly & dismantling of engine components.

Note: Need to perform at least Six Experiments from each of the Labs

PART-A: ENGINES LAB

LIST OF EXPERIMENTS

1. Draw the Valve and Port Timing Diagrams for 4S and 2S engines.
2. Evaluation of Performance and Emissions from 4S Petrol Engine
3. Evaluation of Performance and Emissions from 4S Diesel Engine
4. Evaluation of Frictional Power from the Morse Test on a 4-Stroke Multi Cylinder Engine
5. Determination of Frictional Power by the retardation and Motoring Test on IC Engine
6. Draw the Heat Balance Sheet for a 4-Stroke Petrol or Diesel Engine
7. Analysis of Combustion Characteristics like; P-θ, ~~Differential~~ Heat Release Rate, Cumulative Heat Release and Ignition Delay of diesel engine
8. Calculation of Stoichiometric Air- Fuel mixtures of Conventional fuels through oxidation Equation and compare with Spectrometric analysis
9. Calculation of Volumetric Efficiency of a conventional fuel and compare with Gas based Dual Fuel Operation, when secondary fuel is inducted through inlet manifold
10. Dismantling and Assembly of Agriculture single Cylinder and Multi- Cylinder Automotive Engines

PART-B: FUELS LAB

LIST OF EXPERIMENTS

1. To Perform the ASTM distillation test of liquid fuels.
2. Determining the different components available in a given fuel using Gas Chromatograph and quantify the same using Mass Spectrometry
3. Determining the Qualitative and Quantitative Analysis of given fuel by examining the IR spectrum peaks of the given fuel using FT-IR
4. To study the Structure and connectivity of Organic Molecules of given fuel using NMR C13/H1 analysis
5. To study the quantitative compositional data of hydrocarbon data using HPLC analysis using HPLC analyzer
6. Determination of the Calorific value of liquid and gaseous fuel.
7. Determination of Flash and Fire points of petrol and diesel. (closed and OpenType)
8. Determination of Temperature dependence of viscosity of lubricants & Fuels by Redwood Viscometer.
9. Determination of Viscosity index of lubricants & Fuels by SayboltViscometer.
10. Determination of Ash content and Carbon Residue Test.

11. Determination of flow properties of oil using Cloud and Pour point Test.

Course Outcomes: Attending the laboratory the students shall be able to:

CO's	Statements	Bloom's Level
CO1	know the principles in assembly & dismantling of engine components	L1
CO2	learn characteristics of the fuels and lubricants used in automobile	L1

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA -
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

II B. Tech – II Semester

L	T	P	C
0	0	3	1.5

AUTOMOBILE ELECTRICAL AND ELECTRONICS LAB

Course Objectives:

1. To understand the working principle of Electrical circuits in automobile.
2. To evaluate the working principle of Battery, and starter motor.
3. To understand the working principle of auxiliary systems used in automobiles.
4. To understand the use of sensors in an automobile.
5. To develop a programing knowledge on Microprocessor

Note: Any 6 Experiments from each stream and rest can be considered as extra experiments

Part-A: Automotive Electrical Lab:

List of Experiments:

1. Testing and study of different types of Batteries and constructions.
2. Testing, dismantling and assembling of starter motor used in automobile.
3. Testing, dismantling and assembling of alternator used in automobile.
4. Study of different colour code system used in automotive wiring system.
5. Demonstration and study of Battery Ignition System and their parts used in Automobile Vehicles.
6. Study of different Electrical Equipment's & Accessories (Speedometer, Warning lights, Electric Horn, Wind shield wipers system).
7. Study of different sensors used in modern automotive system.
8. Study of various electronics system (Electronic fuel injection system, electronic ignition system, Air bag, ABS, Electronic fuel injector cleaner).
9. Demonstration and experiment on lighting system of two-wheeler and Four Wheelers.
10. Demonstration, experiment and diagnosis on ignition system.

Part-B: Automotive Electronics:

List of Experiments:

1. Visualization of Engine Sensor Signals and fault Diagnosis using OBD Kit
2. Interface of Seven segment display
3. Interfacing of ADC for a sensor and Interfacing of DAC for an actuator
4. Interface circuit like amplifier, filter, Multiplexer and De Multiplexer
5. Basic microprocessor programming like arithmetic and Logic operation, code conversion,
6. waveform generation, look up table etc.
7. Study of Aurdino Programming
8. EPROM Programming
9. Study of Virtual Instrumentation and Communication Protocols (CAN, LIN, MOST etc.)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA -
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

Course Outcomes: **Attending the laboratory the students shall be able to:**

CO's	Statements	Bloom's Level
CO1	Understand the working principle of Electrical circuits in automobile.	L2
CO2	Evaluate the working principle of Battery, and starter motor.	L5
CO3	Understand the working principle of auxiliary systems used in automobiles.	L2
CO4	Understand the use of sensors in an automobile.	L2

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA -
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

II B. Tech – II Semester

L	T	P	C
0	1	2	2

MACHINE TOOLS AND METROLOGY LAB

Note: minimum of 6 experiments from each section

Course Objective: This practical course covers the topics related to precession measuring instruments and the working and operations of various machine tools.

Part-A: 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 tooth vernier calipers and checking the chordal thickness of spur gear.
4. Machine tool alignment test on the lathe.
5. Machine tool alignment test on milling machine.
6. Angle and taper measurements by bevel protractor, Sine bars etc.
7. Use of spirit level in finding the straightness of a bed and flatness of a surface.
8. Thread measurement by two wire/ three wire method & tool makers microscope.
9. Surface roughness measurement by Talysurf.

Part-B: MACHINE TOOLS LAB

- Study of general-purpose machines -lathe, drilling machine, milling machine, shaper, planning machine, slotting machine, cylindrical grinder, surface grinder and tool and cutter grinder.

1. To perform Step turning and taper turning on lathe machine
2. To perform Thread cutting and knurling on lathe machine.
3. Development of models by Drilling and tapping.
4. Development of models by Shaping and planning.
5. Development of models by Slotting
6. Development of models by Milling
7. To Perform Cylindrical surface grinding
8. To undergo Grinding of tool angles.

Course Outcome: After completing the course, the student will be able to operate various precession measuring instruments and working and operations of various machines tools. (L3)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA -
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

L	T	P	C
1	0	2	2

II B. Tech – II Semester

DESIGN THINKING & INNOVATION

Course Objectives: The objectives of the course are to

- Bring awareness on innovative design and new product development.
- Explain the basics of design thinking.
- Familiarize the role of reverse engineering in product development.
- Train how to identify the needs of society and convert into demand.
- Introduce product planning and product development process.

UNIT – I Introduction to Design Thinking

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

UNIT - II Design Thinking Process

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brainstorming, product development

Activity: Every student presents their idea in three minutes, every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development.

UNIT - III Innovation

Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations. Creativity to Innovation. Teams for innovation, Measuring the impact and value of creativity.

Activity: Debate on innovation and creativity, Flow and planning from idea to innovation, Debate on value-based innovation.

UNIT - IV Product Design

Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications. Innovation towards product design Case studies.

Activity: Importance of modeling, how to set specifications, Explaining their own product design.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

UNIT – V Design Thinking in Business Processes

Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business – Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs. Design thinking for Startups. Defining and testing Business Models and Business Cases. Developing & testing prototypes.

Activity: How to market our own product, about maintenance, Reliability and plan for startup.

Textbooks:

1. Tim Brown, Change by design, 1/e, Harper Bollins, 2009.
2. Idris Mootee, Design Thinking for Strategic Innovation, 1/e, Adams Media, 2014.

Reference Books:

1. David Lee, Design Thinking in the Classroom, Ulysses press, 2018.
2. Shrrutin N Shetty, Design the Future, 1/e, Norton Press, 2018.
3. William lidwell, Kritinaholden, &Jill butter, Universal principles of design, 2/e, Rockport Publishers, 2010.
4. Chesbrough.H, The era of open innovation, 2003.

Online Learning Resources:

- https://nptel.ac.in/courses/110/106/110106124/
- https://nptel.ac.in/courses/109/104/109104109/
- https://swayam.gov.in/nd1_noc19_mg60/preview
- https://onlinecourses.nptel.ac.in/noc22_de16/preview

Course Outcomes:

COs	Statements	Blooms Level
CO1	Define the concepts related to design thinking.	L1
CO2	Explain the fundamentals of Design Thinking and innovation.	L2
CO3	Apply the design thinking techniques for solving problems in various sectors.	L3
CO4	Analyse to work in a multidisciplinary environment.	L4
CO5	Evaluate the value of creativity.	L5

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-I Semester		L	T	P	C
		3	0	0	3
THEORY OF MACHINES					

Course Objectives:
- To study about the kinematic links, different types of pairs, mechanisms and principals involved in assessing the displacement, velocity and acceleration at any point in a link of a mechanism
- To understand the kinematic aspects of friction involved in machineries such as belts, clutches and brakes
- To understand the basic concepts of toothed gearing and kinematics of gear trains
- To understand the motion resulting from a specified set of linkages and cam mechanisms for specified output motions
- To understand the undesirable effects of unbalancing resulting from prescribed motions in mechanism
- To study about the fundamentals of vibration and dynamics of mechanisms

UNIT-I MECHANISMS: Machine Structure – Kinematic link, pair and chain – Grublers criteria – Constrained motion – Degrees of freedom – Slider crank and crank rocker mechanisms – Inversions – Applications – Kinematic analysis of simple mechanisms – Determination of velocity and acceleration.

UNIT-II FRICTION: Friction in screw and nut – Pivot and collar – Thrust bearing – Plate and disc clutches – Belt (flat and V) and rope drives. Ratio of tensions – Effect of centrifugal and initial tension – Condition for maximum power transmission – Open and crossed belt drive.

UNIT-III GEARS: Gear profile and geometry – Nomenclature of spur and helical gears – Gear trains: Simple, compound gear trains and epicyclic gear trains – Determination of speed and torque

UNIT-IV CAMS: Cams – Types of cams – Design of profiles – Knife edged, flat faced and roller ended followers with and without offsets for various types of follower motions
BALANCING: Static and dynamic balancing – Single and several masses in different planes – Balancing of reciprocating masses- primary balancing and concepts of secondary balancing – Single and multi-cylinder engines (Inline) – Balancing of radial V engine – direct and reverse crank method.

UNIT-V VIBRATION: Free, forced and damped vibrations of single degree of freedom systems – Force transmitted to supports – Vibration isolation – Vibration absorption – Torsional vibration of shaft – Single and multi-rotor systems – Geared shafts – Critical speed of shaft.

TEXT BOOKS:

1. Rattan.S.S, “Theory of Machines”, Tata McGraw–Hill Publishing Co., New Delhi, 2004.
2. Ballaney.P.L, “Theory of Machines”, Khanna Publishers, New Delhi, 2002.

REFERENCES:

1. Rao,J.S and Dukkipati, R.V, “Mechanism and Machine Theory”, Second Edition, Wiley Eastern Ltd., 1992.
2. Malhotra, D.R and Gupta, H.C., “The Theory of Machines”, Satya Prakasam, Tech. India Publications, 1989.
3. Gosh, A. and Mallick, A.K., “Theory of Machines and Mechanisms”, Affiliated East West Press, 1989.
4. Shigley, J.E. and Uicker, J.J., “Theory of Machines and Mechanisms”, McGraw-Hill, 1980.

5. Burton Paul, "Kinematics and Dynamic of Planer Machinery", Prentice Hall, 1979.

Course Outcomes: On completion of the course the students should be able to

- Demonstrate the fundamentals of mechanisms and their applications and able to analyse the kinematic properties of mechanism such as displacement, velocity and acceleration
- Analyze the effect of friction in machines such as belt drives, clutches and brakes
- Understand the basic nomenclature of gears and analyze gear kinematics.
- Perform the kinematic analysis of cam and demonstrate the balancing of any kinematic system
- Analyze different types of Vibrations

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-I Semester		L	T	P	C
		3	0	0	3
PRODUCTION TECHNOLOGY					

Course Objective:
To impart basic knowledge and understanding about the primary manufacturing processes such as casting, joining, bulk forming, and sheet metal forming and their relevance in current manufacturing industry.

UNIT – I
CASTING: Steps involved in making a casting – Advantage of casting and its applications. Patterns and Pattern making – Types of patterns – Materials used for patterns, pattern allowances and their construction, Moulding – moulding methods - ingredients of moulding sand –. Moulding materials, Properties of moulding sand, testing of moulding sand. Types of moulding – Hand moulding – Machine moulding. Core – different types of cores – materials – properties of core sand – core manufacturing. Basic principles and applications of special casting processes - Centrifugal casting – True, semi and centrifuging, die casting, Investment casting and shell moulding.

UNIT – II
WELDING: Classification of welding processes, types of welded joints and their characteristics, Gas welding, Different types of flames and uses, Oxy – Acetylene Gas cutting. Basic principles of Arc welding, power characteristics, Manual metal arc welding, submerged arc welding, TIG & MIG welding. Electro – slag welding. Resistance welding, Friction welding, Friction stir welding, Forge welding, Explosive welding; Thermit welding, Plasma Arc welding, Laser welding, electron beam welding, Soldering & Brazing.
Heat affected zones in welding; pre & post heating, weldability of metals, welding defects – causes and remedies – destructive and non-destructive testing of welds.

UNIT – III
PLASTIC DEFORMATION IN METALS AND ALLOYS: Recovery, recrystallization and grain growth. Hot working and Cold Working-Strain hardening and Annealing. Bulk forming processes: Forging - Types of Forging, Smith forging, Drop Forging, Roll forging, Forging hammers, Rotary forging, forging defects; Rolling – fundamentals, types of rolling mills and products, Forces in rolling and power requirements. Extrusion and its characteristics. Types of extrusion, Impact extrusion, Hydrostatic extrusion; Wire drawing and Tube drawing.

UNIT – IV
SHEET METAL FORMING: Blanking and piercing, Forces and power requirement in these operations, Deep drawing, stretch forming, Bending, Spring back and its remedies, Coining, Spinning, Types of presses and press tools. High energy rate forming processes: Principles of explosive forming, electromagnetic forming, Electro hydraulic forming, rubber pad forming, advantages and limitations.

UNIT – V: MACHINING PROCESSES
LATHE MACHINES: Introduction- types of lathes - Engine lathe – principle of working - construction – specification. lathe operations – taper turning methods and thread cutting – drilling on lathes – cutting speed and feed-depth of cut. of lathe. **SHAPING, SLOTTING AND PLANNING MACHINES:** Introduction - principle of working – principal parts – specifications - operations performed. **DRILLING:** Introduction – construction of drilling machines – types of drilling machines - principles of working – specifications- types of drills – geometry of twist drill - operations performed –cutting speed and feed. **MILLING MACHINES:** Introduction - principle of working –classification of Milling Machines. **FINISHING PROCESSES:** Introduction - theory of grinding – classification of grinding machines- cylindrical and surface grinding machines- tool and cutter grinding machines.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

TEXT BOOKS:

1. Manufacturing Processes for Engineering Materials – Kalpakjian S and Steven R Schmid- Pearson Pub, 5th Ed.
2. Manufacturing Technology -Vol I- P.N. Rao- TMH

REFERENCES:

1. Manufacturing Science – A.Ghosh & A.K.Malik – East West Press Pvt. Ltd
2. Process and materials of manufacture- Lindberg- PHI
3. Production Technology- R.K. Jain- Khanna
4. Production Technology-P C Sharma-S. Chand
5. Manufacturing Processes- H.S. Shaun- Pearson
6. Manufacturing Processes- J.P. Kaushish- PHI
7. Workshop Technology -WAJ Chapman/CBS Publishers & Distributors Pvt.Ltd.
8. Production Technology-HMT- Tata McGraw-Hill

Course Outcomes:

- Able to design the patterns and core boxes for metal casting processes
- Able to design the gating system for different metallic components
- Know the different types of welding processes
- Learn about plastic deformation processes

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-I Semester		L	T	P	C
		3	0	0	3
VEHICLE DYNAMICS					

Course Objective:
To impart basic knowledge and understanding underlying the development and design of road vehicles under the influence of dynamic loads and to model, simulate and analyze the conventional road vehicles for better ride comfort.

UNIT I
Introduction: Hypothetical vehicle control loop, Fundamental Approach, Vehicle coordinates, motion variables. Forces – Dynamic axle loads, Static loads on level ground, aerodynamic forces on body, hitch forces – Numerical.

UNIT-II
Acceleration & Braking Performance – Power limited acceleration, Fundamental Expressions, Constant retardation, Wind Resistance, Power, Braking forces, Brakes: disc and drum, front, rear and four-wheel braking, Road friction rolling resistance, Numerical.

UNIT-III
Road Loads: Aerodynamic, Mechanics of pressure distribution – Aerodynamic forces: lift & drag, Spoilers, Lift force, side force and roll, pitch and yaw moments, Crosswind sensitivity. Rolling Resistance, Factors affecting pressure, velocity, slip, temperature– Total Road loads – Fuel Economy Effects.

UNIT-IV
Ride Excitation sources – road roughness, wheel assembly, driveline excitation, engine transmission. **Vehicle response properties**: Suspension isolation, suspension stiffness & damping Wheel Hop Resonance. Road-tyre friction – dynamic response of tires – Rigid body bounce, pitch motion. Perception of ride and other vibration forms, Numerical.

UNIT-V
Steady – State Cornering: Introduction, Low and high-speed turning –Tire cornering forces, governing expressions, understeer gradient, over steer and neutral conditions. Characteristic speed, critical speed, yaw velocity gain, sideslip angle, static margin. Suspension effects on cornering: roll moment distribution – effect of tractive forces on cornering – Numerical.

TEXT BOOKS:
1. Thomas Gillespie, “Fundamentals of Vehicle dynamics.” Society of Automotive engineers Inc, 2014
2. Wong H, Theory of Ground Vehicles, McGraw Hill, Second edition, 2006.

REFERENCES:
1. Hans B Pacejka, Tire and Vehicle Dynamics, 3rd Edition, Elsevier Ltd., 2012.
2. Amitosh D, Vehicle Dynamics, Galgotia Book Ltd., 2010.
3. Rao V Dukkipati, Road Vehicle Dynamics,Springer 2008
4. Werner and Karl, Ground Vehicle Dynamics,Springer Berlin Heidelberg, 2008.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

COURSE OUTCOMES:

- Understand the principles underlying the development and design of road vehicles under the influence of dynamic loads.
- Analyze the performance and establish the design specifications for the acceleration and braking conditions.
- Model, simulate and analyze the conventional road vehicles for better ride comfort.
- Analyze the cornering forces and effects of tractive forces on cornering

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-I Semester		L	T	P	C
		3	0	0	3
ALTERNATIVE FUELS FOR ENGINES (PROGRAM ELECTIVE-I)					

Course Objectives: To impart the necessity of finding alternative energy sources for automobiles and to understand merits and demerits, performance characteristics of various sources of fuels and their comparison.

UNIT I
CONVENTIONAL FUELS FOR I.C. ENGINES

Petroleum based conventional fuels for SI and CI engine, Demand and Availability of crude oil – vehicle population increase – national and international standards for conventional and alternative fuels.

Desirable characteristics of SI Engine fuels – Petrol – Properties, Specification, chemical structure, Volatility characteristics, knock rating and additives. Desirable characteristics of CI Engine fuels – Diesel – Properties, Specification, chemical structure, Ignition quality, Cetane rating and additives.

UNIT II
ALCOHOLS AS FUELS

Availability of different alternative fuels for engines. Alcohols – Properties, Production methods and usage in engines. Blending, dual fuel operation, surface ignition, spark ignition and oxygenated additives. Performance, combustion and emission characteristics in engines. Advantages and disadvantages of alcohol fuels

UNIT III
VEGETABLE OILS AND BIODIESEL AS FUELS

Properties of Vegetable oils and biodiesel- Methods of using vegetable oils – Blending, preheating, and emulsification – Preparation of biodiesel from non-edible, edible oil and Algae - Performance, combustion and emission Characteristics in diesel engines. Advantages and disadvantages of Vegetable oils and biodiesel

UNIT IV
HYDROGEN AS FUEL

Hydrogen – Properties, Production methods, storage and safety aspects. Issues & limitation in Hydrogen. Methods of using hydrogen in engines. Performance, combustion and emission Characteristics in engines. Advantages and disadvantages of Hydrogen fuel.

UNIT V
BIOGAS, CNG AND LPG AS FUELS

Biogas, Compressed Natural gas (CNG) and LPG – Properties and production methods. CO_2 and H_2S scrubbing in Biogas, Modifications required for use in Engines- Performance, combustion and emission Characteristics in engines. Advantages and disadvantages of Gaseous fuels. Working of LPG and CNG kits used in automotive engines.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

REFERENCES

1. Arumugam S. Ramadhas, "Alternative Fuels for Transportation" CRC Press, 2011.
2. Ayhan Demirbas and M. Fatih Demirbas, "Algae Energy-Algae as a New Source of Biodiesel", Springer-Verlag London Limited 2010.
3. Ayhan Demirbas, 'Biodiesel A Realistic Fuel Alternative for Diesel Engines', Springer-Verlag London Limited 2008
4. David M. Mousdale, "Introduction to Biofuels", CRC Press, 2015.
5. Ganesan.V., "Internal Combustion Engineering", Tata McGraw-Hill Publishing Co., New Delhi, 2003.
6. Gerhard Knothe, Jon Van Gerpen, Jargon Krahl, The Biodiesel Handbook, AOCS Press Champaign, Illinois 2005.
7. M. K. Gajendra Babu and K. A. Subramanian, "Alternative Transportation Fuels-Utilisation in Combustion Engines", CRC Press, 2013.
8. M.L. Mathur, R.P.Sharma "A course in internal combustion engines", Dhanpatrai publication, 2003.
9. Richard L Bechtold P.E., Alternative Fuels Guide book, Society of Automotive Engineers, 1997 ISBN 0-76-80-0052-1.

Course Outcomes:

By the end of this course, students will be able to

- Possess a comprehensive understanding of available alternative fuels for IC engines. They will possess complete knowledge on producing different biofuels, modifying them and using them in IC engines
- Acquire the skills in developing new technologies for alternative fuels efficiently in IC engines.
- Demonstrate the importance of using alternative fuels for sustainable energy supply and for emission control in IC engines.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-I Semester		L	T	P	C
		3	0	0	3
TWO AND THREE WHEELERS (PROGRAM ELECTIVE-I)					

Course Objectives:
The objective of this course is to make the students know and understand the constructional details, operating characteristics and design aspects of Two and Three wheelers.

UNIT I- INTRODUCTION
Classifications- design considerations –weight and dimension limitations – requirements, stability problems, gyroscopic effect- pendulum effect of two and three wheelers.

UNIT II- POWER UNITS, IGNITION SYSTEMS ELECTRICAL &BRAKING SYSTEMS
2 stoke and 4 stoke engines. Design criteria for engines – design of cylinders, cylinder head, cooling fins, crank case, connecting rod and crank shaft. Carburetor types. Wiring layout for two wheelers. Braking system in two wheelers, Fundamentals of EFI.

UNIT III -CLUTCHES AND TRANSMISSION
Types of clutches. Design of clutch system. Gears for two and three wheelers. Design of gear box and gear change mechanism. Belt, chain and shaft drive. Freewheeling devices, starting systems.

UNIT IV -FRAMES, SUSPENSION, WHEELS AND TYRES
Types of frames. Wheel frames- construction design of frames for fatigue strength, torsional stiffness and lateral stability. Front and rear forks. Springs for suspension, Dampers, constructional details of wheel and tyres.

UNIT V -THREE WHEELERS
Auto rickshaws - Pick-Ups and delivery type vehicle, frames and transmission, wheel types, wheel mountings attachment, tyre types. Brake systems.

REFERENCES

1. ‘Cycle Motor Manual’, Templeton Press Ltd., London, 1992.
2. Irving P.E., “Motor Cycle Engineering”, Temple Press Book, London, 1964
3. Johns.B.A., ‘Motorcycles’, Good Heart will, 1984.
4. M.M.Griffin., ‘Motor cycles from inside and outside’, Prentice Hall Inc, New Jersey, 1978.
5. Marshal Cavandedish, ‘Encyclopedia of Motor cycling’, New York, 1989
6. Servicing Manuals- various motor cycles, Scooters, Mopeds and three wheelers.
7. Srinivasan.S., ‘Motor cycle, Scooter, Mopeds’, New century book house, 1988

Course Outcomes:

At the end of the course the students will have through knowledge over different frames, suspension system and transmission unit used in various two and three-wheeler vehicles.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-I Semester		L	T	P	C
		3	0	0	3
HEAT TRANSFER (PROGRAM ELECTIVE-I) **(Heat transfer data book allowed)**					

Course Objective: To understand different modes of heat transfer and apply these basics in the design of thermal systems

UNIT – I:
Introduction: Modes and mechanisms of heat transfer – Basic laws of heat transfer –General discussion about applications of heat transfer.
Conduction Heat Transfer: Fourier rate equation – General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates – simplification and forms of the field equation – steady, unsteady and periodic heat transfer – Initial and boundary conditions
One Dimensional Steady State Conduction Heat Transfer: Homogeneous slabs, hollow cylinders and spheres- Composite systems– overall heat transfer coefficient – Electrical analogy – Critical radius of insulation

UNIT – II:
One Dimensional Steady State Conduction Heat Transfer: Variable Thermal conductivity – systems with heat sources or Heat Generation-Extended surface (fins) Heat Transfer – Long Fin, Fin with insulated tip and Short Fin, Application to error measurement of Temperature
One Dimensional Transient Conduction Heat Transfer: Systems with negligible internal resistance – Significance of Biot and Fourier Numbers –Infinite bodies- Chart solutions of transient conduction systems- Concept of Semi-infinite body.

UNIT – III:
Convective Heat Transfer: Classification of systems based on causation of flow, condition of flow, configuration of flow and medium of flow – Dimensional analysis as a tool for experimental investigation– Buckingham Theorem and method, application for developing semi – empirical non- dimensional correlation for convection heat transfer – Significance of non-dimensional numbers – Concepts of Continuity, Momentum and Energy Equations.
Forced convection: External Flows: Concepts about hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer -Flat plates and Cylinders.
Internal Flows: Concepts about Hydrodynamic and Thermal Entry Lengths – Division of internal flow based on this –Use of empirical relations for Horizontal Pipe Flow and annulus flow.

UNIT – IV:
Free Convection: Development of Hydrodynamic and thermal boundary layer along a vertical plate - Use of empirical relations for Vertical plates and pipes.
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.

UNIT V:
Heat Transfer with Phase Change:
Boiling: – Pool boiling – Regimes – Calculations on Nucleate boiling, Critical Heat flux and Film boiling
Condensation: Film wise and drop wise condensation –Nusselt's Theory of Condensation on a vertical plate - Film condensation on vertical and horizontal cylinders using empirical correlations.
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 grey bodies – radiation shields – electrical analogy for radiation networks.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

TEXT BOOKS:

1. Heat Transfer by HOLMAN, Tata McGraw-Hill
2. Heat Transfer by P.K.Nag, TMH

REFERENCE BOOKS:

1. Fundamentals of Heat Transfer by Incropera & Dewitt, John wiley
2. Fundamentals of Engineering, Heat& Mass Transfer by R.C.Sachdeva, NewAge.
3. Heat& Mass Transfer by Amit Pal – Pearson Publishers
4. Heat Transfer by Ghoshdastidar, Oxford University press.
5. Heat Transfer byA Practical Approach, YunusCengel, Boles, TMH
6. Engineering Heat and Mass Transfer by Sarit K. Das, DhanpatRai Pub

Note: Heat and Mass transfer Data Book by C P Kothandaraman and Subrahmanyan is used to design and analyze various thermal processes and thermal equipment.

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

- Represent the physical problems of heat transfer in terms of governing equations or mathematical models
- Differentiate between different boundary conditions and apply the same for solving heat transfer problems
- Design thermal systems applying the concepts of heat transfer under steady state and well as unsteady state conditions
- Design, select and analyze the heat exchangers
- Apply the radiation concepts to the engineering devices.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-I Semester		L	T	P	C
		3	0	0	3
INDUSTRIAL HYDRAULICS AND PNEUMATICS (PROGRAM ELECTIVE-I)					

Course Objectives:
The students will acquire the knowledge:
1. To learn basic concepts of fluid power
2. To learn the functions and working of basic elements of Hydraulic and Pneumatic systems
3. To learn the basic components and their functions of Hydraulic and Pneumatic circuits
4. To learn the operating principles and working of hydraulic and pneumatic devices
5. To learn the procedures of installation, Maintenance and Troubles hooting of Hydraulic and pneumatic systems

Unit – I:
Fluid Power: Power transmission modes, hydraulic systems, pneumatic systems, laws governing fluid flow: Pascal's law, continuity equation, Bernoulli's theorem, Boyle's, Charles', Gay-lussec' laws, flow through pipes - types, pressure drop in pipes, working fluids used in hydraulic and pneumatic systems- types, ISO/BIS standards and designations, properties.

Unit– II:
Hydraulic and Pneumatic Elements:
Hydraulic pipes-Types, standards, designation methods and specifications, pressure ratings, applications and selection criteria, pumping theory, Hydraulic Pumps - types, construction, working principle, applications, selection criteria and comparison, hydraulic Actuators, Control valves, Accessories - their types, construction and working, pneumatic Pipes - materials, designations, standards, properties and piping layout, air compressors, Air receivers, air dryers, Air Filters, Regulators, Lubricators (FRL unit): their types, construction, working, specifications and selection criteria of following air preparation and conditioning elements, pneumatic Actuators and Control valves - types, construction, working, materials and specifications

Unit– III:
Hydraulic and Pneumatic Circuits:
ISO symbols used in hydraulic and pneumatic circuit, basic Hydraulic Circuits – types (such as intensifier, regenerative, synchronizing, sequencing, speed control, safety), circuit diagram, components, working and applications, basic Pneumatic Circuits – types (such as speed control, two step feed control, automatic cylinder reciprocation, time delay, quick exhaust), circuit diagram, components, working and applications, pneumatic Logic circuit design - classic method, cascade method, step counter method, Karnaugh Veitch maps and combinational circuit design.

Unit-IV
Hydraulic and Pneumatic Devices:
Hydraulic and Pneumatic devices – Concept and applications, construction, working principle, major elements, performance variables of: Automotive hydraulic brake, Industrial Fork lift, Hydraulic jack, Hydraulic press, automotive power steering, automotive pneumatic brake, automotive air suspension, Pneumatic drill, Pneumatic gun.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

Unit-V

Installation, Maintenance and Trouble-Shooting:

Installation of hydraulic and pneumatic system causes and remedies for common troubles arising in hydraulic elements, maintenance of hydraulic systems, causes and remedies for troubles arising in pneumatic elements, maintenance of pneumatic systems.

Textbooks:

1. Majumdar, S.R. Oil Hydraulic Systems Tata McGraw-Hill Publication, New Delhi,3/e, 2013
2. Majumdar, S.R. Pneumatic Systems Tata McGraw-Hill Publication, New Delhi,3/e, 2013

References:

1. Srinivasan, R. Hydraulic and Pneumatic Controls Vijay Nicole Imprints Private, New Delhi, Limited, 2/e, 2008
2. Jagadeesha, T. Fluid Power Generation, Transmission and Control Universities Press (India) Private Limited, New Delhi,1/e, 2014
3. Jagadeesha, T. Pneumatics Concepts, Design and Applications Universities Press (India) Private Limited, New Delhi,1/e, 2014
4. Parr, Andrew Hydraulic and Pneumatics a Technician's and Engineer's Guide Jaico Publishing House, New Delhi,2/e, 2013
5. Shanmuga Sundaram, K. Hydraulic and Pneumatics Controls - Understanding Made Easy S. Chand Company Ltd., New Delhi, 1/e, 2006

Course outcomes:

Upon successful completion of this course the student should be able to:

- Illustrate the basic concepts of fluid power
- Understand the functions of elements of Hydraulic and Pneumatic systems
- Analyze the functions of hydraulic and Pneumatic circuits
- Illustrate the working of various hydraulic and pneumatic devices.
- Interpret the procedure of installation, maintenance and trouble shooting of hydraulic and Pneumatic systems

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-I Semester		L	T	P	C
		0	0	3	1.5
PRODUCTION TECHNOLOGY LAB					

Course Objective: To impart practical exposure on manufacturing processes and equipment.

1. Design and making of pattern
   i. Single piece pattern
   ii. Split pattern
2. Sand properties testing
   i. Sieve analysis (dry sand)
   ii. Clay content test
   iii. Moisture content test
   iv. Strength test (Compression test & Shear test)
   v. Permeability test
3. Mould preparation
   i. Straight pipe
   ii. Bent pipe
   iii. Dumble
   iv. Gear blank
4. Gas cutting and welding
5. Manual metal arc welding
   i. Lap joint
   ii. Butt joint
6. Injection moulding
7. Blow moulding
8. Simple models using sheet metal operations
9. Study of deep drawing and extrusion operations
10. Study of Basic powder compaction and sintering
11. Study of TIG/MIG Welding
12. Study of Resistance Spot Welding
13. Study of Brazing and soldering
14. Study of Plastic Moulding Process.

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

- Design and manufacture simple patterns
- Control sand properties in foundry
- Operate arc welding, gas welding and resistance welding equipment
- Use blow moulding and injection moulding equipment

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-I Semester		L	T	P	C
		0	0	3	1.5
THEORY OF MACHINES LAB					

Course Objectives:

- To evaluate performance of a Hartnell governor
- To determine the frequencies of vibration in case of free and forced vibrations of a spring- mass system and whirling speed of a shaft
- To determine motion characteristics of a slider crank mechanism and cam-follower mechanism
- To demonstrate various mechanical power transmission devices / components like screw jack and gears.

1. To determine whirling speed of shaft theoretically and experimentally.
2. To determine the position of sleeve against controlling force and speed of a Hartnell governor and to plot the characteristic curve of radius of rotation.
3. To analyses the motion of a motorized gyroscope when the couple is applied along its spin axis
4. To determine the frequency of undamped free vibration of an equivalent spring mass system.
5. To determine the frequency of damped force vibration of a spring mass system
6. To study the static and dynamic balancing using rigid blocks.
7. To find the moment of inertia of a flywheel
8. To plot follower displacement vs cam rotation for various Cam Follower systems.
9. To plot slider displacement, velocity and acceleration against crank rotation for single slider crank mechanism/Four bar mechanism
10. To find coefficient of friction between belt and pulley.
11. To study simple and compound screw jack and determine the mechanical advantage, velocity ratio and efficiency
12. To study various types of gears- Spur, Helical, Worm and Bevel Gears

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

- Evaluate performance of a Hartnel governor
- Determine the frequencies of vibration in case of free and forced vibrations of a spring- mass system and whirling speed of a shaft
- Determine motion characteristics of a slider crank mechanism and cam-follower mechanism
- Demonstrate various mechanical power transmission devices / components like screw jack and gears.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-I Semester		L	T	P	C
		0	0	4	2
VEHICLE DESIGN AND ANALYSIS LAB					

Course Objectives:
1. To familiarize the students to use modelling software for modelling engine components.
2. To design chassis components with dimensions and strength requirements.
3. To learn the use of standard practices in modelling of components.
4. The use of modelling software to control the quality of the final engineered product.
5. To visualize the complete assembly of the various system.

PART-A - CHASSIS DESIGN EXPERIMENTS (At least 6 experiments)
1. Design and Analysis of frame.
2. Design and Analysis of clutch assembly
3. Design and Analysis of constant mesh gearbox.
4. Design and Analysis of Propeller shaft with universal joint.
5. Design and Analysis of rear axle.
6. Design and Analysis of steering system.
7. Design and Analysis of suspension system.
8. Design and simulation of Differential.
9. Design and simulation of Epicyclic (Gear box).

PART-B – COMPUTATIONAL EXPERIMENTS
Simulation of fluid flow with specific application to

(i) Manifolds,

(ii) After treatment devices and

(iii) Vehicle Aerodynamics

Course Outcomes:
Students will be able to visualize the automotive components with the help of modelling software.

i. Make the modifications instantly if required at the initial stage itself.
ii. Demonstrate the knowledge on designing components to withstand the loads and deformations.
iii. Synthesize, analyze and document the design of the various components.
iv. Demonstrate the ability to use engineering techniques for developing vehicle components with industry standards.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

		L	T	P	C
III Year-I Semester		**2**	**0**	**0**	**0**
INDIAN TRADITIONAL KNOWLEDGE					

Course Objectives:

To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system

Thecourseaimoftheimportingbasicprincipleofthirdprocessreasoningandinference sustainability is at the course of Indian traditional knowledge system

To understand the legal frame work and traditional knowledge and biologicaldiversityact2002 and geographical indication act2003

The courses focus on traditional knowledge and intellectual property mechanism of traditional knowledge and protection

To know the student traditional knowledge in different sector

Course Outcomes:

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

- Understand the concept of Traditional knowledge and its importance
- Know the need and importance of protecting traditional knowledge
- Know the various enactments related to the protection of traditional knowledge
- Understand the concepts of Intellectual property to protect the traditional knowledge

UNIT I

Introduction to traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, and the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-à-vis formal knowledge

UNIT II

Protection of traditional knowledge: the need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

UNIT III

Legal framework and TK: A: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act,2006, Plant Varieties Protection and Farmers RightsAct,2001(PPVFR Act); B: The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016.Geographical indications act 2003.

UNIT IV

Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional Knowledge.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

UNIT V

Traditional knowledge in different sectors: Traditional knowledge and engineering, Traditional medicine system, TK and biotechnology, TK in agriculture, Traditional societies depend on it for their food and health care needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK.

REFERENCEBOOKS:

1) Traditional Knowledge Systemin India, byAmitJha,2009.
2) Traditional Knowledge System and Technology in India by Basanta Kumar Mohanta and Vipin Kumar Singh, PratibhaPrakashan2012.
3) TraditionalKnowledgeSysteminIndiabyAmitJhaAtlanticpublishers,2002
4) "Knowledge Traditions and Practices of India "Kapil Kapoor, Michel Danino

e-Resources:

1) https://www.youtube.com/watch?v=LZP1StpYEPM
2) http://nptel.ac.in/courses/121106003/

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-II Semester		L	T	P	C
		3	0	0	3
AUTOMOBILE COMPONENTS AND CHASSIS DESIGN					

Course Objectives:

- To make students familiar with the constructional details of chassis and components
- To understand about various steering systems, steering linkages and steering gear boxes
- To understand the principle of suspension system
- To learn the gear box design
- To learn the principles of CVT

UNIT I

Chassis and Vehicle Overall

Center of Gravity and handling properties –Body weight & Body center gravity – Mass Moment of Inertia. Vehicle Frame: Study of Loads –Moments and Stresses on Frame Members. Design of Frames for Passenger and Commercial Vehicle.

UNIT II

Steering Design:

Rack & Pinion: Advantages & Disadvantages, Configurations, Steering gear, manual with side tie rod take-off, Steering gear, manual with centre tie rod take-off Recirculating Ball type: Advantages & Disadvantages, Steering Gear, Power Steering Systems: Hydraulic, Electro-Hydraulic and Electrical systems and Steering Kinematics: Maximum displacement of Rack, Calculation of inner and outer wheel angles, Length of Tie rod.

UNIT III

Suspension System:

Wheel travel requirement, Sprung & un-sprung mass distribution, Calculation of Tyre rolling radius, checking of camber change & Toe Change, front view swing arm length, side view swing arm length, Calculation of Jacking force & its effects on suspension, Camber change rate, Wheel base and wheel track change, Anti Dive and Anti- squat considerations

UNIT IV

Gearbox Design:

In-line shaft arrangement, Internal gear arrangement, Face-dog selectors, Bearing arrangement, Crown wheel and pinion layout, Differential location and type, Transverse-shaft arrangement, Selector system, Selector interlock system, Lubrication method and Gearbox casing.

UNIT V

Continuous Variable Transmission (CVT):

Tuning of CVT: Speed & Power- Shift speed, engagement speed, power curves; Drive ratio & efficiency; Driven (secondary) clutch; Driving (primary) clutch; Pressure Spring; Fly weight System, Belt, and Gearing.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

TEXT BOOKS:

1. Automotive Chassis by Jonsen Reimpell, Butterworth Heinemann Pub, 2001
2. Clutch Tuning Hand Book by Olav Aaeen, for serious racers and one who wants more performance from their variable ratio belt transmission.

REFERENCES:

1. Automotive Chassis Volume 1 by Giancarlo Genta & Lorenzo Morello, Springer, 2009
2. Manual Gear Box Design by Alec Stokes, SAE International, Butterworth Heinemann Pub, 1992.

Course Outcomes: After the completion of the course, students should be able to

- Design the frames for the passenger and Commercial vehicles
- Understand the different steering systems design
- Summarize the need for suspension systems and its types

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-II Semester		L	T	P	C
		3	0	0	3
AUTOMOBILE TRANSMISSION SYSTEMS					

OBJECTIVES:

- To know about the various components in transmission system and drive line units of automobiles.
- To learn the working principle of transmission system and hydrodynamic transmission.
- The students able to know about the various automatic transmission systems in a vehicle.
- The students able to know the applications of automatic transmission in a vehicle.
- To know about the hydrostatic drive principle and working of electric drive in a vehicle.

UNIT- I HYDRODYNAMIC TRANSMISSION

Fluid coupling-working principle and Constructional details, Torque capacity and Performance characteristics. Reduction of drag torque in fluid coupling. Torque converter-working principle and constructional details, performance characteristics.

UNIT-II EPICYCLIC GEARBOXES

Requirements of Epicycle gear system, Epicycle gearbox working and operation and Constructional details. Principle of Planetary gear trains - Wilson Gear box, Hydraulic Control system for Automatic Transmission.

UNIT-III AUTOMATIC TRANSMISSIONS APPLICATION

Need for automatic transmission, “Turbo glide” Transmission, Continuously Variable Transmission (CVT) – Types and of a typical CVT and applications, Automatic Transmissions.

UNIT-IV HYDROSTATIC TRANSMISSION

Hydrostatic drive- various types of hydrostatic systems – Principles of Hydrostatic drive system. Advantages and limitations. Comparison of hydrostatic drive with hydrodynamic drive, construction and working of typical Janny hydrostatic drive.

UNIT V ELECTRIC DRIVE

Electric drive, layout of electric drive, types- Principle of early and modified Ward Leonard Control System-Advantages & limitations. Comparison of early and modified ward Leonard control system. Maintenance of transmission system

TEXT BOOKS:

- Heldt, P.M., "Torque converters", Chilton Book Co., 1962.
- Newton and Steeds, "Motor vehicles", Illiffe Publishers, 1985.
- Devaradjane. Dr. G., Kumaresan. Dr. M., "Automobile Engineering", AMK Publishers, 2013.
- A Text book of Auto Transmission and Electrical systems by K.S Raghu Ram.
- Automotive Transmissions Fundamentals, Selection, Design and Application 2011. Naunheimer, H., Bertsche, B., Ryborz, J., Novak, W.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

REFERENCES:

- SAE Transactions 900550 & 930910.
- Hydrostatic transmissions for vehicle applications, I Mech E Conference, 1981
- Crouse, W.H., Anglin, D.L.," Automotive Transmission and Power Trains
- construction", McGraw-Hill, 1976.
- Heinz Heisler, "Advance vehicle Technology", Butterworth-Heinemann, 2002

Course Outcomes:

- Understand the concept of hydrodynamic transmissions.
- Know about the automatic and hydrostatic transmissions and their performance.
- Learn about the epi-cyclic gear boxes and electric drives

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-II Semester		L	T	P	C
		3	0	0	3
VEHICLE BODY ENGINEERING					

Course Objectives:
- To make students familiar with car body details and vehicle aero dynamics
- To understand the bus body details, commercial vehicle details, body materials, trim and mechanisms

UNIT-I: Car Body Details
Types: Saloon, Convertibles, Limousine, Estate Car, Racing and Sports Car. Visibility: Regulations, Driver's Visibility, Tests for Visibility, Methods of Improving Visibility and Space in Cars. Safety: Safety Design, Safety Equipment's for Cars. Car Body Construction; Design Criteria, Prototype Making, Initial Tests, Crash Tests on Full Scale Model, Dummies and Instrumentation

UNIT-II: Vehicle Aerodynamics
Objectives. Vehicle Drag and Types; Various Types of Forces and Moments, Effects of Forces and Moments, Side Wind Effects on Forces and Moments, Various Body Optimization Techniques for Minimum Drag, Wind Tunnel Testing: Flow Visualization Techniques, Scale Model Testing, Component Balance to Measure Forces and Moments.

UNIT-III: Bus Body Details
Types: Mini Bus, Single Decker, Double-Decker, Two Level and Articulated Bus. Bus Body Layout; Floor Height, Engine Location, Entrance and Exit Location, Seating Dimensions. Constructional Details: Frame Construction, Double Skin Construction, Types of Metal Sections used, Regulations, Conventional and Integral Type Construction.

UNIT-IV: Commercial Vehicle Details
Types of Body; Flat Platform, Drop Side, Fixed Side, Tipper Body, Tanker Body, Light Commercial Vehicle Body Types. Dimensions of Driver's Seat Relation to Controls. Drivers Cab Design.

UNIT-V: Body Materials, Trim and Mechanisms
Steel Sheet, Timber, Plastic, GRP, Properties of Materials; Corrosion, Anticorrosion Methods. Selection of Paint and Painting Process. Body Trim Items. Body Mechanisms

Text Books
1. James E Duffy, "Modern Automotive Technology", Goodheart-Wilcox; Seventh Edition, 2011
2. Jack Erjavec, "Automotive Technology – A systems approach", Cengage Learning, 2009,

Reference Books:
1. Geoff Davies, Materials for Automotive Bodies, Elsevier, Butterworth Heinemann, ISBN 0 7506 5692 1, 2003
2. Body Engineering, S. F. Page
3. Automotive Chassis – P.M. Heldt, Chilton & Co. 1952

Course Outcomes: After the completion of the course, the students should be able to
- Understand car body details and vehicle aero dynamics
- Learn the bus body details, commercial vehicle details, body materials, trim and mechanisms

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-II Semester		L	T	P	C
		3	0	0	3
CFD FOR AUTOMOBILE APPLICATIONS (PROGRAM ELECTIVE-II)					

Course Objectives:

- To get conversant with the governing equations in CFD and its application areas
- To understand Elliptic, Parabolic and Hyperbolic partial differential equations and solve the linear equations.
- To analyze the CFD problem by Finite difference and Finite volume methods and apply different computational Techniques.

UNIT-I

Introduction: Philosophy of Computational Fluid Dynamics (CFD), Impact of CFD and its use as research and design tool. Application areas: Automobile & Engine, Civil engineering, Environmental, Naval Architecture.

Governing Equations of fluid dynamics: Derivation, discussion of their physical meaning, models of the flow, substantial derivative, Divergence of a velocity, Navier-Stokes Equation, Physical boundary conditions, Forms of governing equation suited to CFD

UNIT-II

Mathematical behavior of Partial Differential Equations: Classification of Quasi-Linear PDE, The Eigenvalue Method, Hyperbolic, parabolic & Elliptic equations.

Solution of System of Linear Equations: Algorithms for the solution of linear problems; awareness of typical applications for such software and practical issues associated with implementation. Efficient direct and iterative solution algorithms for large, sparse, linear equation systems.

UNIT-III

Finite difference discretization: Basic aspects of discretization, finite difference method, difference equations, Polynomial Approach; Explicit and Implicit schemes, stability analysis; Grid transformations, transformation of equations

Basic Computational Techniques: Lax-Wendroff Technique, Mac Cormack's Technique, Space Marching, Relaxation Technique, Alternating direction implicit method.

UNIT-IV

Basics of Finite Volume Methods: Finite volume discretization, Approximation of Surface Integrals, Approximation of Volume Integrals, Interpolation schemes, Upwind Interpolation, Linear Interpolation, Quadratic Upwind Interpolation, and Higher-Order Schemes.

Applications of Finite Volume Methods: One-dimensional steady state diffusion, Steady one-dimensional convection and diffusion, Assessment of the central differencing scheme for convection-diffusion problems and TDMA algorithm.

UNIT-V

Introduction to finite element method: Basics of finite element method, stiffness matrix, Iso-parametric elements, Formulation of finite elements for one dimensional flow and heat transfer problems.

CFD applied to Automobiles: Introduction of automobile parts and its aerodynamics design analysis. Advantages of the CFD used in automobile. Case studies.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

Text Books:

1. Computational Fluid Dynamics the Basics with Applications, John D Anderson, Jr., McGraw Hill Book Company.
2. An Introduction to Computational Fluid Dynamics: The Finite Volume Method, H K Versteeg, W Malalasekera, Pearson Education Ltd

References:

1. Numerical Heat Transfer and Fluid Flow, Suhas V Patankar, Hemisphere Publishing Co.
2. Fundamentals of Computational Fluid Dynamics, Tapan K. Sengupta, Universities Press.
3. Computational Method for Fluid Dynamics, Joel H. Ferziger and Milovan Peric, 3rd Edition, Springer, 2002.
4. Computational Fluid Mechanics and Heat Transfer, Dale A. Anderson, John C. Tannehill and Richard H. Pletcher,2nd Edition, Taylor and Francis, 1984.

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

- Familiarize with the governing equations in CFD and its application areas
- Understand Elliptic, Parabolic and Hyperbolic partial differential equations and solve the linear equations.
- Analyse the CFD problem by Finite difference method and apply different computational Techniques.
- Analyse the CFD problem by Finite volume method and understand different applications
- Familiarize with finite element method and applications of CFD in the design of automobiles.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-II Semester		L	T	P	C
		3	0	0	3
CONDITION MONITORING (PROGRAM ELECTIVE-II)					

Course Objectives:

- To understand the types of maintenance used and its significance, role of condition-based maintenance in industries, familiarize with different condition monitoring techniques and its advantages in industries.
- To implement the basic signal processing techniques.
- To understand the role of vibration monitoring, its methodology and its use in condition monitoring of rotating and reciprocating machines.
- To understand the significance of mechanical fault diagnosis and non-destructive testing techniques in monitoring and maintenance.
- To study condition monitoring of rolling element bearing, gears and tool condition monitoring techniques in machining.

UNIT – I

Introduction to maintenance and condition-based maintenance, Definition, system approach, objectives, responsibilities of maintenance department, maintenance strategies, principles of maintenance, concepts of maintainability, availability and reliability, implementation of CBM, comparison of CBM with other maintenance techniques and case studies (overview). Introduction to condition monitoring, basic concept, techniques - visual monitoring, temperature monitoring, vibration monitoring, lubricant monitoring, crack monitoring, thickness monitoring, noise and sound monitoring.

UNIT – II

Basic signal processing techniques Probability distribution and density, Fourier analysis, Hilbert Transform, Cestrum analysis, Digital filtering, Deterministic / random signal separation, Time-frequency analysis. Wavelet Transform Introduction to Wavelets, Continuous Wavelet Transform (CWT), Discrete Wavelet Transform (DWT), Wavelet Packet Transform (WPT), types of wavelets –Haar wavelets, Shannon wavelets, Meyer wavelets, Daubechies wavelets, Coffman wavelets and applications of wavelets.

UNIT - III

Vibration Monitoring, Introduction, vibration data collection, techniques, instruments, transducers, selection, measurement location, time domain analysis, frequency domain analysis, time-frequency domain analysis and commonly witnessed machinery faults diagnosed by vibration analysis.
Rotating and reciprocating machines, Vibration signals from rotating and reciprocating machines – signal classification, signals, generated by rotating machines, signals generated by reciprocating machines.

UNIT – IV

Mechanical fault diagnosis, Wear monitoring and lubricant analysis - sources of contamination, techniques, Spectrometric, Oil Analysis Procedure (SOAP) and ferrography. Non-destructive testing techniques, Measurement of surface and subsurface flaws – liquid penetrant inspection, eddy current inspection, radiographic inspection, ultrasonic inspection.

UNIT – V

Condition monitoring of rolling element bearings and gear, Introduction, construction, types of faults, rolling element bearing diagnostics and gear diagnostics. Tool wear monitoring, Introduction, techniques and case studies.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

TEXT BOOKS:

1. Robert Bond Randall – Vibration-Based Condition Monitoring – Industrial, Aerospace and Automotive applications, John Wiley & Sons Ltd., 2011
2. R.A.Collacot – Mechanical Fault Diagnosis – Chapman and Hall Ltd., 1977.
3. ISTE Course material on Condition Monitoring.
4. R.C.Mishra, K.Pathak – Maintenance Engineering and Management, Prentice Hall of India Pvt. Ltd., 2002.
5. K. P. Soman, K. I. Ramachandran, N. G. Resmi – Insight into wavelet from theory to practice, Third Edition, Prentice Hall of India,

REFERENCES BOOKS:

1. John S. Mitchell, Introduction to Machinery Analysis and Monitoring, Penn Well Books, 1993.
2. Elsevier-“Hand book of Condition Monitoring” ELSEVIER SCIENCE
3. R.A. Collacott, “Vibration monitoring and diagnosis”, Wiley, 1979.
4. Rao J.S. “Vibratory Condition Monitoring of Machines”, CRC Press, 2000.
5. “Condition Monitoring manual”, National Productivity Council, New Delhi.

Course Outcomes: At the end of this course the student shall be able to:

- Understand the types of maintenance used and its significance, role of condition-based maintenance in industries, familiarize with different condition monitoring techniques and its advantages in industries.
- Implement the basic signal processing techniques.
- Understand the role of vibration monitoring, its methodology and its use in condition monitoring of rotating and reciprocating machines.
- Understand the significance of mechanical fault diagnosis and non-destructive testing techniques in monitoring and maintenance.
- Study condition monitoring of rolling element bearing, gears and tool condition monitoring techniques in machining.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-II Semester		L	T	P	C
		3	0	0	3
NOISE, VIBRATIONS AND HARSHNESS (PROGRAM ELECTIVE-II)					

Course Objectives:

- To acquire the knowledge in basic of vibration and noise
- To understand the effect of noise a human comfort and environment
- To know the methods of vibration and noise measurement.

UNIT I

FUNDAMENTALS OF ACOUSTICS AND NOISE, VIBRATION

Theory of Sound—Predictions and Measurement, Sound Sources, Sound Propagation in the Atmosphere, Sound Radiation from Structures and Their Response to Sound, General Introduction to Vibration, Vibration of Simple Discrete and Continuous Systems, Random Vibration, Response of Systems to Shock, Passive Damping

UNIT II

EFFECTS OF NOISE, BLAST, VIBRATION, AND SHOCK

General Introduction to Noise and Vibration Effects on People and Hearing Conservation, Sleep Disturbance due to Transportation Noise Exposure, Noise-Induced Annoyance, Effects of Infrasound, Low-Frequency Noise, and Ultrasound on People, Auditory Hazards of Impulse and Impact Noise, Effects of Intense Noise on People and Hearing Loss, Effects of Vibration on People, Effects of Mechanical Shock on People, Rating Measures, Descriptors, Criteria, and Procedures for Determining Human Response to Noise.

UNIT III

VEHICLE NOISE AND VIBRATION—SOURCES, PREDICTION, AND CONTROL

Introduction to Vehicle Noise and Vibration Sources, Internal Combustion Engine Noise Prediction and Control—Diesel, Exhaust and Intake Noise and Acoustical Design of Mufflers, Tire/Road Noise—Generation, Measurement, and Abatement, Aerodynamic Sound Sources in Vehicles—Prediction and Control, Transmission and Gearbox Noise and Vibration Prediction and Control, Brake Noise Prediction and Control.

UNIT IV

VEHICLE INTERIOR NOISE AND VIBRATION SOURCES - PREDICTION AND CONTROL

Introduction to Vehicle Interior Noise and Vibration Sources, Automobile, Bus, and Truck Interior Noise and Vibration Prediction and Control, Noise and Vibration in Off-Road Vehicle Interiors-Prediction and Control,

UNIT V

NOISE AND VIBRATION TRANSDUCERS, SIGNAL PROCESSING, AND MEASURING TECHNIQUES

Introduction to Noise and Vibration Transducers, Measuring Equipment, Measurements, Signal Acquisition, and Processing, Acoustical Transducer Principles and Types of Microphones, Vibration Transducer Principles and Types of Vibration Transducers, Sound Level Meters, Noise Dosimeters, Analyzers and Signal Generators, System for Data Acquisition, Noise and Vibration Measurements, Noise and Vibration Data Analysis, Calibration of Measurement Microphones, Calibration of Shock and Vibration Transducers, Metrology and Traceability of Vibration and Shock Measurements.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

TEXT BOOKS:

1. Clarence W. de Silva, "Vibration Monitoring, Testing, and Instrumentation ",CRC Press, 2007
2. David A.Bies and Colin H.Hansen "Engineering Noise Control: Theory and Practice "Spon Press, London, 2009

REFERENCES:

1. Allan G. Piersol ,Thomas L. Paez "Harris' Shock and Vibration Handbook", McGraw-Hill , New Delhi, 2010
2. Colin H Hansen "Understanding Active Noise Cancellation" , Spon Press , London 2003
3. Matthew Harrison "Vehicle Refinement: Controlling Noise and Vibration in Road Vehicles ", Elsevier Butterworth-Heinemann, Burlington, 2004

Course Outcome:

At the end of the course, the student will understand the sources, effects, prediction, control techniques, measurement techniques of noise, vibration pertaining to an automobile.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-II Semester		L	T	P	C
		3	0	0	3
MEASUREMENTS AND CONTROL SYSTEMS (PROGRAM ELECTIVE-II)					

Course Objectives:
- To impart knowledge of architecture of the measurement system
- To deliver the different working principles of mechanical measurement system.
- To study concept of mathematical modelling of the control system.
- To acquaint with control system under different time domain.

UNIT-I
Introduction: Significance of Mechanical Measurements, Classification of measuring instruments, generalized measurement system, types of inputs: Desired, interfering and modifying inputs.
Static characteristics: Static calibration, Linearity, Static Sensitivity, Accuracy, Static error, Precision, Reproducibility, Threshold, Resolution, Hysteresis, Drift, Span & Range.
Errors in measurement: Types of errors, Effect of component errors, Probable errors.
Displacement Measurement: Transducers for displacement, displacement measurement, potentiometer, LVDT, Capacitance Types, Nozzle Flapper Transducer

UNIT-II
Strain Measurement: Theory of Strain Gauges, gauge factor, temperature Compensation, Bridge circuit, orientation of strain gauges for force and torque, Strain gauge-based load cells and torque sensors.
Measurement of Angular Velocity: Tachometers, Tacho generators, Digital tachometers and Stroboscopic Methods.
Acceleration Measurement: theory of accelerometer and vibrometers, practical accelerometers, strain gauge based and piezoelectric accelerometers

UNIT-III
Pressure Measurement: Elastic pressure transducers viz. Bourdon tubes, diaphragm, bellows and piezoelectric pressure sensors, High Pressure Measurements, Bridge man gauge.
Vacuum measurement: Vacuum gauges viz. McLeod gauge, Ionization and Thermal Conductivity gauges.
Flow Measurement: Bernoulli flowmeters, Ultrasonic Flowmeter, Magnetic flow meter, Rota meter.
Temperature Measurement: Electrical methods of temperature measurement Resistance thermometers, Thermistors and thermocouples, Pyrometers.

UNIT-IV
Sensitivity analysis of sensor-influence of component variation, Signal conditioning: Amplifier, Conversion, Filtering, Impedance Buffering, Modulation / Demodulation, Linearization, Grounding and Isolation Introduction to control systems, Classification of control system. Open loop and closed loop systems. Mathematical modelling of control systems, concept of transfer function, Block diagram algebra.

UNIT-V
Transient and steady state analysis of first and second order system: Time Domain specifications. Step response of second order system. Steady-state error, error coefficients, steady state analysis of different type of systems using step, ramp and parabolic inputs.
Stability analysis: Introduction to concepts of stability, The Routh criteria for stability, Experimental determination of frequency response, Stability analysis using Root locus, Bode plot and Nyquist Plots, State space modeling, Process control systems, ON-OFF control. P-I-D Control.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

Text Books:

1. Measurement Systems: Applications and Design, by EO Doebelin,5 th Edition, McGraw Hill
2. Mechanical Engineering Measurements, A K Sawhney, Dhanpat Rai& Sons, New Delhi
3. Instrumentation & Mechanical Measurements, A K Thayal
4. Control System Engineering by Nagrath IJ and Gopal M, Wiley Eastern Ltd.
5. Modem Control engineering: by K Ogata, Prentice Hall

References:

1. Control systems by Dhanesh Manik, Cengage Learning.
2. Engineering Metrology and Measurements by N V Raghavendra and L Krishnamurthy, Oxford University Press.
3. Instrumentation and Control System, W. Bolton, Elsevier.
4. Experimental Methods for Engineers by J P Holman, McGraw Hills Int. Edition.
5. Engineering Experimentation by EO Doebelin, McGraw Hills Int. Edition.
6. Mechanical Measurements by S P Venkateshan, Ane books, India

Course Outcomes: After the completion of the course, the students should be able to

- Classify various types of static characteristics and types of errors occurring in the system.
- Select proper measuring instrument for linear and angular displacement.
- Learn about pressure and temperature measurement.
- Analyze error and differentiate various types of control systems and time domain specifications.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-II Semester		L	T	P	C
		0	0	3	1.5
AUTO SCANNING & VEHICLE TESTING LAB					

Course Objective: To impart to the learner the skills to analyze engine and to study its performance, wheel balancing and alignment machines.

1. Computerized engine analyzer study and practice.
2. Computerized wheel balancing machine study and practice.
3. Two-wheeler chassis dynamometer study and practice
4. Study of wind tunnel -determining of coefficient of drag for a given automobile model.
5. Road worthiness test a) Acceleration b) Gradeability c) Maximum speed d) Constant speed fuel consumption (High way drive) e) city drive fuel consumption tests.
6. Head light focusing test.
7. Visibility test.
8. Braking distance test.
9. Drawings of automobile bodies -light and heavy vehicles for different seating capacities.
10. Dimensional drawings of bus depots and service station workshop layouts.

Course outcomes: The students completing the course will be able to understand automotive scan tools and diagnostic equipment for fault diagnosis and troubleshooting.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-II Semester		L	T	P	C
		0	0	3	1.5
VEHICLE MAINTENANCE LABORATORY					

COURSE OBJECTIVES:

- To impart the fundamental knowledge in evaluation and maintenance.
- To know about the various methods of maintaining vehicles and their subsystems.

STUDY EXPERIMENTS:

1. Study and layout of an automobile repair, service and maintenance shop.
2. Safety aspects with respect to man, machine and tools.
3. General procedures for servicing and maintenance schedule.
4. Fault diagnosis and service of transmission system
5. Fault diagnosis and service of Electrical system like battery, starting system, charging system, lighting system etc.
6. Fault diagnosis and service of vehicle air conditioning system

LIST OF PRACTICAL EXPERIMENTS

1. Minor and major tune up of gasoline and diesel engines.
2. Calibration of Fuel injection pump.
3. Cylinder reboring - checking the cylinder bore, Setting the tool and reboring.
4. Calibration of fuel injection nozzle and tester
5. Removal and fitting of tire and tube.
6. Fault diagnosis of ignition system and spark plug cleaner & tester
7. Adjustment of pedal play in clutch, brake, hand brake lever and steering wheel.
8. Wheel alignment procedure for servicing and maintenance.
9. Fault diagnosis of brake/clutch
10. Calibration of head lamp aligner
11. Calibration of Re-facer of valve.

Course Outcomes: At the completion of the course, the student should be able to

- Acquire the fundamental knowledge in evaluation and maintenance.
- Understand the various methods of maintaining vehicles and their subsystems.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-II Semester		L	T	P	C
		0	0	3	1.5
VEHICLE EVALUATION LAB					

Course objectives: To make the learner understand the various standards used for testing of vehicles

(Note: Minimum 6 Experiments)
(Demonstration of these standards for the identified tests also permitted)

1. Brake Performance Evaluation for 4 -Wheelers (as per IS 11852-2001, Part 1 to 8, and IS 11852-2003, Part 9) Brake Performance
2. Gradeability Test for all Vehicles (as per AIS 003:1999 & IS 13988-2002)
3. Coast Down Test for all Vehicles (as per IS 14785-2000)
4. Pass-by Noise Level Measurement Test for all vehicles (as per IS 3028-1998)
5. Interior Noise Level Measurement Test for N2 / N3 and M2 / M3 category of vehicles (as per AIS 020)
6. Constant Speed Fuel Consumption
   As per IS 10881-1994 for 2-Wheelers
   As per AIS 054 for 3-Wheelers
   As per IS 11921-1993 for Other than 2-Wheelers
7. Speedometer Calibration (as per IS 11827-2008 for all Vehicles)
8. Turning Circle Diameter Check for all vehicles other than 2- Wheelers (as per IS 12222-2011)
9. Steering Effort Measurement for all vehicles other than 2- Wheelers (as per IS 11948-1998)
10. Hood Latch Test (for all four wheelers fitted with a front bonnet) (as per IS 14226-1995)
11. Odometer Calibration (as per IS 11850:1986) for all vehicles
12 Stationary Noise Level Measurement (as per ISO 5130:1982(E), IS 10399:1998 for all vehicles
13. Tell Tale Symbols Checks (as per AIS: 071-2009)
14. Cooling Performance Trials (as per IS 14557-1998) for all vehicles fitted with water cooled engines other than 2 and three wheelers
15. Range Test for LPG / CNG fuelled vehicles (as per AIS 055) Physical Verification Tests for All type of vehicles (as per CMVR)
16. Vehicle Weighment for all vehicles (as per IS 11825-1986) Wheel Guard Measurement for Passenger Cars (as per IS 13943-1994)
17. Safety Checks for CNG / LPG fuelled vehicles (as per AIS 026, AIS 027 and AIS 028)
18. Requirement of Temporary Cabin for Drive Away Chassis (as per AIS 070)
19. Electro-Magnetic Radiation from Automotive Vehicles (as per AIS 004)
20. Acceleration performance of 2-wheeler (as per IS 10407: 1998)
21. Acceleration performance of automotive vehicles other than 2 & 3 wheelers (as per IS 11851:1986)
22. Fuel efficiency test Highway fuel consumption City fuel consumption
23. Maneuverability on Serpentine Course
24. Spark arrester devices as per petroleum rule 2002-chapter 10 ESC evaluation
25. Bus body code as per AIS:052
26. Truck code as per AIS:093
27. Ambulance code as per AIS:125
28. School Bus as per AIS:063
29. Sleeper Coach as per AIS:119
30. Double Decker Buses as per AIS:139

Course outcomes: Students at the end of the course will be able to gain knowledge on various standards used for testing of vehicles.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-II Semester		L	T	P	C
		0	0	4	2
SOFT SKILS					

Course Outcomes:

- At the end of the Course, the Student will be able to:
- Use language fluently, accurately and appropriately in debates and group discussions
- Use their skills of listening comprehension to communicate effectively in cross-cultural contexts.
- Learn and use new vocabulary.
- Write resumes, project reports and reviews.
- Exhibit interview skills and develop soft skills.

1. Group Discussion–dynamics of group discussion, Lateral thinking, Brain storming.
2. Interview Skills– concept and process, pre-interview planning, opening strategies, answering strategies, interview through tele and video-conferencing.
3. Meetings-making meeting effective, chairing a meeting, decision-making, seeking opinions, interrupting and handling interruptions, clarifications, closure, Negotiation skills.
4. Listening comprehension – Achieving ability to comprehend material delivered at relatively fasted; comprehending spoken material in Standard Indian English, British English, and American English.
5. Cross-Cultural Communication / Non-Verbal Communication, Problems of Language, Lack of Language equivalency/ difficulties in using English.
6. Vocabulary building, Creativity in using Advertisements, Case Studies etc.
7. Personality Development: Decision-Making, Problem Solving, Goal Setting, Time Management & Positive Thinking.
8. Resume writing –structure and presentation, planning, defining the career objective.
9. Writing Skills–Letter writing, Email etiquette; Essays for competitive examinations, Analyzing newspaper articles.
10. Technical Report Writing/Project Proposals–Types of format sand styles, subject matter– organization, clarity,
11. Coherence and style, planning, data-collection, tools, analysis- Progress and Project Reports.

REFERENCES:

1. M.Ashraf Rizvi, “Effective Technical Communication”, Tata McGraw-Hill Publishing Company Ltd. 2005.
2. Andrea J.Rutherford, “Basic Communication Skills for Technology”, 2nd Edition, Pearson Education, 2007.
3. Meenakshi Raman & Sangeeta Sharma, “Technical Communication”, Oxford University Press, 2011.
4. DELTA ’skey to the Next Generation TOEFL Test: “Advanced Skill Practice,” New Age

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-II Semester		L	T	P	C
		2	0	0	0

TECHNICAL PAPER WRITING & IPR

Course Outcomes (COs)

After the completion of this course, the students will be able to:

- Understand the purpose and importance of technical report writing.
- Identify different types of technical reports and their specific requirements.
- Utilize various data visualization techniques to present technical information effectively.
- Understand the Intellectual Property (IP) Concepts.
- Understand the Procedure for grants of patents.

UNIT-I
Introduction to Technical Report Writing
Definition and importance of technical reports, Characteristics of effective technical writing
Differences between technical and nontechnical writing
Types of Technical Reports
Formal reports, Informal reports Progress reports Feasibility studies Laboratory reports Research reports

UNIT-II
Data Visualization Techniques Graphs, charts, and tables best practices for presenting data visually
Choosing the appropriate visualization for different types of data Citation and Referencing
Importance of citing sources in technical writing Overview of common citation styles (e.g., APA, IEEE, Chicago) Guidelines for citing various types of Sources (e.g., books, journals, websites)

UNIT-III
Interpretation and Report Writing
Effective technical writing, how to write a report, Paper Developing a Research Proposal, Format of Research proposal, presentation and assessment by a review committee. Interpretation of Data and Paper Writing – Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, When and Where to publish? Ethical issues related to publishing, Plagiarism and Self-Plagiarism.

UNIT-IV
IPR Nature of Intellectual Property: Patents, Designs, Trade and Copyrights. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property, Procedure for grants of patents, Patenting under PCT

UNIT-V
Intellectual Patent Rights and Developments Scope of Patent Rights. Licensing and transfer of technology, Patent information and databases, Geographical Indications. New Developments in IPR: Administration of Patent System, New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge, Case Studies, IPR and IITs / NITs/ IIITs.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

TEXT BOOKS

1. Kompal Bansal &Parshit Bansal,"Fundamentals of IPR for Beginner's", 1st Edition, BS Publications, 2016.
2. Kothari,C.,R., "Research Methodology", 3rd Edition, New Age International, 2017.
3. Ranjit Kumar, "Research Methodology – A Step by Step for Beginner's", 2nd Edition, Pearson, Education, 2016.
4. Ramappa,T., "Intellectual Property Rights Under WTO", 2nd Edition, S Chand, 2015

References

1. Kompal Bansal & Parshit Bansal, "Fundamentals of IPR for Beginner's", 1st Ed., BS Publications, 2016.
2. William S. Pfeiffer and Kaye A. Adkins, "Technical Communication: A Practical Approach", Pearson.
3. Ramappa,T., "Intellectual Property Rights Under WTO", 2nd Ed., S Chand, 2015

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

IV Year-I Semester		L	T	P	C
		3	0	0	3
AUTOMOBILE SAFETY (PROGRAM ELECTIVE-III)					

Course objective: To impart the knowledge of the safety concepts, comfort and convenience system, driver assistance system and other requirements of automotive safety**.**

UNIT-I INTRODUTION
Design of the body for safety, energy equation, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, concept of crumble zone, safety sandwich construction. Safety standards.

UNIT-II
SAFETY AND FATIGUE ASPECTS
Design of body, forces in roll over, head on impact, plastics collapse and analysis, fatigue and vibration, test on box sections, structural vibration.

UNIT-III
SAFETY CONCEPT
Active safety: driving safety, conditional safety, perceptibility safety, operating safety- crash safety
Passive safety: exterior safety, interior, safety, deformation behavior of vehicle body, speed and acceleration characteristics of passenger compartment on impact.
Safety equipment: Seat belt, regulations, automatic seat belt tightened system, Anti-locking braking system (ABS), Speed limiting device (SLD)
Automatic traction control, automatic vehicle stability control, Collapsible steering system, tilt able steering system, air bags system, bumpers design for safety.

UNIT-IV
COLLISION WARNING AND AVOIDANCE
Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection, braking system interactions.

UNIT-V
COMFORT AND CONVENIENCE SYSTEM
Steering and mirror adjustment system, central locking system, tyre pressure monitoring and control system, rain sensor system, automatic climate control systems, environment information system.

TEXT BOOKS:

1. Bosch /Automotive Handbook/5th edition /SAE publication
2. Junsz Pawlowski/Vehicle Body Engineering/Business book limited, 1989.
3. Ronald K Jurgen/Navigation and Intelligent Transportation Systems-Progress in Technology/ Automotive Electronics Series, SAE. USA,1998.

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

- Understand the design of the automobile body for safety and different safety standards
- Design the automobile body with respect to safety and fatigue aspects
- Understand active and passive safety systems
- Familiarize with different comfort and convenience systems

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

IV Year-I Semester		L	T	P	C
		3	0	0	3
AUTOMOBILE HVAC (PROGRAM ELECTIVE-III)					

Course objective: To impart the knowledge of the refrigeration, Psychrometry, Air Conditioning Systems, Air-distribution systems and air-conditioning service and control required for automobiles.

UNIT I

Refrigeration

Introduction - Methods of refrigeration, Vapour compression refrigeration system - Vapour absorption refrigeration system, commonly used refrigerants, Refrigerants used in automobile air conditioning

UNIT II PSYCHROMETRY

Psychrometric properties, tables, charts - Psychrometric processes - Comfort charts – Factors affecting comfort - Effective temperature - Ventilation requirements

UNIT III

Air Conditioning Systems

Classification and layouts - Central / unitary air conditioning systems - Components like compressors, evaporators, condensers, expansion devices, fan blowers, heating systems.
Load Analysis: Outside & inside design consideration - Factors affecting load on refrigeration & air conditioning systems - Cooling & heating load calculations - Load calculations for automobiles - Effect of air conditioning load on engine performance.

UNIT IV

Air Distribution Systems

Distribution duct system, sizing, supply / return ducts - Types of grills, diffusers, ventilation, air noise level - Layout of duct systems for automobiles and their impact on load calculations.
Air Routine & Temperature Control: Objectives - evaporator air flow - Through the ASHRAE-circulating unit - Automatic temperature control - Controlling flow - Control of air handling systems.

UNIT V

Air Conditioning Service and Control

Air conditioner maintenance & service - servicing heater system - Removing & replacing components.
Air Conditioning Control: Common control such as thermostats- Humidity status – Control dampers - Pressure cut-outs and relays

Text Books

1. Mark Schnubel, “Automotive heating and Air conditioning”, Today’s Technician, 5th edn,2013
2. C. P. Arora, Refrigeration & Air Conditioning
3. William. H. Cruise – Automotive Air-Conditioning. Mc-Graw Hill

References

1. Steven Daly, “Automotive Air Conditioning and Climate Control Systems”, Butterworth - Heinemann; 1 edition (2006)
2. Norman C. Harris, “Modern Air-Conditioning Practice”, McGraw-Hill Education 1984
3. R.J. Dossat, “Principles of Refrigeration”, Prentice Hall, 5th ed, 2001.

4. Paul Lung, "Automotive Air Conditioning", C.B.S. Publisher & Distributor, (Delhi. 1991)

Course Outcomes: After the completion of the course, students will be able to

- Understand the basic of refrigeration and vapour compression refrigeration system.
- Familiarize with the concepts of Psychrometry, Air Conditioning and Air Distribution systems
- Understand the various aspects of Air conditioning Maintenance, Service and Control.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

IV Year-I Semester		L	T	P	C
		3	0	0	3
SPECIAL PURPOSE VEHICLES (PROGRAM ELECTIVE-III)					

Course Objectives:

- To enhance the knowledge of the students about the various equipment's used in earth moving, applications.
- To understand the construction and working of the vehicle for constructional application
- To describe the working nature of farm equipment's based on their application.
- To discriminate the various industrial vehicles based on the purpose.
- To acquire the knowledge on the functioning of military vehicle.

UNIT I
EARTH MOVING EQUIPMENTS

Construction layout, capacity and applications of dumpers, articulated haulers, front-end loaders, backhoe loaders, bulldozers, scrappers, motor graders, skid steer loaders, excavator, hydraulic shovels, bucket conveyors, surface miners – high wall Miners. Selection criteria of prime mover for dumpers.

UNIT II
CONSTRUCTIONAL EQUIPMENTS

Construction layout, capacity and applications of cranes – types, Articulated Trucks, concrete ready mixer, trenchers, Asphalt Pavers, road recliners, Compactors – types, draglines, drillers, borewell machine.

UNIT III
FARM EQUIPMENTS

Classification of tractors – Main components of tractor. Working attachment of tractors – Auxiliary equipment –- Top lifting harvesters. General description, working, specification and functions paddy harvesting machines, Sugarcane harvesting, feller bunchers, forest machines.

UNIT IV
INDUSTRIAL VEHICLES

Constructional features, capacity and working of fork lifts, Utility vehicles, towing vehicles, man-lift chassis, scissor lift trucks, material handlers, recliners, Street sweepers.

UNIT V
MILITARY AND COMBAT VEHICLES

Special features and constructional details of Main Battle tank, gun carriers, transport vehicles, Armoured vehicle-launched bridge, amphibious bridging vehicle, communication vehicles.

TEXT BOOKS:

1. Abrosimov. K. Bran berg.A. andKatayer.K."Road making Machinery ", MIR Publishers, Moscow, 1971.
2. Rodichev and G.Rodicheva, Tractor and Automobiles, MIR Publishers, 1987.
3. Wong.J.T., "Theory of Ground vehicles ", John Wiley & Sons, New York, 1987.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

REFERENCES:

1. B. Geleman and M. Moskovin, Farm tractors, MIR publishers, Moscow.
2. Bart H Vanderveen, Tanks and Transport vehicles, Frederic Warne and Co ltd., London.
3. Kolchin, A., and V.Demidov, Design of Automotive Engines for Tractor, MIR Publishers, 1972.
4. Peurifoy R.L "Construction Planning, Equipment and Methods", Tata McGraw-Hill, New Delhi, 2002.
5. Wong J "Terramechanics and Off-Road Vehicle Engineering", Butterworth-Heinemann, 2009

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

- Acquire the knowledge about the various equipments used in earth moving, applications.
- Understand the construction and working of the vehicle for constructional application
- Describe the working nature of farm equipment's based on their application.
- Discriminate the various industrial vehicles based on the purpose.
- Acquire the knowledge on the functioning of military vehicle.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

IV Year-I Semester		L	T	P	C
		3	0	0	3
ENGINE MANAGEMENT SYSTEMS (PROGRAM ELECTIVE-III)					

Course objective: To impart the knowledge of the Spark Ignition and compression ignition engine management systems, engine diagnostics procedure, Computerized electronic fuel injection systems and air flow fuel management strategies.

UNIT-I
Computerized Electronic Fuel Injection: Engine Input Sensors Coolant & Intake Temperature, Crankshaft Position, Camshaft Position, Manifold Absolute Pressure, Throttle Position, Oxygen, Air/Fuel Ratio, Knock Speed& Distance, Battery & Switches Output Devices -Relays, Injector Sequencing & Management, Ignition Operation, Idle Air Control, EGR, EVAP, Waste gate Solenoids, Torque Converter & Speed Control, Malfunction Indicator Light

UNIT -II
Speed Density/Mass Air Flow Fuel Management Strategies: Key ON Mode, Crank Mode, Open & Closed Loop, Wide-Open Throttle, Adaptive Memory Cells, Cruise &Deceleration, Wide-Open Throttle, Key OFF Mode Fuel Injection Systems -Electronic Fuel Systems, Computer Self-Diagnostic Circuits, Electronic Throttle Actuator Control Systems, Fuel Control, Fuel Supply System Control, Injection System Inspection and Maintenance.

UNIT -III
Engine Diagnostic Procedures: Fuel System testing, On Board Diagnostics, Monitored &Non-Monitored Circuits, Diagnostic Trouble Codes, Digital Engine Control System: Open loop and close loop control system, engine cooling and warm up control, idle speed control, acceleration and full load enrichment, deceleration fuel cut-off. Fuel control maps, open loop control of fuel injection and closed loop lambda control exhaust emission control, on-board diagnostics, diagnostics, future automotive electronic systems, Electronic dash board instruments – Onboard diagnosis system.

UNIT -IV
SI Engine Management: Feedback carburetor system, throttle body injection, multi-point fuel injection and direct injection systems, Layout and working of SI engine management systems like Bosch Mono- Jetronic, L-Jetronic and LH-Jetronic. Group and sequential injection techniques. Advantages of electronic ignition systems. Types of solid-state ignition systems and their principle of operation, Contactless electronic ignition system, electronic spark timing control. Three-way catalytic converter, conversion efficiency versus lambda.

UNIT - V
CI Engine Management: Fuel injection system, parameters affecting combustion, noise and emissions in CI engines. Pilot, main, advanced, post injection and retarded post injection. Electronically controlled Unit Injection system. Layout of the common rail fuel injection system. Working of components like fuel injector, fuel pump, rail pressure limiter, flow limiter, EGR valve control in electronically controlled systems.

TEXT BOOKS:
1. Diesel Engine Management by Robert Bosch, SAE Publications, 3rd Edition, 2004
2. Gasoline Engine Management by Robert Bosch, SAE Publications, 2nd Edition, 2004

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

REFERENCES:

1. Halderman, J. & Linder, J. (2012). Automotive Fuel and Emissions Control Systems (3rd Edition) Upper Saddle River, NJ: Pearson Education.
2. Halderman, J. D. (2011). Diagnosis &Troubleshooting of Automotive Electrical, Electronic, &Computer Systems (6th Edition) Upper Saddle River, NJ: Pearson Education.
3. Understanding Automotive Electronics – Bechfold SAE 1998
4. Automobile Electronics by Eric Chowanietz SAE
5. Fundamentals of Automotive Electronics - V.A.W.Hilliers - Hatchin, London
6. Automobile Electrical & Electronic Equipment (2000) Young, Griffitns - Butterworths, London.
7. Understanding Automotive Electronics, William B. Ribbens, 5th Edition, Newnes, Butterworth–Heinemann, 2001.
8. Automotive Computers & Digital Instrumentation – Robert N. Brandy, Prentice Hall, 2004
9. The Fundamentals of Electrical Systems - John Hartly - Longman Scientific & Technical, 2002.

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

- Acquire the knowledge about Computerized Electronic Fuel Injection, Battery & Switches Output Devices
- Understand the Air Flow Fuel Management Strategies and Electronic fuel systems.
- Describe the Engine Diagnostic Procedures Fuel System testing.
- Analyze the spark ignition and compression ignition management systems.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

IV Year-I Semester		L	T	P	C
		3	0	0	3
AUTOMOBILE CERTIFICATION AND HOMOLOGATION (PROGRAM ELECTIVE-IV)					

Course objective: To understand the classifications of vehicles, different Vehicle Performance and Road and Track Testing procedures and analyses the procedures for Active and Passive Safety testing and components testing.

UNIT I
Introduction
Specification & Classification of Vehicles, Regulations overview (ECE, FMVSS, AIS, CMVR, ADR), Type approval and Conformity of Production, Engine and Vehicle specifications, Two-Wheeler certification.

UNIT II
Vehicle Performance Testing
Methods for evaluating vehicle performance- energy consumption (well to wheel) in conventional automobiles, performance, emission and fuel economy, Operation at full load and part load conditions, effect of vehicle condition, tyre and road condition and traffic condition and driving habits on fuel economy, Gradeability test, Turning circle diameter test, Steering Impact test, Steering effort test.

UNIT III
Road and Track Testing:
Initial inspection, PDI, engine running in and durability, intensive driving, maximum speed and acceleration, brake testing on the road, hill climbing, handling and ride characteristics, safety, mechanism of corrosion, three chamber corrosion testing, wind tunnel testing, road testing, test tracks, coast down test, Portable exhaust measurement system.

UNIT IV
Active and Passive Safety Testing:
Wheel rim testing for cornering and radial fatigue, Fire resistance test, bumper test, crash test, side impact test, rollover test, safety belt test, Airbag test, Safety belt anchorages, Seat anchorages & head restraints, Occupant protection Impact test, Side door intrusion test.

UNIT V
Components Testing:
Size and Ply rating of tyres, Safety Glasses, Wind screen wiping system, Hydraulic brake hose, Hydraulic brake fluid, Rear view mirror specification (Exterior), Rear view mirror specification (Interior), Wheel rims, Wheel nut, Wheel discs & hub caps, Safety belt assemblies, Safety belt anchorages, Seat anchorages & head restraints, door locks & door retention.
Overview and study of testing standards like; AIS testing standards, Euro Standards, SAE standards. ISO26262 standards for functional safety of electrical and/or electronic systems in automobiles.

TEXT BOOKS
1. Raymond M. Brach and R. Matthew Brach, "Vehicle Accident Analysis and Reconstruction Methods", SAE International, 2011
2. Automotive Industry Standards, AIS

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

REFERENCES

1. Ulrich Seiffert and Lothar Wech, "Automotive Safety Handbook", SAE International, 2007
2. ISO Standards, ICS: 43.020, 43.040, 43.100

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

- Understand the specifications and classification of the vehicles
- Understand the methods for evaluating vehicle performance
- Describe the different road and track testing.
- Understand the active and passive safety testing and components testing.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

IV Year-I Semester		L	T	P	C
		3	0	0	3
ELECTRICAL VEHICLES AND HYBRID TECHNOLOGY (PROGRAM ELECTIVE-IV)					

Course Objectives: The course should enable the students to:

- General aspects of Electric and Hybrid Vehicles (EHV), including architectures, modeling, sizing, sub-system design and hybrid vehicle control.

UNIT I INTRODUCTION

Need for hybrid and electric vehicles – main components and working principles of a hybrid and electric vehicles, Different configurations of hybrid and electric vehicles. Comparative study of diesel, petrol, hybrid and electric Vehicles. Advantages and Limitations of hybrid and electric Vehicles. Case study on specification of electric and hybrid vehicles.

UNIT II

DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES

Design requirement for electric vehicles- Range, maximum velocity, acceleration, power requirement, mass of the vehicle. Various Resistance- Transmission efficiency- Electric vehicle chassis and Body Design, Electric Vehicle Recharging and Refueling Systems.

UNIT III

ENERGY SOURCES

Battery Parameters- - Different types of batteries – Lead Acid- Nickel Metal Hydride - Lithium ion- Sodium based- Metal Air. Battery charging- Quick Charging devices. Battery Management System.
Polymer Exchange Membrane Fuel Cell- Characteristics- Half reactions of fuel cell. Cells in series and parallel- water management - Thermal Management.

UNIT IV MOTORS

Characteristics of DC motors (Brush and Brushless), AC single phase and 3-phase motor, PM motors, switched reluctance motors, Motor Drives and speed controllers, Torque Vectoring, Regenerative Braking. Rectifiers, Inverters, DC/AC converters.

UNIT V

SUBSYSTEMS OF HYBRID AND ELECTRIC VEHICLES

Power Split devices for Hybrid Vehicles - Operation modes - Control Strategies for Hybrid Vehicle- Economy of hybrid Vehicles. Choice of Tires.

TEXT BOOKS:

1. Iqbal Husain, “Electric and Hybrid Vehicles-Design Fundamentals”, CRC Press, 2003
2. Mehrdad Ehsani, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles”, CRC Press, 2005.

REFERENCES:

1. James Larminie and John Lowry, “Electric Vehicle Technology Explained “John Wiley & Sons, 2003
2. Lino Guzzella, “Vehicle Propulsion System” Springer Publications, 2005
3. Ron Hokinson, “Light Weight Electric/ Hybrid Vehicle Design”, Butterworth Heinemann Publication, 2005

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

Course Outcomes: The students will be able to understand

- Electric and hybrid vehicle operation and architectures
- Design of hybrid and electric vehicles.
- Energy requirement for vehicles.
- Vehicle characteristics, operating modes, and performance parameters of the vehicle
- Different subsystems of hybrid and electric vehicles

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

IV Year-I Semester		L	T	P	C
		3	0	0	3
FACILITIES PLANNING AND MATERIAL HANDLING (PROGRAM ELECTIVE-IV)					

Course Objectives:

- To understand the overall facilities planning process
- To educate product, process and schedule design and their effects on the facility layout
- To introduce concepts of material handling and safety in industries.

UNIT-I Design of layout of factories, Office, Storage area, Consideration of facilities for working people, Storage facilities and general equipment for amenities of working people – Product, Process and combination layout –Systematic layout planning, Design of Assembly lines, Line balancing methods.

UNIT II
Computer applications in layout designs, Environmental aspects like lighting, Ventilation, dust control, humidity. Different type of Plant services like steam compressed air.

UNIT III
Plant safety, Elements off Industrial safety- Causes and prevention of accidents – Pollution and environmental consideration.

UNIT IV
Introduction, Material Handling Process, Material Handling principles, Classification of Material Handling Equipment, Relationship of material handling to plant layout.

UNIT V
Basic Material Handling systems: Selection, Material Handling method- path, Equipment, function-oriented systems.
Methods to minimize cost of material handling- Maintenance of Material Handling Equipment's, Safety in handling, Ergonomics of Material Handling equipment. Design, Miscellaneous equipment

Text books:

1. A W Peymberton, Plant layout and Material Handling, John Wiley
2. James A Apple, Plant layout and Material Handlin, Krieger Pub Co,1998
3. John A Sehbin, Plant layout and Material Handling-
4. K C Arora & Shinde, Aspects of Material handling, Lakshmi Publications.
5. P B Mahapatra, Operations Management, PHI, 2010

Course Outcomes: The students will be able to

- Assess the value of facility planning on the strategy of a firm
- Develop a systematic plant layout
- Know the environmental and economic aspects in facilities planning
- Understand various material handling systems

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

IV Year-I Semester		L	T	P	C
		3	0	0	3
RAPID PROTOTYPING (PROGRAM ELECTIVE-IV)					

Course Objectives: The course should enable the students to understand and use techniques for processing of CAD models for rapid prototyping and apply fundamentals of rapid prototyping techniques.

UNIT I
Introduction: Introduction to Prototyping, Traditional Prototyping vs Rapid Prototyping (RP), Classification of Rapid Manufacturing Processes: Additive, Subtractive, Formative, Generic RP process.

UNIT II
CAD Modelling and Data Processing for RP: CAD model preparation, Data interfacing: formats (STL, SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP), conversation, validity checks, repair procedures; Part orientation and support generation, Support structure design, Model Slicing algorithms and contour data organization, direct and adaptive slicing, Tool path generation.

UNIT III
RP Processes-1: Process Physics, Tooling, Process Analysis, Material and technological aspects, Applications, limitations and comparison of various rapid manufacturing processes. Photo polymerization (Stereo-lithography (SL), Micro-stereo lithography), Powder Bed Fusion (Selective laser Sintering (SLS),

UNIT IV
RP Processes-2: Electron Beam melting (EBM), Extrusion-Based RP Systems (Fused Deposition Modelling (FDM), 3D Printing, Sheet Lamination (Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC), Beam Deposition (Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD).

UNIT V
Errors in RP Processes: Pre-processing, processing, post-processing errors, Part building errors in SLA, SLS.

Reference Books:

1. Chua C K, Leong K F, Chu S L, Rapid Prototyping: Principles and Applications in Manufacturing, World Scientific.
2. Gibson D W Rosen, Brent Stucker., Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer.
3. Noorani R, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley & Sons.
4. Liou W L, Liou F W, Rapid Prototyping and Engineering applications: A tool box for prototype development, CRC Press.
5. Kamrani A K, Nasr E A, Rapid Prototyping: Theory and practice, Springer,

Course Outcomes:
On completion of this course students will be able to:
- Understand and use techniques for processing of CAD models for rapid prototyping.
- Understand and apply fundamentals of rapid prototyping techniques.
- Use appropriate tooling for rapid prototyping process.
- Utilize rapid prototyping techniques.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

IV Year-I Semester		L	T	P	C
		3	0	0	3
LEAN MANUFACTURING (PROGRAM ELECTIVE-V)					

Course Objectives: To understand the Lean and factory simulation, and comparison of Lean manufacturing with other methods and also the tools of Lean manufacturing, Value Stream mapping and best practices in Lean manufacturing.

Unit I
Introduction to Lean and Factory Simulation: History of Lean and comparison to other methods – The 7 Wastes, their causes and the effects – An overview of Lean Principles / concepts / tools – Stockless Production.

UNIT-II The Tools of Lean Manufacturing: Continuous Flow – Continuous Flow Manufacturing and Standard Work Flow – 5S and Pull Systems (Kanban and Con WIP systems) – Error Proofing and Set-up Reduction – Total Productive Maintenance (TPM) – Kaizen Event examples. Toyota production systems, Ford production systems

Unit- III
Value Stream Mapping – Current state: Preparation for building a Current State Value Stream Map – Building a Current State Map (principles, concepts, loops, and methodology) – Application to the factory Simulation scenario.

Unit - IV
Value Stream Mapping – Future State: Key issues in building the Future State Map – Process tips in building the map and analysis of the customer loop, supplier loop, manufacturing loop and information loop – Example of completed Future State Maps – Application to factory simulation – Implementation of lean practices – Best Practices in Lean Manufacturing.

UNIT-V
TQM Tools and Techniques: The seven traditional tools of quality, new management tools, and six sigma: Concepts, methodology, applications to manufacturing, service sector including IT, Bench marking, Reason to bench mark, Bench marking process, FMEA, Stages, and Types. Quality circles, Quality Function Deployment (QFD), Taguchi quality loss function, TPM, Concepts, improvement needs, Cost of Quality, Performance measures

Text Books:

1. Womack J. P., Jones D.T. and Roos D. – 'The Machine that Changed the World: The Story of Lean Production' – Simon & Schuster, New York – 1996
2. Liker J. K. – 'Becoming Lean' – Industrial Engineering and Management Press – 1998
3. Womack J. P. and Jones D. T. – 'Lean Thinking' – Simon & Schuster, USA – 1996
4. Rother M. and Shook J. – 'Learning to See' – The Lean Enterprise Institute, Brookline, USA – 2003

Course Outcomes: After the completion of the course, the student will be able to
- Understand the basics of Lean manufacturing and comparison with other methods of manufacturing
- Learn the tools used in Lean Manufacturing and total predictive maintenance
- Appreciate the value stream mapping and Application to the factory Simulation scenario.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

IV Year-I Semester		L	T	P	C
		3	0	0	3
VEHICLE DESIGN DATA CHARACTERISTICS (PROGRAM ELECTIVE-V)					

Course Objectives: To understand the fundamentals of vehicle design, power estimation and performance. To determine the gear ratios and determine the characteristics of different vehicle sub systems.

UNIT-I
INTRODUCTION: Fundamentals of vehicle design, laden and un-laden weights, Front and rear axle weights, Frontal Area, maximum speed, maximum acceleration, gradeability in different gears, vehicle center of gravity

UNIT-II
POWER ESTIMATION: Analysis of air and rolling resistances at various vehicle speeds - Calculation, Estimation of Driving force, determination of power requirement at different loads and speeds, Maximum Power calculation, numerical.

UNIT-III
PERFORMANCE: Torque and Mechanical Efficiency at different vehicle speeds, Pressure – Volume diagram, Calculation of Mean Effective Pressure and Engine Cubic Capacity, numerical.

UNIT-IV
VELOCITY, ACCELERATION AND TURNING MOMENT: Connecting rod length to Crank Radius Ratio, Piston Velocity and Acceleration against Crank Angle plot, Gas force, inertia force and Resultant force against Crank Angle plot, Turning Moment and Side Thrust against Crank Angle plot.

UNIT-V
POWER TRAIN: Determination of Gear Ratios, Acceleration and Gradeability, Numerical on Vehicle performance.
OVERALL VEHICLE PERFORMANCE: Characteristics of different vehicle sub systems.

TEXT BOOKS:
1. Heinz Heisler Advanced Vehicle Technology, 2nd edition, Publisher Elsevier -2002.
2. Hilliers Fundamentals of Motor Vehicle Technology 6th Edition, Publisher Oxford - 2014

REFERENCES:
1. N. K. Giri, Automotive Mechanics, Khanna Publishers, New Delhi, 2005.
2. Heldt, P.M., High Speed Combustion Engines, Oxford and I.B.H. Publishing Co. Kolkata, 2002.

Course Outcomes: After the completion of the course, the student will be able to
- Understand the fundamentals of vehicle design, power estimation and performance.
- Learn the velocity, acceleration and turning moment and analyses corresponding plots
- Appreciate the overall performance and determination of gear ratios.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

IV Year-I Semester		L	T	P	C
		3	0	0	3
RELIABILITY ENGINEERING (PROGRAM ELECTIVE-V)					

Course Objectives:

- To comprehend the concept of Reliability
- Derive the expressions for probability of failure, Expected value and standard deviation of Binominal distribution, Poisson distribution, normal distribution and Weibull distributions.
- Formulating expressions for Reliability analysis of series-parallel and non-series parallel systems
- Deriving expressions for Time dependent and Limiting State Probabilities using Markov models.

UNIT –I

Rules for combining probabilities of events, Definition of Reliability. Significance of the terms appearing in the definition. Probability distributions: Random variables, probability density and distribution functions. Mathematical expectation, Binominal distribution, Poisson distribution, normal distribution, Weibull distribution.

UNIT – II

Hazard rate, derivation of the reliability function in terms of the hazard rate. Failures: Causes of failures, types of failures (early failures, chance failures and wear-out failures). Bath tub curve. Preventive and corrective maintenance. Modes of failure. Measures of reliability: mean time to failure and mean time between failures.

UNIT – III

Classification of engineering systems: series, parallel and series-parallel systems- Expressions for the reliability of the basic configurations. Reliability evaluation of non-series-parallel configurations: Decomposition, Path based and cutest based methods, Deduction of the Paths and cut sets from Event tree.

UNIT – IV

Discrete Markov Chains: General modeling concepts, stochastic transitional probability matrix, time dependent probability evaluation and limiting state probability evaluation of one component repairable model. Absorbing states. Continuous Markov Processes: Modeling concepts, State space diagrams, Stochastic Transitional Probability Matrix, evaluating time dependent and limiting state Probabilities of one component repairable model. Evaluation of limiting state probabilities of two component repairable model.

UNIT – V

Approximate system Reliability analysis of Series systems, parallel systems with two and more than two components, Network reduction techniques. Minimal cutest/failure mode approach.

TEXT BOOKS:

1. “Reliability evaluation of Engineering systems”, Roy Billinton and Ronald N Allan, BS Publications.
2. “Reliability Engineering”, Elsayed A. Elsayed, Prentice Hall Publications.

REFERENCES:

1. “Reliability Engineering: Theory and Practice”, By Alessandro Birolini, Springer Publications.
2. “An Introduction to Reliability and Maintainability Engineering”, Charles Ebeling, TMH Publications.
3. “Reliability Engineering”, E. Balaguruswamy, TMH Publications.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

Course Outcomes: Upon the completion of this course, the student will be able to

- Apply fundamental knowledge of Reliability to modeling and analysis of series parallel and non-series parallel systems.
- Understand Discrete Markov Chains and Continuous Markov Processes
- Analyze the Reliability analysis of Series systems, parallel systems and Network reduction techniques

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

IV Year-I Semester		L	T	P	C
		3	0	0	3
SMART, AUTONOMOUS AND CONNECTED VEHICLES (PROGRAM ELECTIVE-V)					

Course Objectives: To understand the concept of automobile electronics, Connected and Autonomous Vehicle Technology, Sensor Technology, Advanced Driver Assistance system, Troubleshooting and Maintenance of Advanced Driver Assistance Systems and Non-Passenger Car Advanced Driver Assistance Systems and Autonomous Operation.

UNIT-I

Introduction – Concept of Automobile Electronics - History and Evaluation - Infotainment, Body, Chassis, and Powertrain Electronics - Advanced Driver Assistance Electronic Systems.
Connected and Autonomous Vehicle Technology: Basic Control System Theory applied to Automobiles-Overview of the Operation of ECUs-Basic Cyber-Physical System Theory and Autonomous Vehicles-Role of Surroundings Sensing Systems and Autonomy- Role of Wireless Data Networks and Autonomy

UNIT-II

Sensor Technology for Advanced Driver Assistance Systems: Basics of Radar Technology and Systems - Ultrasonic Sonar Systems - Lidar Sensor Technology and Systems - Camera Technology - Night Vision Technology - Other Sensors - Use of Sensor Data Fusion - Integration of Sensor Data to On-Board Control Systems, overview on wireless Technology.

UNIT-III: Wireless Networking and Applications to Vehicle Autonomy: Basics of Computer Networking – the Internet of vehicles- Wireless Networking Fundamentals - Integration of Wireless Networking and On-Board Vehicle Networks - Review of On-Board Networks – Use & Function

Advanced Driver Assistance System Technology: Basics of Theory of Operation – Applications: Legacy, New and Future - Integration of ADAS Technology into Vehicle Electronics - System Examples - Role of Sensor Data Fusion

UNIT-IV: Connected Car Display Technology: Center Console Technology - Gauge Cluster Technology - Heads-Up Display Technology - Warning Technology – Driver Notification
Impaired Driver Technology: Driver Impairment Sensor Technology - Sensor Technology for Driver Impairment Detection -Transfer of Control Technology
Vehicle Prognostics Technology: Monitoring of Vehicle Components - Basic Maintenance - End-of-Life Predictions - Advanced Driver Assistance System Sensor Alignment and Calibration.

UNIT-V: Autonomous Vehicles: Driverless Car Technology - Moral, Legal, Roadblock Issues - Technical Issues - Security Issues
Troubleshooting and Maintenance of Advanced Driver Assistance Systems: Failure Modes – Self Calibration - Sensor Testing and Calibration - Redundant Systems - Standard Manufacturing Principles.
Non-Passenger Car Advanced Driver Assistance Systems and Autonomous Operation: Uber/Lyft – Disruptive Technology –Trucking – Farming – Mining - Shipping & Rail – Military

Text books:

1. G. Mullett, *Wireless Telecommunications Systems and Networks,* Thomson – Delmar Learning, ISNB#1-4018-8659-0,2006
2. G. Mullett, *Basic Telecommunications: The Physical Layer*, Thomson – Delmar Learning, ISBN#1-4018-4339-5, 2003

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

Course Outcomes: Upon the completion of this course, the student will be able to

- Understand the concept of Automobile Electronics and Connected and Autonomous Vehicle Technology
- Learn Sensor Technology for Advanced Driver Assistance Systems, Troubleshooting and Maintenance of Advanced Driver Assistance Systems and Non-Passenger Car Advanced Driver Assistance Systems and Autonomous Operation

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

IV Year-I Semester		L	T	P	C
		3	0	0	3

PROFESSIONAL ETHICS

Course objectives

- To understand the moral values that ought to guide the engineering profession,
- To create an awareness on Engineering Ethics and Human Values.
- To inspire Moral and Social Values and Loyalty.
- To appreciate the rights of others.
- Resolve the moral issues in the profession
- To justify the moral judgment concerning the profession.
- Intended to develop a set of beliefs, attitudes, and habits that engineers should display concerning morality

UNIT I: Engineering Ethics

The History of Ethics-Purposes for Engineering Ethics-Engineering Ethics- Consensus and Controversy –Professional and Professionalism –Professional Roles to be played by an Engineer –Self Interest, Customs and Religion-Uses of Ethical Theories-Professional Ethics-Types of Inquiry – Engineering and Ethics-Kohlberg‟s Theory – Gilligan‟s Argument –Heinz‟s Dilemma.

UNIT II: Engineering as Social Experimentation

Comparison with Standard Experiments – Knowledge gained – Conscientiousness – Relevant Information – Learning from the Past – Engineers as Managers, Consultants, and Leaders – Accountability – Role of Codes – Codes and Experimental Nature of Engineering.

UNIT III: Engineers' Responsibility for Safety and Risk

Safety and Risk, Concept of Safety – Types of Risks – Voluntary v/s Involuntary Risk- Short Term v/s long term Consequences- Expected Probability- Reversible Effects- Threshold Levels For Risk- Delayed v/s Immediate Risk- Safety and the Engineer – Designing for Safety – Risk-Benefit Analysis-Accidents.

UNIT IV: Engineers' Responsibilities and Rights

Collegiality-Techniques for Achieving Collegiality –Two Senses of Loyalty- obligations of Loyalty-misguided Loyalty – professionalism and Loyalty- Professional Rights –Professional Responsibilities – confidential and proprietary information-Conflict of Interest-solving conflict Problems – Self- interest, Customs and Religion- Ethical Egoism-Collective bargaining-Confidentiality-Acceptance of Bribes/Gifts-when is a Gift and Bribe- examples of Gifts v/s Bribes-problem solving-interests in other companies- Occupational Crimes-industrial espionage-Price fixing-endangering lives- Whistle Blowing-types of whistles blowing-when should it be Attempted- preventing whistle blowing.

UNIT V: Global Issues

Globalization- Cross-culture Issues-Environmental Ethics-Computer Ethics- computers as the Instrument of Unethical behavior-computers as the object of Unethical Acts-autonomous Computers-computer codes of Ethics- Weapons Development-Ethics and Research-Analyzing Ethical Problems in Research-Intellectual Property Rights.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

Course outcomes:

Upon successful completion of the course, students will be able to:

- Realize the importance of ethical behavior in business
- Handle ethical issues in business operations correctly and confidently
- Exhibit ethical behavior towards employees
- Become individuals with desired qualities and humanistic approach

TEXT BOOKS

1. Engineering Ethics & Human Values" by M.Govindarajan, S.Natarajan and V.S.SenthilKumar-PHI Learning Pvt. Ltd-2009.
2. Professional Ethics and Morals" by Prof.A.R.Aryasri, Dharanikota Suyodhana-Maruthi Publications.
3. "Professional Ethics and Human Values" by A.Alavudeen, R.Kalil Rahman and M. Jayakumaran- Laxmi Publications
4. Professional Ethics and Human Values" by Prof. D.R. Kiran.
5. Indian Culture, Values and Professional Ethics" by PSR Murthy- BS Publication.
6. Ethics in Engineering" by Mike W. Martin and Roland Schinzinger – Tata McGraw-Hill – 2003.
7. Engineering Ethics" by Harris, Pritchard and Rabins, CENGAGE Learning, India Edition, 2009.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

IV Year-I Semester		L	T	P	C
		1	0	2	2
ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING LAB					

Course Objectives: To acquire the knowledge on Artificial Intelligence and Machine Learning

1. Data Preprocessing with Weka or Python
2. Building Decision Trees for Soybean classification model using Weka or Python
3. Generating association rules on Weather data using Weka or Python
4. Exploring machine learning models including classification and clustering using scikit-learn or Weka or Python
5. Build Neural Network Classifier using Weka or Python
6. Supervisory - Perform Data Labelling for various images using object recognition
7. Image Classifier using Tensor Flow or OpenCV
8. Automatic Facial recognition using Microsoft Azure or OpenCV

References:

1. Weka Documentation, https://www.cs.waikato.ac.nz/ml/weka/documentation.html
2. Weka Knowledge Flow, https://www.cs.waikato.ac.nz/~eibe/WEKA_Ecosystem.pdf

Course outcomes: The student will be able to apply the techniques learnt to real-life problems.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-I Semester		L	T	P	C
		3	0	0	3
BASIC AUTOMOBILE ENGINEERING (OPEN ELECTIVE-I)					

Course Objectives:
The course imparts the principles of automobile systems and provides the salient features of safety, emission and service of automobiles.

UNIT – I
Engines – Classification
INTRODUCTION: Components of 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 – engine lubrication, splash and pressure lubrication systems, oil filters, oil pumps – crank case ventilation

UNIT – II
TRANSMISSION SYSTEM: Clutches, principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel – gear boxes, types, sliding mesh, construct mesh, synchro mesh gear boxes, epicyclic gear box, over drive torque converter. propeller shaft – Hotchkiss drive, Torque tube drive, universal joint, differential rear axles – types – wheels and tyres.

UNIT – III
STEERING SYSTEM: Steering geometry – camber, castor, king pin rake, combined angle toe-in, center point steering. types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism, steering gears – types, steering linkages.

UNIT – IV
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, master cylinder, and wheel cylinder tandem master cylinder requirement of brake fluid, pneumatic and vacuum brakes.
ELECTRICAL SYSTEM: Charging circuit, generator, current – voltage regulator – starting system, Bendix drive mechanism solenoid switch, lighting systems, horn, wiper, fuel gauge – oil pressure gauge, engine temperature indicator.

UNIT – V
ENGINE SPECIFICATIONS AND SAFETY SYSTEMS: Introduction- engine specifications with regard to power, speed, torque, no. of cylinders and arrangement, lubrication and cooling.
Safety: Introduction, safety systems - seat belt, air bags, bumper, anti-lock brake system (ABS), wind shield, suspension sensors, traction control, mirrors, central locking and electric windows, speed control.

TEXT BOOKS:
1. Automotive Mechanics – Vol. 1 & Vol. 2 / Kirpal Singh/standard publishers
2. Automobile Engineering / William Crouse/TMH Distributors
3. Automobile Engineering/P. S Gill/S.K. Kataria & Sons/New Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

REFERENCES:

1. Automotive Engines Theory and Servicing/James D. Halderman and Chase D. Mitchell Jr., / Pearson education Inc.
2. Automotive Engineering / K Newton, W. Steeds & TK Garrett/SAE
3. Automotive Mechanics: Principles and Practices/ Joseph Heitner/Van Nostrand Reinhold
4. Automobile Engineering / C Srinivasan/McGraw-Hill.

Course Outcomes:

The student after undergoing the course, shall learn about transmission, steering, suspension, braking and safety and should know the vehicle troubleshooting.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-I Semester		L	T	P	C
		3	0	0	3
AUTOMOBILE MAINTENANCE AND SAFETY (OPEN ELECTIVE-I)					

Course objective: To impart the knowledge of the safety concepts, and electrical and chassis maintenance. To learn about different comfort and safety systems used in automobiles.

UNIT I
INSPECTION SCHEDULE AND MAINTENANCE OF RECORDS
Need for maintenance, types of maintenance: preventive and breakdown maintenance, requirements of maintenance, preparation of check lists. Inspection schedule, maintenance of records, log sheets and other forms, safety precautions in maintenance: general safety, tool safety.

UNIT II
ENGINE MAINTENANCE
Tools used for engine disassembly, dismantling of engine components: cylinder head, valve train, cylinder block, connecting rod, piston and crankshaft assembly; cleaning and inspection of engine components, reconditioning of components, servicing and maintenance of fuel system, engine tune-up, cooling system: water pump, radiator, thermostat. Lubrication system maintenance, anticorrosion and anti-freeze additives

UNIT III
CHASSIS MAINTENANCE
Servicing and maintenance of clutch, gear box, universal joints, propeller shaft, differential system. Service and maintenance of brake – disc and drum brakes, steering wheel and suspension systems, wheel alignment, and vehicle body maintenance

UNIT IV
ELECTRICAL SYSTEM MAINTENANCE
Servicing and maintenance of battery, starter motor, alternator and generator, ignition system lighting system, electric horn, and wiper motor.

UNIT-V
COMFORT AND SAFETY SYSTEMS
Steering and mirror adjustment system, central locking system, tyre pressure monitoring and control system, rain sensor system, automatic climate control systems, environment information system, air bag system, collapsible steering column, anti-lock braking system, electronic brake force distribution.

Text Books:

1. Knott and Phil Knott, “An Introductory Guide to Motor Vehicle Maintenance: Light
2. Vehicles”, EMS publishing, 2010
3. Vehicle Maintenance and Garage Practice by Jigar A Doshi, PHI Pub, 2014.
4. Prasad, Priya and Belwafa Jamel, "Vehicles Crashworthiness and Occupant Protection”, American Iron and Steel Institute, USA
5. JullianHappian-Smith “An Introduction to Modern Vehicle Design” SAE, 2002

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

Reference Books:

1. William H. Crouse and Donald L. Anglin, "Automotive Mechanics", 10th edition, 2007
2. Tim Giles, "Automotive service: Inspection, maintenance and repair", 3rd edition, 2007
3. Jack Erjavec, "Automotive technology: A systems approach", 5th edition, 2009
4. Recent development in Automotive Safety Technology", SAE International Publication. Editor: Daniel J Helt,2013

Course outcomes: After the completion of the course, the student should be able to acquire knowledge of the safety concepts, understand engine maintenance and electrical and chassis maintenance.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-I Semester		L	T	P	C
		3	0	0	3
AUTOMOBILE EMISSIONS AND ITS EFFECTS (OPEN ELECTIVE-I)					

Course objective: To impart the knowledge of different regulatory test procedures, pollutants and particulates. To acquire understanding about SI engine and CI engine emissions and different emission control techniques.

UNIT I
Laws and Regulation: Historical background, regulatory test procedures (European cycles). European statutory limits, Pollutants: Carbon and Nitrogen compounds- (CO.CO_2 NOx), Hydrocarbons. Volatile compounds, evaporative emissions, particulates.

UNIT-II
SI engine emissions: Mechanism & formation of HC, CO and NOx in SI engines. Engine operating variables affecting pollutants.
CI engine emissions: Mechanism & formation of HC, CO and NOx, and Soot in CI engines. Factors affecting emission formation.

UNIT-III
Emission Control Techniques in SI Engines:
Lean burn & stratified charge engines. Multipoint fuel injection and gasoline direct injection systems, exhaust gas composition, catalytic convertors, positive crank case ventilation and evaporative emission control.

UNIT-IV
Emission Control Techniques in CI Engines:
Common rail fuel injection in diesel engines. Post combustion treatments: exhaust gas recirculation, particulate traps, particulates trap regeneration, installation of catalysts in exhaust lines treatment, diesel oxidation converter.

UNIT-V
Health and environmental effects: Effects of HC, CO, NOx, SOx, CO_2 and PM emissions from SI and CI engine on living beings. Effect on environment, Acid rain formation, climate change.

TEXT BOOKS:

1. Internal Combustion Engine Fundamentals/Heywood/Mc Graw Hill
2. Internal combustion engines and air pollution/ Edward Frederic Obert/ Intext Educ. Pub
3. Bosch – Gasoline fuel injection /Bosch Publications
4. Bosch – Diesel fuel injection /Bosch Publications
5. Engine emissions – B. P. Pundir, Narosa Publishers

REFERENCE BOOKS:

1. Automobiles and Pollution /Paul Degobert/ OPHRYS
2. SAE Surface Vehicle Emissions Standards Manual/ Society of Automotive Engineers
3. Automobile Pollution, Concerns, Priorities, and Challenges/ Shyam Kishor Agarwal/ APH Publishing
4. Diesel engine operation manual /V.L. Maleev/CBS Pub

5. Engine emission /Springer and Patterson/Plenum Press
6. Internal Combustion Engines /Heins Aeisth /SAE Publications.

Course outcome: The students completing this course will be in a position to derive various measures to be taken to reduce the exhaust gas pollutants coming out of automobiles to meet the laws and regulations in practice.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-II Semester		L	T	P	C
		3	0	0	3
ALTERNATIVE FUELS FOR AUTOMOBILES (OPEN ELECTIVE-II)					

Course Objectives: To impart the necessity of finding alternative energy sources for automobiles. To understand merits and demerits, performance characteristics of various sources of fuels and their comparison.

UNIT I
CONVENTIONAL FUELS FOR I.C. ENGINES
Petroleum based conventional fuels for SI and CI engine, Demand and Availability of crude oil – vehicle population increase – national and international standards for conventional and alternative fuels.
Desirable characteristics of SI Engine fuels – Petrol – Properties, Specification, chemical structure, Volatility characteristics, knock rating and additives. Desirable characteristics of CI Engine fuels – Diesel – Properties, Specification, chemical structure, Ignition quality, Cetane rating and additives.

UNIT II
ALCOHOLS AS FUELS
Availability of different alternative fuels for engines. Alcohols – Properties, Production methods and usage in engines. Blending, dual fuel operation, surface ignition, spark ignition and oxygenated additives. Performance, combustion and emission Characteristics in engines. Advantages and disadvantages of alcohol fuels

UNIT III
VEGETABLE OILS AND BIODIESEL AS FUELS
Properties of Vegetable oils and biodiesel- Methods of using vegetable oils – Blending, preheating, and emulsification – Preparation of biodiesel from non-edible, edible oil and Algae - Performance, combustion and emission Characteristics in diesel engines. Advantages and disadvantages of Vegetable oils and biodiesel

UNIT IV
HYDROGEN AS FUEL
Hydrogen – Properties, Production methods, storage and safety aspects. Issues & limitation in Hydrogen. Methods of using hydrogen in engines. Performance, combustion and emission Characteristics in engines. Advantages and disadvantages of Hydrogen fuel.

UNIT V
BIOGAS, CNG AND LPG AS FUELS
Biogas, Compressed Natural gas (CNG) and LPG – Properties and production methods. CO_2 and H_2S scrubbing in Biogas, Modifications required for use in Engines- Performance, combustion and emission Characteristics in engines. Advantages and disadvantages of Gaseous fuels. Working of LPG and CNG kits used in automotive engines.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

REFERENCES

1. Arumugam S. Ramadhas, "Alternative Fuels for Transportation" CRC Press, 2011.
2. Ayhan Demirbas and M. Fatih Demirbas, "Algae Energy-Algae as a New Source of Biodiesel", Springer-Verlag London Limited 2010.
3. Ayhan Demirbas, 'Biodiesel A Realistic Fuel Alternative for Diesel Engines', Springer-Verlag London Limited 2008
4. David M. Mousdale, "Introduction to Biofuels", CRC Press, 2015.
5. Ganesan.V., "Internal Combustion Engineering", Tata McGraw-Hill Publishing Co., New Delhi, 2003.
6. Gerhard Knothe, Jon Van Gerpen, Jargon Krahl, The Biodiesel Handbook, AOCS Press Champaign, Illinois 2005.
7. M. K. Gajendra Babu and K. A. Subramanian, "Alternative Transportation Fuels-Utilisation in Combustion Engines", CRC Press, 2013.
8. M.L. Mathur, R.P.Sharma "Internal combustion engines", Dhanpatrai publication, 2003.
9. Richard L Bechtold P.E., Alternative Fuels Guide book, Society of Automotive Engineers, 1997 ISBN 0-76-80-0052-1.

Course Outcomes:

By the end of this course, students will be able to

- Possess a comprehensive understanding of available alternative fuels for IC engines. They will possess complete knowledge on producing different biofuels, modifying them and using them in IC engines
- Acquire the skills in developing new technologies for alternative fuels efficiently in IC engines.
- Demonstrate the importance of using alternative fuels for sustainable energy supply and for emission control in IC engines.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-II Semester		L	T	P	C
		3	0	0	3
VEHICLE STABILITY AND CONTROL (OPEN ELECTIVE-II)					

Course Objectives: To impart the knowledge of vehicle dynamics and tires.

- To analyses longitudinal, lateral and vertical dynamics.
- To perform the mathematical modelling of vehicle.

Unit I: Introduction to vehicle dynamics - Dynamics of the motor vehicle, Vehicle fixed coordinates system, Earth fixed coordinates system, Details of vehicle systems, wheel angles and typical data of vehicles.
Tires - Types, axis system, mechanics of pneumatic tires-tire forces Tire forces and moments, Tire structure, Longitudinal and Lateral force at various slip angles, rolling resistance, Tractive and cornering property of tire. Ride property of tires. Conicity and Ply Steer, Tire models, Estimation of tire road friction.

Unit II: Longitudinal dynamics - Forces and moments on vehicle, Equation of motion, Tire forces, rolling resistance, weight distribution, Tractive effort and Power available from the engine, Calculation of Maximum acceleration Braking torque, Braking Force, Brake Proportioning, Braking Efficiency, Stopping Distance, Prediction of Vehicle performance. ABS, stability control, Traction control.

Unit III: Lateral Dynamics - Steering geometry, Types of steering systems, Fundamental condition for true Rolling, Development of lateral forces. Steady state handling characteristics. Yaw velocity, Lateral Acceleration, Curvature response & directional stability.

Unit IV: Vertical Dynamics - Human response to vibrations, Sources of Vibration, Suspension systems, Functions of suspension system. Body vibrations: Bouncing and pitching. Doubly conjugate points. Body rolling. Roll centre and roll axis, Stability against body rolling.

Unit V: Mathematical Modelling of Vehicle - Quarter car suspension model; Half car suspension model; Full car suspension model for ride and road holding performance considering two-degree freedom model for sprung & un-sprung mass, two-degree freedom model for pitch & bounce and motion of vehicle on undulating road.

Text Books:

1. Thomas D. Gillespie, "Fundamentals of Vehicle Dynamics", 2013, Society of Automobile Engineers Inc., ISBN: 978-1560911999
2. J. Y. Woung, "Theory of Ground Vehicles", John Willey & Sons, NY.
3. Rajesh Rajamani, "Vehicle dynamics and control", Springer publication.

References:

1. J. G. Giles, "Steering, Suspension & Tyres", Ilete Books Ltd., London.
2. W. Steed, "Mechanics of Road Vehicles", Ilete Books Ltd. London.
3. P. M. Heldt , "Automotive Chassis", Chilton Co. NK.
4. Reza N Jazar , "Vehicle Dynamics : Theory and Application", Springer publication

Course Outcomes: After the completion of the course, the student should be able to acquire the knowledge of vehicle dynamics. The student should be able to analyse longitudinal, lateral and vertical dynamics and perform the mathematical modelling of vehicle.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-II Semester		L	T	P	C
		3	0	0	3
ELECTRICAL VEHICLES AND HYBRID TECHNOLOGY (OPEN ELECTIVE-II)					

Course Objectives: The course should enable the students to:

- Study Electric and Hybrid Vehicles (EHV), including architectures, modeling, sizing, sub-system design and hybrid vehicle control.
- Understand about vehicle dynamics,
- Design the required energy storage devices,
- Understand the hybrid electric vehicles.

UNIT I INTRODUCTION

Need for hybrid and electric vehicles – main components and working principles of a hybrid and electric vehicles, Different configurations of hybrid and electric vehicles. Comparative study of diesel, petrol, hybrid and electric Vehicles. Advantages and Limitations of hybrid and electric Vehicles. Case study on specification of electric and hybrid vehicles.

UNIT II

DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES

Design requirement for electric vehicles- Range, maximum velocity, acceleration, power requirement, mass of the vehicle. Various Resistance- Transmission efficiency- Electric vehicle chassis and Body Design, Electric Vehicle Recharging and Refueling Systems.

UNIT III

ENERGY SOURCES

Battery Parameters- - Different types of batteries – Lead Acid- Nickel Metal Hydride - Lithium ion- Sodium based- Metal Air. Battery charging- Quick Charging devices. Battery Management System.
Polymer Exchange Membrane Fuel Cell- Characteristics- Half reactions of fuel cell. Cells in series and parallel- water management - Thermal Management.

UNIT IV MOTORS

Characteristics of DC motors (Brush and Brushless), AC single phase and 3-phase motor, PM motors, switched reluctance motors, Motor Drives and speed controllers, Torque Vectoring, Regenerative Braking. Rectifiers, Inverters, DC/AC converters.

UNIT V

SUBSYSTEMS OF HYBRID AND ELECTRIC VEHICLES

Power Split devices for Hybrid Vehicles - Operation modes - Control Strategies for Hybrid Vehicle- Economy of hybrid Vehicles. Choice of Tires.

TEXT BOOKS:

1. Iqbal Husain, “Electric and Hybrid Vehicles-Design Fundamentals”, CRC Press, 2003
2. Mehrdad Ehsani, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles”, CRC Press, 2005.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

REFERENCES:

1. James Larminie and John Lowry, "Electric Vehicle Technology Explained "John Wiley & Sons, 2003
2. Lino Guzzella, "Vehicle Propulsion System" Springer Publications, 2005
3. Ron Hokinson, "Light Weight Electric/ Hybrid Vehicle Design", Butterworth Heinemann Publication, 2005

Course Outcomes: The students able to understand

- Electric and hybrid vehicle operation and architectures
- Design of hybrid and electric vehicles.
- Energy requirement for vehicles.
- Vehicle characteristics, operating modes, and performance parameters of the vehicle
- Different subsystems of hybrid and electric vehicles

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

IV Year-I Semester		L	T	P	C
		3	0	0	3
AUTOMOBILE SAFETY (OPEN ELECTIVE-III)					

Course objective: To impart the knowledge of the safety concepts, comfort and convenience system, driver assistance system and other requirements of automotive safety**.**

UNIT-I INTRODUTION
Design of the body for safety, energy equation, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, concept of crumble zone, safety sandwich construction. Safety standards.

UNIT-II
SAFETY AND FATIGUE ASPECTS
Design of body, forces in roll over, head on impact, plastics collapse and analysis, fatigue and vibration, test on box sections, structural vibration.

UNIT-III
SAFETY CONCEPT
Active safety: driving safety, conditional safety, perceptibility safety, operating safety- crash safety
Passive safety: exterior safety, interior, safety, deformation behavior of vehicle body, speed and acceleration characteristics of passenger compartment on impact.
Safety equipment: Seat belt, regulations, automatic seat belt tightened system, Anti-locking braking system (ABS), Speed limiting device (SLD)
Automatic traction control, automatic vehicle stability control, Collapsible steering system, tilt able steering system, air bags system, bumpers design for safety.

UNIT-IV
COLLISION WARNING AND AVOIDANCE
Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection, braking system interactions.

UNIT-V
COMFORT AND CONVENIENCE SYSTEM
Steering and mirror adjustment system, central locking system, tyre pressure monitoring and control system, rain sensor system, automatic climate control systems, environment information system.

TEXT BOOKS:
1. Bosch /Automotive Handbook/5th edition /SAE publication
2. Junsz Pawlowski/Vehicle Body Engineering/Business book limited, 1989.
3. Ronald K Jurgen/Navigation and Intelligent Transportation Systems-Progress in Technology/ Automotive Electronics Series, SAE. USA,1998.

Course Outcomes: After the completion of the course, the student will be able to
- Understand the design of the automobile body for safety and different safety standards
- Design the automobile body with respect to safety and fatigue aspects
- Understand active and passive safety systems
- Familiarize with different comfort and convenience systems

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

IV Year-I Semester		L	T	P	C
		3	0	0	3
AUTOMOBILE POWER TRAIN (OPEN ELECTIVE-III)					

Course objective: To impart the knowledge of the combustion in spark ignition and compression ignition engines.
To acquire knowledge on gear trains, propeller shaft, front and rear axles.

UNIT I:

Combustion in I.C Engines – Stages of Combustion in S.I Engines – Phenomenon of Detonation and Pre Ignition – Stages of Combustion in C.I Engines – Diesel Knock – Factors influencing abnormal combustion in S.I Engines – Factors influencing abnormal combustion in C.I Engines – Requirements of S.I. and C.I. Engine combustion chambers – Types of S.I and C.I. engine combustion chambers – S.I. Engine Combustion chambers – Ricardo turbulent, Bath tub, Wedge head, Spheroidal and Hemispherical. C.I Engine Combustion chambers – Direct injection type, pre-combustion chambers and Turbulence chambers and types – Air cell combustion chamber – Relative advantage s and disadvantages.

UNIT II:

Dynamics of moving vehicles-Types of resistances encountered by a vehicle-Road resistance, Gradient resistance, Air Resistance-Traction-Tractive Effort-Simple related problems. Need of a gear box in the transmission system- Types of gear boxes- Principles and operation of sliding mesh-constant mesh-synchromesh gearbox- Types of gear shifting mechanism- Floor shifting mechanism -Column shifting mechanism-working principle of simple epi-cyclic gear train- Principle and working of freewheel unit.

UNIT-III:

Overdrive mechanism- Transfer case – Fluid coupling – Construction and working -Advantages and disadvantages -percentage slip in fluid coupling -Torque converter its principle and working – Principle of automatic transmission system and advantages-CVT-Principle of operation in two-wheeler-advantages and disadvantages. Working principle of AMT (Automated Manual Transmission) with block diagram.

UNIT IV:

Propeller shaft – Function of propeller shaft – slip joint or sliding joint – universal joint -. Types of universal joints- cross type or spider and two yoke type-ball and trunnion type- constant velocity type- Different types of Constant velocity joints. Differential gear-Final drive-purpose of final drive, types of final drive- Bevel, worm and worm wheel, Hypoid gear and Palloid gear-single and double reduction final drives – Four-wheel drive – differential gear – differential lock – self-locking differential – Transaxle.
Unit V: Front axle and rear axle: Live and dead axles – Components of Front axle -stub axle-types of stub axles-Elliot-Reversed Elliot-Lamoine-Reversed Lamoine. Loads on the rear axle-Types of rear axles-semi floating-Three quarter floating-fully floating axles-Axle Housings and types-Split, Banjo and Salisbury Types-Types of drives-Hotchkiss drive, Torque tube drive.
Wheels and tyres: Wheel quality, assembly, types of wheels, wheel rims. Construction of tyres and tyre specifications.

Text Books:

1. Automobile Engineering Vol. I & II by Dr. Kirpal Singh
2. Automotive Mechanics by Heitner
3. Automobile Engineering by G.B.S. Narang
4. Automobile Engineering by R.B.Gupta
5. Automobile Engineering by Banga and Nathun Singh

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

Course objective: After the completion of the course, the student should be able to understand the combustion in spark ignition and compression ignition engines. The student should be able to analyses gear trains, propeller shaft, and front and rear axles.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

IV Year-I Semester		L	T	P	C
		3	0	0	3
IC ENGINES (OPEN ELECTIVE-III)					

Course Objectives:
- To impart the knowledge and providing holistic view on IC Engines and its developments
- To enable the students to calculate the performance and testing of IC engines
- To learn SI & CI fuelling system and combustion behavior and its advancements to meet the stringent emission norms
- Understanding the formation and control strategies of SI and CI Engine emissions

UNIT-I:
Engine Principles: Introduction, Comparison of Air Standard and Actual Cycles, Constructional Details of Four Stroke SI and CI Engines, Working Principle, Actual Indicator Diagram, Two Stroke Engine Construction and Operation, Comparison of Four Stroke and Two Stroke Engine Operation, Firing Order and Its Significance.

UNIT-II:
ENGINE TESTING & PERFORMANCE
Engine Performance Testing & Numerical- methods and Performance Characteristics; Performance Maps. Lubrication and Cooling systems, Introduction to Supercharging and Turbocharging; Introduction to Engine Cooling and Lubrication

UNIT-III:
SI ENGINE COMBUSTION
Carburetor Working Principle, Requirements of an Automotive Carburetor, and types, Fuel Injection Systems; Pre-mixed charge combustion, SI Engine Combustion Conceptual models, Knocking Combustion

UNIT-IV:
CI ENGINE COMBUSTION
Fuel Injection and Spray Structure: Fuel Atomization. Diesel Combustion Process Characterization: Ignition Delay, Effect of Engine and Operational Parameters on Delay, Pre-mixed Combustion and Mixing Controlled Combustion.

UNIT-V:
ADVANCED COMBUSTION MODES
GDI, Flexi Fuel, CAI, Introduction to Low Temperature Combustion Like: Homogeneous Charge Compression Ignition (HCCI), Fuel Stratified Charge combustion/ Reactivity Controlled Compression Ignition (RCCI) and Pre-mixed Charge Compression (PCCI) technologies.

Text Books:
1. IC Engines, M.L. Mathur & R.P. Sharma, Dhanpath Rai & Sons
2. Engine Emissions, Pollutant Formation and Advances in Control Technology, B.P. Pundir, Narosa Publishing House

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

Reference Books:

1. IC Engines Fundamentals, John B. Heywood, Mc Graw Hill Publications
2. Engineering Fundamentals of I C Engines, Wiliard W.Pulkrabek, Prentice Hall Publications

Course Outcomes: At the end of the course, the students should be able to

- Differentiate the ideal, air standard cycles and actual thermodynamic cycles.
- Evaluate the Engine performance based on the experimental data
- Analyse the fuelling system and combustion behaviour of SI engine
- Analyse the fuelling system and combustion behaviour of CI engine
- Explain the formation of emissions and its control strategies of bot SI & CI Engines.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

IV Year-I Semester		L	T	P	C
		3	0	0	3
AUTOMOBILE MATERIALS AND MANUFACTURING TECHNIQUES (OPEN ELECTIVE-IV)					

Course objective: To impart the knowledge of common engineering materials and processes with relevance to automotive applications. The student shall learn about battery materials and technology, primary and secondary processes for automotive applications and futuristic technology and material for automotive applications.

UNIT-I
Introduction to common engineering materials; metallic and non-metallic automotive materials. Materials and processes with relevance to automotive applications. Advanced materials, light weight material, nano material and synthesis and in-situ materials for automotive applications, corrosion, Standards for automotive materials.

UNIT-II
High strength low alloy steels (HSLA), Advanced high strength steels, dual phase steels, martensitic steels, Advanced plastics and composites, Novel material for automotive applications, ultra-light weight material, Graphene - Case studies.

UNIT-III
Battery materials and technology, case studies related to automotive applications. Case studies on crank shaft, connecting rod, piston, gear and gear box, propeller shaft.

UNIT-IV
Primary and secondary processes for automotive applications – casting, forging, heavy and sheet forming, hard and soft machining, moulding, surface modification processes and Heat Treatment, Joining methods for automotive applications. Case studies on Vehicle body materials- G.I and Interstitial Free Steel processes, Power train components -Tailor Welded Blank.

UNIT-V
Futuristic technology and material for automotive applications, designing hybrid materials- material for auto piloting, manufacturing considerations for various lightweight automotive structures, 3D printing- materials, processes and applications. Case studies on Li-ion battery, polymer composites and sensor materials.

Text Books:

1. Michel F Ashby, “Material Selection in Mechanical Design”, Butterworth Heinemann, 2007.
2. Michel F Ashby, “Material and Design: The Art and Science of Material Selection in Product Design”, Butterworth Heinemann, 2008.
3. John Mortimer, “Advanced Manufacturing in the Automotive Industry” Springer, 1997.
4. Harry Peck, “Design for Manufacturing”, Pitman Publications, 1983.
5. Cantor B, Johnston, Colin Grant and Patrick, “Automotive Engineering: Lightweight, Functional and Novel Materials”, Taylor & Francis Ltd, 2008.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

Course Outcomes: After the completion of the course, the student shall acquire the knowledge of engineering materials and processes with relevance to automotive applications. The student should be able to learn about battery materials and technology, primary and secondary processes for automotive applications and futuristic technology and material for automotive applications.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

IV Year-I Semester		L	T	P	C
		3	0	0	3
ENGINE MANAGEMENT SYSTEMS (OPEN ELECTIVE-IV)					

Course objective: To impart the knowledge of the Spark Ignition and compression ignition engine management systems, engine diagnostics procedure, computerized electronic fuel injection systems and air flow fuel management strategies.

UNIT-I
Computerized Electronic Fuel Injection: Engine Input Sensors Coolant & Intake Temperature, Crankshaft Position, Camshaft Position, Manifold Absolute Pressure, Throttle Position, Oxygen, Air/Fuel Ratio, Knock Speed& Distance, Battery & Switches Output Devices -Relays, Injector Sequencing & Management, Ignition Operation, Idle Air Control, EGR, EVAP, Waste gate Solenoids, Torque Converter & Speed Control, Malfunction Indicator Light

UNIT-II
Speed Density/Mass Air Flow Fuel Management Strategies: Key ON Mode, Crank Mode, Open & Closed Loop, Wide-Open Throttle, Adaptive Memory Cells, Cruise &Deceleration, Wide-Open Throttle, Key OFF Mode Fuel Injection Systems -Electronic Fuel Systems, Computer Self-Diagnostic Circuits, Electronic Throttle Actuator Control Systems, Fuel Control, Fuel Supply System Control, Injection System Inspection and Maintenance.

UNIT-III
Engine Diagnostic Procedures Fuel System testing: On Board Diagnostics, Monitored & Non-Monitored Circuits, Diagnostic Trouble Codes, Digital Engine Control System: Open loop and close loop control system, engine cooling and warm up control, idle speed control, acceleration and full load enrichment, deceleration fuel cut off. Fuel control maps, open loop control of fuel injection and closed loop lambda control exhaust emission control, on-board diagnostics, diagnostics, future automotive electronic systems, Electronic dash board instruments – Onboard diagnosis system.

UNIT-IV
SI Engine Management: Feedback carburetor system, throttle body injection, multi-point fuel injection and direct injection systems, Layout and working of SI engine management systems like Bosch Mono- Jetronic, L-Jetronic and LH-Jetronic. Group and sequential injection techniques. Advantages of electronic ignition systems. Types of solid-state ignition systems and their principle of operation, Contactless electronic ignition system, electronic spark timing control. Three-way catalytic converter, conversion efficiency versus lambda.

UNIT-V
CI Engine Management: Fuel injection system, parameters affecting combustion, noise and emissions in CI engines. Pilot, main, advanced, post injection and retarded post injection. Electronically controlled Unit Injection system. Layout of the common rail fuel injection system. Working of components like fuel injector, fuel pump, rail pressure limiter, flow limiter, EGR valve control in electronically controlled systems.

Text Books:
1. Diesel Engine Management by Robert Bosch, SAE Publications, 3rd Edition, 2004
2. Gasoline Engine Management by Robert Bosch, SAE Publications, 2nd Edition, 2004

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

References:

1. Halderman, J. & Linder, J. (2012). Automotive Fuel and Emissions Control Systems (3rd Edition)Upper Saddle River, NJ: Pearson Education.
2. Halderman, J. D. (2011). Diagnosis & Troubleshooting of Automotive Electrical, Electronic, &Computer Systems (6th Edition) Upper Saddle River, NJ: Pearson Education.
3. Understanding Automotive Electronics – Bechfold SAE 1998
4. Automobile Electronics by Eric Chowanietz SAE
5. Fundamentals of Automotive Electronics - V.A.W.Hilliers - Hatchin, London
6. Automobile Electrical & Electronic Equipments (2000) Young, Griffitns - Butterworths, London.
7. Understanding Automotive Electronics, William B. Ribbens, 5th Edition, Newnes, Butterworth–Heinemann, 2001.
8. Automotive Computers & Digital Instrumentation – Robert N. Brandy, Prentice Hall, 2004
9. The Fundamentals of Electrical Systems - John Hartly - Longman Scientific & Technical, 2002.

Course Outcomes:

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

- Acquire the knowledge about Computerized Electronic Fuel Injection, Battery & Switches Output Devices
- Understand the Air Flow Fuel Management Strategies and electronic fuel systems.
- Describe the Engine Diagnostic Procedures Fuel System testing.
  Analyze the spark ignition and compression ignition management systems.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

IV Year-I Semester		L	T	P	C
		3	0	0	3
AUTOMOBILE ELCTRICAL & ELECTRONICS (OPEN ELECTIVE-IV)					

Course objective: To acquire the knowledge of Batteries and Accessories, starting system, Charging system, Automotive Electronics, Sensors and Actuators.

UNIT-I
Batteries and Accessories:
Principle and Construction of Lead Acid Battery, Characteristics of battery, rating capacity and Efficiency of Batteries, Various Tests on Batteries, Maintenance and Charging. Lighting System: Insulated and Earth Return System, Details of Head Light and Side Light, LED Lighting System, Head Light Dazzling and Preventive Methods – Horn, Wiper System and Trafficator.

UNIT-II
Starting System
Condition at Starting, Behavior of Starter during Starting, Series Motor and its Characteristics, Principle and Construction of Starter Motor, Working of Different Starter Drive Units, Care and Maintenances of Starter Motor, Starter Switches.

UNIT-III
Charging System
Generation of Direct Current, Shunt Generator Characteristics, Armature Reaction, Third Brush Regulation, Cutout. Voltage and Current Regulators, Compensated Voltage Regulator, Alternators Principle and Constructional Aspects and Bridge Rectifiers, New Developments.

UNIT-IV
Fundamentals of Automotive Electronics
Current Trends in Automotive Electronic Engine Management System, Electro Magnetic Interference Suppression, Electromagnetic Compatibility, Electronic Dashboard Instruments, Onboard Diagnostic System, Security and Warning System.

UNIT-V
Sensors & Actuators
Types of Sensors: Sensor for Speed, Throttle Position, Exhaust Oxygen Level, knock, Manifold Pressure, Crankshaft Position, Coolant Temperature, Exhaust Temperature, Impact sensor, Air Mass Flow for Engine Application. Solenoids, Stepper Motors, Relay.

Text Books:

1. Young A.P. & Griffiths. L. “Automotive Electrical Equipment”, ELBS & NewPress-1999.
2. William B.Riddens “Understanding Automotive Electronics”, 5th edition -Butter worth Heinemann Woburn, 1998.

References:

1. Bechhold “Understanding Automotive Electronics”, SAE,1998.
2. Crouse, W.H “Automobile Electrical Equipment”, McGraw-Hill Book Co., Inc., New York, 3rd edition, 1986.
3. Judge A.W “Modern Electrical Equipment of Automobiles”, Chapman & Hall, London, 1992.
4. Kholi.P.L “Automotive Electrical Equipment”, Tata McGraw-Hill Co., Ltd., New Delhi, 1975.

5. Robert Bosch "Automotive Hand Book", SAE (5th Edition), 2000.

Course Outcomes: After the completion of the course, the student should be able to acquire the knowledge of Batteries and Accessories, starting system, Charging system, Automotive Electronics, Sensors and Actuators.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

MINOR		L	T	P	C
		4	0	0	4
BASIC AUTOMOBILE ENGINEERING					

Course Objectives:
The course imparts the principles of automobile systems and provides the salient features of safety, and service of automobiles.

UNIT – I
Engines – Classification
INTRODUCTION: Components of 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 – engine lubrication, splash and pressure lubrication systems, oil filters, oil pumps – crank case ventilation

UNIT – II
TRANSMISSION SYSTEM: Clutches, principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel – gear boxes, types, sliding mesh, construct mesh, synchro mesh gear boxes, epicyclic gear box, over drive torque converter. propeller shaft – Hotchkiss drive, Torque tube drive, universal joint, differential rear axles – types – wheels and tyres.

UNIT – III
STEERING SYSTEM: Steering geometry – camber, castor, king pin rake, combined angle toe in, center point steering. Types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism, steering gears – types, steering linkages.

UNIT – IV
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, master cylinder, and wheel cylinder tandem master cylinder requirement of brake fluid, pneumatic and vacuum brakes.
ELECTRICAL SYSTEM: Charging circuit, generator, current – voltage regulator – starting system, Bendix drive mechanism solenoid switch, lighting systems, horn, wiper, fuel gauge – oil pressure gauge, engine temperature indicator.

UNIT – V
ENGINE SPECIFICATIONS AND SAFETY SYSTEMS: Introduction- engine specifications with regard to power, speed, torque, no. of cylinders and arrangement, lubrication and cooling.
Safety: Introduction, safety systems - seat belt, air bags, bumper, anti-lock brake system (ABS), wind shield, suspension sensors, traction control, mirrors, central locking and electric windows, speed control.

TEXT BOOKS:
1. Automotive Mechanics – Vol. 1 & Vol. 2 / Kirpal Singh/standard publishers
2. Automobile Engineering / William Crouse/TMH Distributors
3. Automobile Engineering/P. S Gill/S.K. Kataria & Sons/New Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

REFERENCES:

1. Automotive Engines Theory and Servicing/James D. Halderman and Chase D. Mitchell Jr., / Pearson education Inc.
2. Automotive Engineering / K Newton, W.Steeds & TK Garrett/SAE
3. Automotive Mechanics: Principles and Practices/ Joseph Heitner/Van Nostrand Reinhold
4. Automobile Engineering / C Srinivasan/McGraw-Hill.

Course Outcomes:

The student after undergoing the course, shall learn about transmission, steering, suspension, braking and safety and vehicle troubleshooting.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

MINOR		L	T	P	C
		4	0	0	4
IC ENGINES					

Course Objectives:

- To impart the knowledge and providing holistic view on IC Engines and its developments
- To enable the students to calculate the performance and testing of IC engines
- To learn about SI & CI fueling system and combustion behavior and its advancements to meet the stringent emission norms
- Understanding the formation and control strategies of SI and CI Engine emissions

UNIT-I:

Engine Principles: Introduction, Comparison of Air Standard and Actual Cycles, Constructional Details of Four Stroke SI and CI Engines, Working Principle, Actual Indicator Diagram, Two Stroke Engine Construction and Operation, Comparison of Four Stroke and Two Stroke Engine Operation, Firing Order and Its Significance.

UNIT-II:

ENGINE TESTING & PERFORMANCE

Engine Performance Testing & Numerical- methods and Performance Characteristics; Performance Maps. Lubrication and Cooling systems, Introduction to Supercharging and Turbocharging; Introduction to Engine Cooling and Lubrication

UNIT-III:

SI ENGINE COMBUSTION

Carburetor Working Principle, Requirements of an Automotive Carburetor, and types, Fuel Injection Systems; Pre-mixed charge combustion, SI Engine Combustion Conceptual models, Knocking Combustion

CI ENGINE COMBUSTION

Fuel Injection and Spray Structure: Fuel Atomization. Diesel Combustion Process Characterization: Ignition Delay, Effect of Engine and Operational Parameters on Delay, Pre-mixed Combustion and Mixing Controlled Combustion.

UNIT-V:

ADVANCED COMBUSTION MODES

GDI, Flexi Fuel, CAI, Introduction to Low Temperature Combustion Like: Homogeneous Charge Compression Ignition (HCCI), Fuel Stratified Charge combustion/ Reactivity Controlled Compression Ignition (RCCI) and Pre-mixed Charge Compression (PCCI) technologies.

Text Books:

1. IC Engines, M.L. Mathur & R.P. Sharma, Dhanpath Rai & Sons
2. Engine Emissions, Pollutant Formation and Advances in Control Technology, B.P. Pundir, Narosa Publishing House

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

Reference Books:

1. IC Engines Fundamentals, John B. Heywood, Mc Graw Hill Publications
2. Engineering Fundamentals of I C Engines, Wiliard W.Pulkrabek, Prentice Hall Publications

Course Outcomes: At the end of the course, the students should be able to

- Evaluate the Engine performance based on the experimental data
- Analyse the fuelling system and combustion behaviour of SI engine
- Analyse the fuelling system and combustion behaviour of CI engine
- Explain the formation of emissions and its control strategies of bot SI & CI Engines.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

MINOR		L	T	P	C
		4	0	0	4
VEHICLE BODY ENGINEERING					

Course Objectives:
- To make students familiar with car body details and vehicle aero dynamics
- To understand the bus body details, commercial vehicle details, body materials, trim and mechanisms

UNIT-I: Car Body Details
Types: Saloon, Convertibles, Limousine, Estate Car, Racing and Sports Car. Visibility: Regulations, Driver's Visibility, Tests for Visibility, Methods of Improving Visibility and Space in Cars. Safety: Safety Design, Safety Equipment's for Cars. Car Body Construction; Design Criteria, Prototype Making, Initial Tests, Crash Tests on Full Scale Model, Dummies and Instrumentation

UNIT-II: Vehicle Aerodynamics
Objectives: Vehicle Drag and Types; Various Types of Forces and Moments, Effects of Forces and Moments, Side Wind Effects on Forces and Moments, Various Body Optimization Techniques for Minimum Drag, Wind Tunnel Testing: Flow Visualization Techniques, Scale Model Testing, Component Balance to Measure Forces and Moments.

UNIT-III: Bus Body Details
Types: Mini Bus, Single Decker, Double-Decker, Two Level and Articulated Bus. Bus Body Layout; Floor Height, Engine Location, Entrance and Exit Location, Seating Dimensions. Constructional Details: Frame Construction, Double Skin Construction, Types of Metal Sections used, Regulations, Conventional and Integral Type Construction.

UNIT-IV: Commercial Vehicle Details
Types of Body; Flat Platform, Drop Side, Fixed Side, Tipper Body, Tanker Body, Light Commercial Vehicle Body Types. Dimensions of Driver's Seat Relation to Controls. Drivers Cab Design.

UNIT-V: Body Materials, Trim and Mechanisms
Steel Sheet, Timber, Plastic, GRP, Properties of Materials; Corrosion, Anticorrosion Methods. Selection of Paint and Painting Process. Body Trim Items. Body Mechanisms

Text Books
1. James E Duffy, "Modern Automotive Technology", Goodheart-Wilcox; Seventh Edition, 2011
2. Jack Erjavec, "Automotive Technology – A systems approach", Cengage Learning, 2009,

Reference Books:
1. Geoff Davies, Materials for Automotive Bodies, Elsevier, Butterworth Heinemann, ISBN 07506 5692 1, 2003
2. Body Engineering, S. F. Page
3. Automotive Chassis – P.M. Heldt, Chilton & Co. 1952

Course Outcomes: After the completion of the course, the students should be able to
- Understand car body details and vehicle aero dynamics
- Understand the bus body details, commercial vehicle details, body materials, trim and mechanisms

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

MINOR		L	T	P	C
		4	0	0	4
VEHICLE DYNAMICS					

Course Objective:

To impart basic knowledge and understanding underlying the development and design of road vehicles under the influence of dynamic loads.

UNIT I

Introduction: Hypothetical vehicle control loop, Fundamental Approach, Vehicle coordinates, motion variables. Forces – Dynamic axle loads, Static loads on level ground, aerodynamic forces on body, hitch forces – Numerical.

UNIT-II

Acceleration & Braking Performance – Power limited acceleration, Fundamental Expressions, Constant retardation, Wind Resistance, Power, Braking forces, Brakes: disc and drum, front, rear and four-wheel braking, Road friction rolling resistance, Numerical.

UNIT-III

Road Loads: Aerodynamic, Mechanics of pressure distribution – Aerodynamic forces: lift & drag, Spoilers, Lift force, side force and roll, pitch and yaw moments, Crosswind sensitivity. Rolling Resistance, Factors affecting pressure, velocity, slip, temperature– Total Road loads – Fuel Economy Effects.

UNIT-IV

Ride Excitation sources – road roughness, wheel assembly, driveline excitation, engine transmission. Vehicle response properties: Suspension isolation, suspension stiffness & damping Wheel Hop Resonance. Road-tyre friction – dynamic response of tires – Rigid body bounce, pitch motion. Perception of ride and other vibration forms, Numerical.

UNIT-V

Steady – State Cornering: Introduction, Low and high-speed turning –Tire cornering forces, governing expressions, understeer gradient, over steer and neutral conditions. Characteristic speed, critical speed, yaw velocity gain, sideslip angle, static margin. Suspension effects on cornering: roll moment distribution – effect of tractive forces on cornering – Numerical.

TEXT BOOKS:

1. Thomas Gillespie, “Fundamentals of Vehicle dynamics.” Society of Automotive engineers Inc, 2014
2. Wong H, Theory of Ground Vehicles, McGraw Hill, Second edition, 2006.

REFERENCES:

1. Hans B Pacejka, Tire and Vehicle Dynamics, 3rd Edition, Elsevier Ltd., 2012.
2. Amitosh D, Vehicle Dynamics, Galgotia Book Ltd., 2010.
3. Rao V Dukkipati, Road Vehicle Dynamics,Springer 2008
4. Werner and Karl, Ground Vehicle Dynamics,Springer Berlin Heidelberg, 2008.

Course Outcomes: After the completion of the course, the student will be able to have knowledge and understanding underlying the development and design of road vehicles under the influence of dynamic loads.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

MINOR		L	T	P	C
		4	0	0	4
AUTOMOBILE ELCTRICAL AND ELECTRONICS					

Course objective: To acquire the knowledge of Batteries and Accessories, starting system, Charging system, Automotive Electronics, Sensors and Actuators.

UNIT-I
Batteries and Accessories:
Principle and Construction of Lead Acid Battery, Characteristics of battery, rating capacity and Efficiency of Batteries, Various Tests on Batteries, Maintenance and Charging. Lighting System: Insulated and Earth Return System, Details of Head Light and Side Light, LED Lighting System, Head Light Dazzling and Preventive Methods – Horn, Wiper System and Trafficator.

UNIT-II
Starting System
Condition at Starting, Behavior of Starter during Starting, Series Motor and its Characteristics, Principle and Construction of Starter Motor, Working of Different Starter Drive Units, Care and Maintenances of Starter Motor, Starter Switches.

UNIT-III
Charging System
Generation of Direct Current, Shunt Generator Characteristics, Armature Reaction, Third Brush Regulation, Cutout. Voltage and Current Regulators, Compensated Voltage Regulator, Alternators Principle and Constructional Aspects and Bridge Rectifiers, New Developments.

UNIT-IV
Fundamentals of Automotive Electronics
Current Trends in Automotive Electronic Engine Management System, Electro Magnetic Interference Suppression, Electromagnetic Compatibility, Electronic Dashboard Instruments, Onboard Diagnostic System, Security and Warning System.

UNIT-V
Sensors & Actuators
Types of Sensors: Sensor for Speed, Throttle Position, Exhaust Oxygen Level, knock, Manifold Pressure, Crankshaft Position, Coolant Temperature, Exhaust Temperature, Impact sensor, Air Mass Flow for Engine Application. Solenoids, Stepper Motors, Relay.

Text Books

1. Young A.P. & Griffiths. L. “Automotive Electrical Equipment”, ELBS & NewPress-1999.
2. William B.Riddens “Understanding Automotive Electronics”, 5th edition -Butter worth Heinemann Woburn, 1998.

References

1. Bechhold “Understanding Automotive Electronics”, SAE,1998.
2. Crouse, W.H “Automobile Electrical Equipment”, McGraw-Hill Book Co., Inc., New York, 3rd edition, 1986.
3. Judge A.W “Modern Electrical Equipment of Automobiles”, Chapman & Hall, London,1992.
4. Kholi.P.L “Automotive Electrical Equipment”, Tata McGraw-Hill Co., Ltd., New Delhi,1975.
5. Robert Bosch “Automotive Hand Book”, SAE (5th Edition),2000.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

Course Outcomes: After the completion of the course, the student should be able to acquire the knowledge of Batteries and Accessories, starting system, Charging system, Automotive electronics, Sensors and Actuators.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

MINOR		L	T	P	C
		4	0	0	4
ELECTRICAL VEHICLES AND HYBRID TECHNOLOGY					

Course Objectives: To

- Understand the general aspects of Electric and Hybrid Vehicles (EHV), including architectures, modeling, sizing, sub-system design and hybrid vehicle control.

UNIT I
INTRODUCTION

Need for hybrid and electric vehicles – main components and working principles of a hybrid and electric vehicles, Different configurations of hybrid and electric vehicles. Comparative study of diesel, petrol, hybrid and electric Vehicles. Advantages and Limitations of hybrid and electric Vehicles. Case study on specification of electric and hybrid vehicles.

UNIT II
DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES

Design requirement for electric vehicles- Range, maximum velocity, acceleration, power requirement, mass of the vehicle. Various Resistance- Transmission efficiency- Electric vehicle chassis and Body Design, Electric Vehicle Recharging and Refueling Systems.

UNIT III
ENERGY SOURCES

Battery Parameters- - Different types of batteries – Lead Acid- Nickel Metal Hydride - Lithium ion- Sodium based- Metal Air. Battery charging- Quick Charging devices. Battery Management System.
Polymer Exchange Membrane Fuel Cell- Characteristics- Half reactions of fuel cell. Cells in series and parallel- water management - Thermal Management.

UNIT IV
MOTORS

Characteristics of DC motors (Brush and Brushless), AC single phase and 3-phase motor, PM motors, switched reluctance motors, Motor Drives and speed controllers, Torque Vectoring, Regenerative Braking. Rectifiers, Inverters, DC/AC converters.

UNIT V
SUBSYSTEMS OF HYBRID AND ELECTRIC VEHICLES

Power Split devices for Hybrid Vehicles - Operation modes - Control Strategies for Hybrid Vehicle- Economy of hybrid Vehicles. Choice of Tires.

TEXT BOOKS:

1. Iqbal Husain, “Electric and Hybrid Vehicles-Design Fundamentals”, CRC Press, 2003
2. Mehrdad Ehsani, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles”, CRC Press, 2005.

REFERENCES:

1. James Larminie and John Lowry, “Electric Vehicle Technology Explained “John Wiley & Sons, 2003
2. Lino Guzzella, “Vehicle Propulsion System” Springer Publications, 2005
3. Ron Hokinson, “Light Weight Electric/ Hybrid Vehicle Design”, Butterworth Heinemann Publication, 2005

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

Course Outcomes: The students able to understand

- Electric and hybrid vehicle operation and architectures
- Design of hybrid and electric vehicles.
- Energy requirement for vehicles.
- Vehicle characteristics, operating modes, and performance parameters of the vehicle
- Different subsystems of hybrid and electric vehicles

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

MINOR		L	T	P	C
		4	0	0	4
AUTOMOBILE MATERIALS AND MANUFACTURING TECHNIQUES					

Course objective: To impart the knowledge of common engineering materials and processes with relevance to automotive applications. The student shall learn about battery materials and technology, primary and secondary processes for automotive applications and futuristic technology and material for automotive applications.

UNIT-I
Introduction to common engineering materials; metallic and non-metallic automotive materials. Materials and processes with relevance to automotive applications. Advanced materials, light weight material, nano material and synthesis and in-situ materials for automotive applications, corrosion, Standards for automotive materials.

UNIT-II
High strength low alloy steels (HSLA), Advanced high strength steels, dual phase steels, martensitic steels, Advanced plastics and composites, Novel material for automotive applications, ultra-light weight material, Graphene - Case studies.

UNIT-III
Battery materials and technology, case studies related to automotive applications. Case studies on crank shaft, connecting rod, piston, gear and gear box, propeller shaft.

UNIT-IV
Primary and secondary processes for automotive applications – casting, forging, heavy and sheet forming, hard and soft machining, moulding, surface modification processes and Heat Treatment, joining methods for automotive applications. Case studies on Vehicle body materials- G.I and Interstitial Free Steel processes, Power train components -Tailor Welded Blank.

UNIT-V
Futuristic technology and material for automotive applications, designing hybrid materials- material for auto piloting, manufacturing considerations for various lightweight automotive structures, 3D printing-materials, processes and applications. Case studies on Li-ion battery, polymer composites and sensor materials.

Text Books:

1. Michel F Ashby, “Material Selection in Mechanical Design”, Butterworth Heinemann, 2007.
2. Michel F Ashby, “Material and Design: The Art and Science of Material Selection in Product Design”, Butterworth Heinemann, 2008.
3. John Mortimer, “Advanced Manufacturing in the Automotive Industry” Springer, 1997.
4. Harry Peck, “Design for Manufacturing”, Pitman Publications, 1983.
5. Cantor B, Johnston, Colin Grant and Patrick, “Automotive Engineering: Lightweight, Functional and Novel Materials”, Taylor & Francis Ltd, 2008.

Course Outcomes: After the completion of the course, the student shall acquire the knowledge of common engineering materials and processes with relevance to automotive applications. The student should be able to learn about battery materials and technology, primary and secondary processes for automotive applications and futuristic technology and material for automotive applications.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

MINOR		L	T	P	C
		4	0	0	4
AUTOMOBILE POLLUTION AND ITS EFFECTS					

Course objective: To impart the knowledge of different regulatory test procedures, pollutants and particulates. To acquire understanding about SI engine and CI engine emissions and different emission control techniques.

UNIT I
Laws and Regulation: Historical background, regulatory test procedures (European cycles). European statutory limits, Pollutants: Carbon and Nitrogen compounds-(CO.CO_2 NOx), Hydrocarbons. Volatile compounds, evaporative emissions, particulates.

UNIT-II
SI engine emissions: Mechanism & formation of HC, CO and NOx in SI engines. Engine operating variables affecting pollutants.
CI engine emissions: Mechanism & formation of HC, CO and NOx, and Soot in CI engines. Factor affecting emission formation.

UNIT-III
Emission Control Techniques in SI Engines:
Lean burn & stratified charge engines. Multipoint fuel injection and gasoline direct injection systems, exhaust gas composition, catalytic convertors, positive crank case ventilation and evaporative emission control.

UNIT-IV
Emission Control Techniques in CI Engines:
Common rail fuel injection in diesel engines. Post combustion treatments: exhaust gas recirculation, particulate traps, particulates trap regeneration, installation of catalysts in exhaust lines treatment, diesel oxidation converter.

UNIT-V
Health and environmental effects: Effects of HC, CO, NOx, SOx, CO_2 and PM emissions from SI and CI engine on living beings. Effect on environment, Acid rain formation, climate change.

TEXT BOOKS:
1. Internal Combustion Engine Fundamentals/Heywood/Mc Graw Hill
2. Internal combustion engines and air pollution/ Edward Frederic Obert/ Intext Educ. Pub
3. Bosch – Gasoline fuel injection /Bosch Publications
4. Bosch – Diesel fuel injection /Bosch Publications
5. Engine emissions – B. P. Pundir, Narosa Publishers

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

REFERENCE BOOKS:

1. Automobiles and Pollution /PaulDegobert/ OPHRYS
2. SAE Surface Vehicle Emissions Standards Manual/ Society of Automotive Engineers
3. Automobile Pollution, Concerns, Priorities, and Challenges/ Shyam Kishor Agarwal/ APH Publishing
4. Diesel engine operation manual /V.L. Maleev/CBS Pub
5. Engine emission /Springer and Patterson/Plenum Press
6. Internal Combustion Engines /Heins Aeisth /SAE Publications.

Course outcome: The students completing this course will be in a position to derive various measures to be taken to reduce the exhaust gas pollutants coming out of automobiles to meet the laws and regulations in practice.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

II Year-II Semester	Honors	L	T	P	C
		4	0	0	4
ENGINE TRIBOLOGY					

Course Objectives:

The course imparts the basic principles of automobile tribology and assessment of surface texture measurement. The students shall learn about lubrication, its classification and hemodynamics lubrication.

UNIT I

Introduction:

General tribological considerations in the design of bearings, gears, cams, reciprocating components

UNIT II

Engine Tribology Basics: Tribological aspects of engine components such as bearings, piston assembly, valve train and drive train components. Surface properties of metals, composites, Surface texture measurement and assessment, statistical methods of surface texture assessment

UNIT III

Friction: Theories of friction, sliding friction – Rolling friction characteristics of common metals and non- metals – friction under different environments. Engine friction – Losses and engine design parameters.

Wear: Wear theories, types of wear and their mechanism, factors affecting wear, selection of materials for different wear situations, measurement of wear, tribometers and tribometry. Engine wear mechanisms, wear resistant materials and coatings and failure mode analysis

UNITIV

Lubrication: Hydrodynamics, basic concepts, generalized Reynolds equation, slider bearings, fixed & pivoted shoe bearings, hydrodynamic journals bearings, short and finite bearings, thrust bearings, sintered bearing, non-circular bearings and multi side surface bearings. Hydrostatic bearing -basic concepts, bearing pads, flat, conical and spherical pad thrust bearing, multi-recess journal and thrust bearings, air and gas lubricated bearings.

UNIT V

Lubricants: Type of lubricants, properties and testing, service, lubrication of tribological components, lubrication system, lubricant monitoring, ferrography and other rapid testing methods for lubricants contamination. Hemodynamics (Static) Lubrication: Non-Newtonian fluids, characteristics, general recommendations of lubricants, SAE & other cloud numbers, thixotropic materials and Bingham solids, grease lubrication, tribology of components in extreme environments like vacuum, pressure, temperature

Text Books

1. Friction and Lubrication, Bowden F.P. & Tabor D., Heinemann Edu. Books Ltd. 1974
2. A. Cameron, “Basic Lubrication Theory”, Ellis Harwood Ltd, 1981.

Reference Books:

1. A. Cameron, “The principles of lubrication”, Longmans Green & Co. Ltd, 1966.
2. D.D. Fuller, “Theory and Practice of Lubrication for Engineers”, John Wiley and Sons, 1984.

Course Outcomes: After the completion of the course, the student will be able to understand the basic principles of automobile tribology and assessment of surface texture measurement. The students shall learn about lubrication, its classification and hemodynamics lubrication.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

II Year-II Semester		L	T	P	C
		4	0	0	4
MICRO ELECTRO MECHANICAL SYSTEMS					

Course Objectives:

- To understand basics of Micro Electro Mechanical Systems (MEMS), mechanical sensors and actuators
- To illustrate thermal sensors and actuators used in MEMS.
- To apply the principle and various devices of Micro-Opto-Electro Mechanical Systems (MOEMS), magnetic sensors and actuators.
- To analyze applications and considerations on micro fluidic systems.
- To illustrate the principles of chemical and bio medical micro systems.

UNIT-I

INTRODUCTION: Definition of MEMS, MEMS history and development, micro machining, lithography principles & methods, structural and sacrificial materials, thin film deposition, impurity doping, etching, surface micro machining, wafer bonding, LIGA.
MECHANICAL SENSORS AND ACTUATORS: Principles of sensing and actuation: beam and cantilever, capacitive, piezo-electric, strain, pressure, flow, pressure measurement by micro phone, MEMS gyroscopes, shear mode piezo actuator, gripping piezo actuator, Inchworm technology.

UNIT-II

THERMAL SENSORS AND ACTUATORS: Thermal energy basics and heat transfer processes, thermistors, thermo devices, thermo couple, micro machined thermo couple probe, Peltier effect heat pumps, thermal flow sensors, micro hot plate gas sensors, MEMS thermo vessels, pyro electricity, shape memory alloys (SMA), U-shaped horizontal and vertical electro thermal actuator, thermally activated MEMS relay, micro spring thermal actuator, data storage cantilever.

UNIT-III

MICRO-OPTO-ELECTRO MECHANICAL SYSTEMS: Principle of MOEMS technology, properties of light, light modulators, beam splitter, micro lens, micro mirrors, digital micro mirror device (DMD), light detectors, grating light valve (GLV), optical switch, wave guide and tuning, shear stress measurement.
MAGNETIC SENSORS AND ACTUATORS: Magnetic materials for MEMS and properties, magnetic sensing and detection, magneto resistive sensor, more on hall effect, magneto diodes, magneto transistor, MEMS magnetic sensor, pressure sensor utilizing MOKE, mag MEMS actuators, by directional micro actuator, feedback circuit integrated magnetic actuator, large force reluctance actuator, magnetic probe- b a s e d storage device.

UNIT-IV

MICRO FLUIDIC SYSTEMS: Applications, considerations on micro scale fluid, fluid actuation methods, dielectrophoretic (DEP), electro wetting, electro thermal flow, thermo capillary effect, electro osmosis flow, opto electro wetting (OEW), tuning using micro fluidics, typical micro fluidic channel, micro fluid dispenser, micro needle, molecular gate, micro pumps. RADIO FREQUENCY (RF) MEMS: RF – based communication systems, RF MEMS, MEMS inductors, tuner/filter, resonator, clarification of tuner, filter, resonator, MEMS switches, phase shifter

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

UNIT-V

CHEMICAL AND BIO MEDICAL MICRO SYSTEMS: Sensing mechanism & principle, membrane- transducer materials, chem.-lab-on-a-chip (CLOC) chemo-resistors, chemo-capacitors, chemo-transistors, electronic nose (E-nose), mass sensitive chemo-sensors, fluorescence detection, calorimetric spectroscopy.

TEXT BOOK:

1. MEMS, Nitaigour Premchand Mahalik, TMH

REFERENCE BOOKS:

1. Foundation of MEMS, Chang Liu, Prentice Hall Ltd.
2. MEMS and NEMS, Sergey Edward Lyshevski, CRC Press, Indian Edition.
3. MEMS and Micro Systems: Design and Manufacture, Tai-Ran Hsu, TMH Publishers.
4. Introductory MEMS, Thomas M Adams, Richard A Layton, Springer International Publishers.

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

- To understand basics of Micro Electro Mechanical Systems (MEMS), mechanical sensors and actuators
- Illustrate thermal sensors and actuators used in MEMS.
- To apply the principle and various devices of Micro-Opto-Electro Mechanical Systems (MOEMS), magnetic sensors and actuators.
- Analyze applications and considerations on micro fluidic systems.
- Illustrate the principles of chemical and bio medical micro systems.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

II Year-II Semester		L	T	P	C
		4	0	0	4
STANDARDS AND TEST PROCEDURES OF FUEL AND VEHICLE EMISSIONS					

Course Objectives:
The course imparts the understanding of emission standards followed all over the world. The student shall learn the mass emissions, fuel standards and evaporative emissions test procedures. The students shall learn about engine and chassis dynamometers.

UNIT I

Test/Driving Cycles - Emission standards
Test Cycles for Light, Medium and Heavy-Duty Vehicles: US Environmental Protection Agency (US EPA), European, Japanese, Indian Driving Cycles, Types of Emission tests, Indian, US, TREM, Evaporative and European Emission standards

UNIT II

Mass Emissions Testing Procedure
Sampling Procedure, chassis dynamo meter, CVS bags, dilution, CFV, Cyclonic separators, PEMS

UNIT III

Fuel Standards and Evaporative Emissions Testing Procedure
Fuel standards, Fuel Requirements, Effect of temperature on fuel, SHED methods, USEPA Evaporative test procedure

Unit IV
Emission Measurements systems
NDIR Analyzer, Flame Ionization Detector, Chemiluminescence Analyzer, Para magnetic Oxygen Analyzer, Smoke meters, Aldehyde measurement, FTIR Analyzer, Particulate mass (Dilution-Tunnel technique) and Particle number measurement.

Unit V
Engine and Chassis Dynamometers
Construction and working principles of Inertia, Water- Brake/Hydraulic and Electric Dynamometer. Diagnostics of engine emissions with Engine Dynamo, Transient Engine Dynamo and Chassis Dynamo and its comparison. Factors affecting the accuracy of the Dynamometer.

Text Books:
1. Evangelos G. Giakoumis, Driving and Engine Cycles, Springer, ISBN: 978-3-319-49034-2

References
1. T J Barlow, S Latham et al., A Reference Book of Driving Cycles for use in the Measurement of Road Vehicle Emissions., TRL Limited, ISSN: 0968-4093
2. Engine Emissions, B P Pundir, Narosa Publications

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

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

2. Understand the emission standards followed all over the world.
3. Learn the mass emissions, fuel standards and evaporative emissions test procedures.
4. Learn about engine and chassis dynamometers.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

II Year-II Semester		L	T	P	C
		4	0	0	4
ENGINE MODELLING					

Course Objectives:
The course imparts the understanding of the fundamental governing equations and other basic concepts of engine modelling. The student shall learn the thermodynamic combustion models of engines, modelling of charging system and mathematical modelling of spark ignition engines.

UNIT I
Fundamentals: Governing equations, Equilibrium charts of combustion chemistry, Chemical reaction rates, Approaches of modeling, Model building and integration methods. Gas exchange through valves, engine and porting geometry, exhaust gas recirculation, valve lift.

UNIT II
Thermodynamic Combustion Models of Engines: Single zone models, premixed and diffusive combustion models, combustion heat release using Wiebe function, wall heat transfer correlations, ignition delay, internal energy estimation, two-zone model, heat release analysis.

UNIT III
Modelling of Charging System: Constant-pressure and pulse turbo-charging, compressor and turbine maps, charge air cooler.

UNIT IV
Fuel Spray Characteristics: Fuel injection, overall spray structure, fuel atomization, spray penetration, droplet size distribution, spray evaporation models, thick spray models, droplet turbulence-interactions, droplet impingement on walls.

UNIT V
Mathematical Models of SI Engines: Simulation of Otto cycle at full throttle, part throttle and supercharged conditions, progressive combustion, Auto-ignition Modeling, single zone models, multi-zone models and mass burning rate estimation, SI engine with stratified charge. Friction in pumping, in piston assembly, bearings and valve train. Friction estimation.

Text Books

1. Internal Combustion Engine Fundamentals, John B Heywood, McGraw-Hill, 1988.
2. Internal Combustion Engine Modeling, J.I. Ramos, Hemisphere Publishing Corporation, 1989.
3. Modeling Engine Spray and Combustion Processes, G. Stiesch, Springer Verlag, 2003.

References:

1. Simulating Combustion: Simulation of combustion and pollutant formation for engine, Günter P. Merker, Christian Schwarz, Gunnar Stiesch, Frank Otto, Springer, 2008.
2. Introduction to Modeling and Control of IC Engine Systems, Guzzella Lino, Springer Verlag, 2004.
3. Thermodynamic analysis of combustion engines, Ashley, S, Campbell, John Wiley and Sons, 1980.
4. Combustion Modeling in Reciprocating Engines, J. N. Mattavi and C. A. Amann, Plenum press 1980.

5. Design and Simulation of Four-Stroke Engines, G. P. Blair, SAE, 1999.
6. Modelling Diesel Combustion, Lakshminarayanan, P. A., Aghav, Yoghesh V., Mechanical Engineering Series, Springer, 2010.
7. Computer Simulation of SI Engine Processes – V. Ganesan
8. Computer Simulation of CI Engine Processes – V. Ganesan

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

- Understand the fundamental governing equations and other basic concepts of engine modelling.
- Learn the thermodynamic combustion models of engines, modelling of charging system and mathematical modelling of spark ignition engines.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-I Semester		L	T	P	C
		4	0	0	4
METAL FORMING PROCESSES					

Course Objectives:

The course gives the understanding of the classification of the forming processes, and basic concepts of yield criteria. The student shall learn the understanding of forging, rolling mills, explosive forming, water hammer forming and electro hydraulic forming.

UNIT – I

Classification of forming processes – flow curves and their significance in forming – Effect of temperature, speed and metallurgical structure on forming processes – Effect of friction on forming processes. Basic concepts of yield criteria – types.

UNIT – II

Classifications of forging processes - Forging equipment – forging die design procedure for simple products – forging defects – determination of forging load – concept of P/M forging – Applications.

UNIT – III

Rolling mills – Estimation of rolling load and power – rolling defects – Applications.
Direct extrusion equipment - hydrostatic extrusion - extrusion of tubes – determination of extrusion stress - extrusion defects – Applications.

UNIT – IV

Drawing of rods, wires and tubes-Determination of drawing loads through conical dies, sheet metal forming: Shearing, blanking, bending, punching, piercing, stretch forming, deep drawing, rubber pad forming – Applications.

UNIT – V

High-rate energy forming processes: Introduction - Effect on mechanical properties and microstructures – Explosive forming, Electro hydraulic forming – Electromagnetic forming, Water hammer forming.

Text Books:

1. Dieter, Mechanical Metallurgy, McGraw-Publishing Co., New York, 1998.
2. P.C.Sharma, Production Engineering, S.Chand& Co., New Delhi, 1995.

Text / Reference Books:

1. G.W.Rowe, An Introduction to the Principles of Metal Working", Edward, Arnold Publications, 1973.
2. Gyril Donaldson, Tool Design, Tata McGraw Hill Publishing Co. Ltd., 1989.
3. ASTME, Hand Book – Fundamental of Tool Design, Prentice Hall of India, Pvt. Ltd., New Delhi, 1976

Course Outcomes: After the completion of the course, the students will be able to

- Understand the classification of the forming processes and basic concepts of yield criteria. T
- Learn the understanding of forging, rolling mills, explosive forming, water hammer forming and electro hydraulic forming.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-I Semester		L	T	P	C
		4	0	0	4
STATISTICAL DESIGN IN QUALITY CONTROL					

Course Objectives:

- To Interpret quality engineering in production design, Loss Function and Quality Level in production process
- To explain tolerance design for N-type. L-type and S-type characteristics and tolerance allocation
- To interpret ANOVA techniques and need for ANOVA with multiple level factors.
- To make use of orthogonal arrays for typical test strategies and interpolate experimental results
- To explain six sigma DMAIC methodology and tools for process improvement in services and small organizations

UNIT-I

QUALITY VALUE AND ENGINEERING: An overall quality system, quality engineering in production design, quality engineering in design of production processes. Loss Function and Quality Level: Derivation and use of quadrantile loss function, economic consequences of tightening tolerances as a means to improve quality, evaluations and types tolerances. (N-type, S-type and L-type)

UNIT-II

TOLERANCE DESIGN AND TOLERANCING: Functional limits, tolerance design for N-type. L-type and S-type characteristics, tolerance allocation for multiple components. Parameter and Tolerance Design: Introduction to parameter design, signal to noise ratios, Parameter design strategy, some of the case studies on parameter and tolerance designs.

UNIT-III

ANALYSIS OF VARIANCE (ANOVA): Introduction to ANOVA, Need for ANOVA, NO way ANOVA, One-way ANOVA, Two-way ANOVA, Critique of F-test, ANOVA for four level factors, multiple level factors.

UNIT-IV

ORTHOGONAL ARRAYS: Typical test strategies, better test strategies, efficient test strategies, steps in designing, conducting and analyzing an experiment. Interpolation of Experimental Results: Interpretation methods, percent contributor, estimating the mean.

UNIT-V

SIX SIGMA AND THE TECHNICAL SYSTEM: Six sigma DMAIC methodology, tools for process improvement, six sigma in services and small organizations, statistical foundations, statistical methodology.

TEXT BOOK:

1. Taguchi Techniques for Quality Engineering / Phillip J. Ross / McGraw Hill/ Intl. II Edition, 1995.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

REFERENCES:

1. Quality Engineering in Production systems by G. Taguchi, A. Elsayed et al, McGraw Hill Intl.Pub 1989.
2. Taguchi Methods explained: Practical steps to Robust Design / Papan P. Bagchi*I* Prentice Hall Pvt.Ltd. New Delhi

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

- Interpret quality engineering in production design, Loss Function and Quality Level in production process
- Illustrate tolerance design for N-type. L-type and S-type characteristics and tolerance allocation
- Interpret ANOVA techniques and need for ANOVA with multiple level factors.
- Make use of orthogonal arrays for typical test strategies and interpolate experimental results
- Understand six sigma DMAIC methodology and tools for process improvement in services and small organizations

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-I Semester		L	T	P	C
		4	0	0	4
DESIGN FOR MANUFACTURING & ASSEMBLY					

Course Objectives:

- To understand the basic concepts of design for manual assembly
- To interpret basic design procedure of machining processes
- To understand design considerations metal casting, extrusion and sheet metal work
- To interpret the design considerations of various metal joining process.
- To interpret the basic design concepts involved in the assembly automation

UNIT – I

Introduction to DFM, DFMA: How Does DFMA Work? Reasons for Not Implementing DFMA, What Are the Advantages of Applying DFMA During Product Design? Typical DFMA Case Studies, Overall Impact of DFMA on Industry.

Design for Manual Assembly: General Design Guidelines for Manual Assembly, Development of the Systematic DFA Methodology, Assembly Efficiency, Effect of Part Symmetry, Thickness, weight on Handling Time, Effects of Combinations of Factors and application of the DFA Methodology.

UNIT – II

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 parts.

UNIT – III

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.

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.

UNIT – IV

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.

Forging: Design factors for forging – closed die forging design – parting lines of dies –drop forging die design – general design recommendations.

UNIT – V

Design for Assembly Automation: Fundamentals of automated assembly systems, System configurations, parts delivery system at workstations, various escapement and placement devices used in automated assembly systems, Quantitative analysis of Assembly systems, Multi station assembly systems, and single station assembly lines.

Design for Additive Manufacturing: Design considerations, allowances

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

TEXT BOOKS:

1. Design for manufacture, John Cobert, Adisson Wesley. 1995
2. Design for Manufacture by Boothroyd,
3. Design for manufacture, James Bralla

REFERENCE:

- ASM Hand book Vol.20

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

- Understand the basic concepts of design for manual assembly
- Identify basic design procedure of various machining processes.
- Illustrate the design considerations metal casting, extrusion and sheet metal work
- Interpret the design considerations of various metal joining process.
- Understand the basic design concepts involved in the assembly automation and additive manufacturing.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-I Semester		L	T	P	C
		4	0	0	4
ROBOTICS & AUTOMATION					

Course Objective:
The objective of this course is to impart basic knowledge related to industrial robots for their control, design and application in robotics & automation Industries.

UNIT-I
Introduction to Robotics:
Types and components of a robot, Classification of robots, Kinematics systems; Definition of mechanisms and manipulators, Degrees of Freedom

UNIT-II
Robot Kinematics and Dynamics
Kinematic Modelling: Translation and Rotation, Representation, Coordinate transformation, DH parameters, Forward and inverse kinematics, Jacobian, Singularity, and Statics
Dynamic Modelling: Forward and inverse dynamics, Equations of motion using Euler Lagrange formulation, Newton Euler formulation

UNIT-III
Robot Sensors & Actuators
Sensors: Contact and Proximity, Position, Velocity, Force, Tactile, Introduction to Cameras, Camera calibration, Geometry of Image formation Euclidean/Similarity/Affine/Projective transformations, Vision applications in robotics.
Actuators: Electric, Hydraulic and Pneumatic; Transmission: Gears, Timing Belts and Bearings, Parameters for selection of actuators

UNIT-IV
Control Hardware and Interfacing
Basics of control: open loop- closed loop, Transfer functions, Control laws: P, PD, PID, Linear and Non-linear controls.
Embedded systems: Microcontroller Architecture and integration with sensors, actuators, components, Programming Applications for Industrial robot - programming in – VAL II

UNIT-V
AI in Robotics:
Applications in unmanned systems, defense, medical, industries, Robotics and Automation for Industry 4.0, Robot safety and social robotics.

Text Books:
- Introduction to Robotics: J. Craig , Pearson
- Robot Dynamics and Control, Spong& Vidyasagar, Mc Graw Hill

References:
- Robotics Engineering: R. Klafter, PHI
- Robotics : Subir K Saha , Mc GrawHill
- Industrial Robotics : M. P. Groover, Ashish Dutta , McGraw Hill

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

Course Outcomes:

After the completion of this course, the students will be able to:

- Perform kinematic and dynamic analyses with simulation.
- Design control laws for a simple robot.
- Integrate mechanical and electrical hardware for a real prototype of robotic device.
- Select a robotic system for given industrial application.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-II Semester		L	T	P	C
		4	0	0	4
ADVANCED MICROCONTROLLER FOR AUTOMOBILE SYSTEMS					

Course Objectives: The student will

- Learn concepts of microprocessors and micro controllers, micro controller peripheral configurations.
- Understand different micro controllers' assembly language and programming for multi-tasking.
- Learn concepts of micro controller architecture and architectural inheritance.
- Study the features of sub systems and peripherals.

UNIT-I
Micro-processors and Micro-controllers:
Salient differences and salient features between micro-controllers and micro-processors; requirements of micro-controllers for Real Time applications; Integrated Development Environment – Editor – Machine Code; Compiler – Cross compiler - Debugger –Emulator – Simulator. C and C++ compliers and de-buggers. Micro-controller peripheral configurations;

UNIT-II
Programming: 8-, 16- and 32-bit Microcontrollers using assembly language and embedded C, Programming for multi-tasking; process scheduling; prioritization of tasks; AVR microcontroller

UNIT-III
Architecture: AVR microcontroller, ATMEGA 8, 16, memory organization, addressing modes, instruction set, programming techniques, Assembly language & C programming- Development, Tools, Cross Compilers, Hardware Design Issues. ARM Microcontroller: Arcon RISC Machine, Architectural Inheritance, Core & Architectures -Registers, ARM Design Philosophy, Registers, Program Status Register, Instruction Pipeline, Interrupts and Vector Table, Architecture Revision, ARM Processor Families.

UNIT-IV
Designing of Sub-systems and Peripherals:
Designing of (i) Timers, (ii) Data acquisition interfaces; and (iii) drivers; Programming of Timers – Control and status registers – Capture and compare mode – PWM - Watchdog Timers
Analog Interfacing: - ADC – DAC-Data acquisition system design, Memory Interfacing: General memory bus timing, external bus timing, memory interface examples, configuration of interrupts.

UNIT-V
Communication interface
Synchronous Serial Interface SPI - description – Design issues of Serial Communication Interface (SCI) - Expansion of I / O space -I2C Bus - Principle - Data Transfer on the I2C Bus - Software Implementation – Design of RS232 – Ethernet – Parallel port – USB; Design of parallel port interface-LED, LCD, Keypad- Relays-Solenoids-DC motor- Stepper Motor-Case Study- Microcontroller based PID controllers; Communication between Multiple Processors.

Text Books:
1. ARM Systems Developer's Guides- Designing & Optimizing System Software – Andrew N. Sloss, Dominic Symes, Chris Wright, 2008, Elsevier.
2. Dananjay V. Gadre 'Programming and Customizing the AVR microcontroller', McGraw Hill 2001
3. Ramesh S. Goankar, "Microprocessor Architecture, Programming and Applications with 8085", 5th Edition, Prentice Hall

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

Reference Book:

1 Embedded Systems: Introduction to Arm(r) Cortex -M Microcontrollers by Jonathan W Valvano.
2. Make: AVR Programming by Elliot Williams.
3. Automotive Microcontrollers, volume 2 by Ronald K Jurgen (SAE Publication).
4. Designing Embedded Hardware Second Edition by John Catsoulis (Publisher: O'Reilly Media).

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

- Understand the concepts of microprocessors and micro controllers, micro controller peripheral configurations.
- Understand different micro controllers' assembly language and programming for multi-tasking.
- Acquire knowledge about the concepts of micro controller architecture and architectural inheritance.
- Understand the features of sub systems and peripherals.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-II Semester		L	T	P	C
		4	0	0	4
AUTOMOBILE SENSORS ACTUATORS & DATA ACQUISITION SYSTEM					

Course Objectives: The student will

- Learn the fundamental principles of transducers, classification and understand the different characteristics of the transducers.
- Understand different vehicle body sensors and their working.
- Learn concepts of different automotive vehicle convenience and security systems.
- Study the different Automotive Actuator Technologies– features, operation and application.

UNIT-I
Fundamental Principles of Transducer:
Transducers classification and basic principles, General Input-output configuration, static characteristics and dynamic characteristics of instruments, Variable resistance transducers, Metal and semiconductor strain gages and their signal conditioning, Inductive transducers, Electromagnetic sensors, Hall effect sensors, Capacitive transducers, Piezoelectric transducers and their signal conditioning, Ultrasonic sensors

UNIT-II
Vehicle Sensors:
Vehicle Body: - Torque sensors/ Force sensors, Sensors Flap air flow sensors, Temperature sensor, Ultrasonic sensors, ranging radar (ACC) Power Train: - Fuel level sensors, Speed and RPM sensors, Lambda Oxygen sensor, Hotwire air mass meter, NOX sensors Chassis: - Steering wheel angle sensor, Vibration and acceleration sensors, Pressure sensors, Speed and RPM sensors, torque sensors, roll and yaw sensors

UNIT-III
Automotive Vehicle Convenience and Security Systems:
Tyre pressure monitoring systems, two-wheeler and four-wheeler security systems, parking guide systems, anti-lock braking system, future safety technologies. Vehicle diagnostics and health monitoring, Safety and Reliability, Traction Control, Vehicle Dynamics Control, accelerators and tilt sensors for sensing skidding and anti-collision - anti-collision techniques using ultrasonic Doppler sensors.

UNIT-IV
Actuators:
Automotive Actuator Technologies-Operation and application of Brushed DC and Brushless DC Motor, Magneto-rheological Actuators-Suspension semi active actuators, Magneto - strictive anti vibration actuators, Solenoids and actuators, Piezoelectric Actuators, Micro positioning, Motion Controller-Servo and stepper motors, Smart micro actuators, different types of relays, Switched reluctance motor.

UNIT-V
Data acquisition and processing:
Single channel DAS, Multi-channel DAS, Components used in DAS– Converter Characteristics-Resolution- Non-linearity, settling time, Monotonicity DAS Hardware, DAS Software. Data logger – DIGITAL TO ANALOG CONVERTERS (DACS): Principles and design of – Parallel R– 2R, Weighted resistor, inverted ladder ANALOG TO DIGITAL CONVERTERS (ADCS): Classification of A/D converters. Parallel feedback – Successive approximation – Ramp comparison – Dual slope integration

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

Text Books:

1. D. Patranabis, “Sensors and Transducers”, PHI Learning Private Limited.
2. W. Bolton, “Mechatronics”, Pearson Education Limited

References:

- William B. Ribbens, Understanding Automotive Electronics, 5th edition, Newnes, 2016

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

- Learn the fundamental principles of transducers, classification and understand the different characteristics of the transducers.
- Understand different vehicle body sensors and their working.
- Understand the concepts of different automotive vehicle convenience and security systems.
- Analyse different Automotive Actuator Technologies– features, operation and application.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-II Semester		L	T	P	C
		4	0	0	4
AUTOMOBILE INSTRUMENTATION AND EMBEDDED SYSTEM					

Course Objectives:
- To acquire the knowledge on working of automotive instruments
- To gain knowledge on measurement analysis
- To develop the knowledge on embedded systems
- To attain the knowledge on real time operating system (RTOS)

UNIT-I

Measurement Characteristics:
Instrument Classification, Characteristics of Instruments - Static and dynamic, experimental error analysis, Systematic and random errors, Statistical analysis, Uncertainty, Experimental planning and selection of measuring instruments, Reliability of instruments

UNIT-II

Automotive Instrumentation:
Modern automotive instrumentation - computerized instrumentation system, multiplexing, sampling and advantages - Measurements - fuel quality, coolant temperature, oil pressure vehicle speed, Display devices - LED, LCD, VFD, CRT and types, CAN Bus and wind shield information system.
On board diagnostics - fault code displays. Off board diagnostics - engine data display, expert system occupant protection system - Airbag deployment system security and warning systems.

UNIT-III

Measurement:
Chemical, thermal, magnetic and optical gas analyzers, measurement of smoke, dust and moisture, gas chromatography, spectrometry, measurement of pH, Review of basic measurement techniques.

UNIT-IV

Introduction to Embedded System:
Introduction to functional building blocks of embedded systems - Register, memory devices, ports, timer, interrupt controllers using circuit block diagram representation for each category -Devices, & buses for devices network - serial communication using I2C, CAN, USB buses – parallel communication using ISA, PCI - device drivers in a system - Serial port & parallel port.

UNIT-V

Real Time Operating Systems (RTOS):
Introduction to basic concepts of RTOS, Basics of real time & embedded system operating systems, RTOS – Interrupt handling, task scheduling; embedded system design issues in system development process – Action plan, use of target system, emulator, use of software tools

Text Books
1. William B. Ribbens - Understanding Automotive Electronics, 5th edition- Butter worth Heinemann, Woburn- 2015
2. Rajkamal, 'Embedded System - Architecture, Programming, Design', Tata McGraw Hill, 2013

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

References

1. Daniel W. Lewis 'Fundamentals of Embedded Software', Prentice Hall of India, 2014.
2. Holman, J.P., Experimental methods for engineers, McGraw-Hill, 2013
3. Raman, C.S., Sharma, G.R., Mani, V.S.V., Instrumentation Devices and Systems, Tata McGraw Hill

Course Outcomes: After the completion of the course, the student should be able to

- Familiarize on measurement characteristics
- Acquire the knowledge on working of automotive instruments
- Gain knowledge on measurement analysis
- Develop the knowledge on embedded systems
- Attain the knowledge on real time operating system (RTOS)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

III Year-II Semester		L	T	P	C
		4	0	0	4
AUTOMOBILE ACCIDENT INVESTIGATION					

Course Objectives:
- To familiarize on the effect of the forces acting on a vehicle in motion and during a collision
- To acquire the knowledge on brake and tyre characteristics and their Influence on a vehicle
- To develop knowledge on the Accident reconstruction techniques
- To gain knowledge on damage assessment and cost estimation

UNIT-I
Forces, Effect of Friction and Collision:
Forces during collision- Newton ‘s Laws of motion on a moving vehicle; determination of tractive effort and tractive resistance. Effect of friction on stopping distances, cornering speeds and rolling Deceleration and braking theory; brake efficiency; Vehicle collision: Collision with moving and stationary bodies; conservation of momentum and energy; calculation of impact speeds; Effect of vehicle Projections on impact and load transfer.

UNIT-II
Brakes and its Behavior:
Influence of vehicle brake characteristics on vehicle. Types of brake circuits: single line braking circuit; front and rear split circuit; diagonally split circuit; H-split; L-split; full dual circuit; air/hydraulic circuits; air brake circuits; Types of pressure valves: pressure limiting valves; load sensing valve; inertia sensing valve. Characteristics of brake fluid: types of fluid; constituents; contamination boiling point; vapor lock point Brake defects: braking faults like effect of air in brake fluid, temporary loss of breaking, air contamination, heat soak, uneven braking, brake fade, drum expansion.

UNIT-III
Tyre Behavior and Characteristics:
Influence of vehicle tyre characteristics on vehicle, Tyre Specifications, Vehicle handling and tyre behavior: slip angle; self-aligning torque; cornering force; centrifugal force; cornering power; instantaneous center. neutral steer; under steer; over steer; effects of fault suspension dampers on vehicle handling Factors affecting adhesion, effects of impact or concussion damage.

UNIT-IV
Accident Reconstruction Techniques:
Tyre marks and vehicle damage: skid marks; scuff marks; deceleration scuff and Tyre prints; debris; secondary impact; vehicle position before and after impact. Accident scene construction plans: immediate scene, intermediate scene, extended scene; sketch plans and scale plans using CAD; triangulation, base line and offsets.

UNIT-V
Damage Assessment and Cost Evaluation:
Damage assessment: vehicle details; vehicle condition; body repair; mechanical components; geometry; production of damage assessment report; post-repair inspection. Manufacturer’s down times, computer estimation of paint and materials; cash in lieu of repairs Repair methods and materials: suitability of repair methods; vehicle construction; materials used in vehicle construction; method and types of joining; plastic repairs.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

Text Books:

1. Vehicular Accident Investigation and Reconstruction, Donald J Van Kirk CRC Press, 01-Jan-2012 – Law
2. Accident investigation in the private sector - Volume One, Two and Three by Jack Murray, M.B.A., C.L.I., C.F.E.

References:

1. Road Vehicle Dynamics, Rao S, Dukkipatti
2. Vehicle Accident Analysis and Reconstruction Methods, Second Edition, Raymond Brach, Matthew Brach - Published by SAE International with a Product Code of R-397

Course Outcomes: After the completion of the course, the students should be able to

- Familiarize on the effect of the forces acting on a vehicle in motion and during a collision
- Acquire the knowledge on brake and tyre characteristics and their Influence on a vehicle
- Develop knowledge on the accident reconstruction techniques
- Gain knowledge on damage assessment and cost estimation

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

IV Year-I Semester		L	T	P	C
		4	0	0	4
AUTOMOBILE PRODUCT DESIGN AND DEVELOPMENT					

Course Objectives:

- To familiarize on the basics of engineering design process
- To acquire the concepts of benchmarking for quality improvement
- To gain knowledge on the systematic methods of creative designing
- To get Expertise in the various steps involved in automotive product design
- To get Expertise in the various processes involved in automotive product development

UNIT-I
Engineering Design Process

Need for developing products – importance of engineering design – types of design – design process – relevance of product lifecycle issues in design –designing to codes and standards- societal considerations in engineering design –generic product development process –various phases of product development-planning for products – establishing markets- market segments- relevance of market research. Introduction to Automotive design, History of Automotive design, Car design brands & brand values and Brand history and Styling DNA and Case studies.

UNIT-II
Bench Marking:

Identifying customer needs –voice of customer –customer populations- hierarchy of human needs, data collection methods – affinity diagrams –establishing engineering characteristics-competitive benchmarking-quality function deployment- house of quality- product design specification-case studies.

UNIT-III
Creative Design:

Creative thinking –creativity and problem solving- creative thinking methods- generating design concepts-systematic methods for designing –functional decomposition – physical decomposition –functional representation –morphological methods

UNIT-IV
Product Design:

Decision making –decision theory –utility theory –decision trees –concept evaluation methods –Pugh concept selection method- weighted decision matrix –analytic hierarchy process –introduction to embodiment design – product architecture – types of modular architecture –steps in developing product architecture

UNIT-V
Product Development:

Industrial design –Advance product Quality plan (APQP)- human factors design –user friendly design– design for serviceability – design for environment – prototyping and testing – Production part approval process (PPAP) –Feedback assessment and Corrective action- cost evaluation.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

Text Books:

1. George E.Dieter, Linda Schmidt, "Engineering Design", McGraw-Hill International Edition,4th Edition, 2009,
2. Anita Goyal, Karl T Ulrich, Steven D Eppinger, "Product Design and Development ", 4th Edition, 2009, Tata McGraw-Hill Education

References:

1. Kevin Otto, Kristin Wood, "Product Design", Indian Reprint 2004, Pearson Education
2. YousefHaik, T. M. M. Shahin, "Engineering Design Process", 2nd Edition Reprint, CengageLearning, 2010,
3. Clive L.Dym, Patrick little, "Engineering Design: A Project-based Introduction", 3rd Edition,John Wiley & Sons, 2009.

Course Outcomes: After the completion of the course, the student should be able to

- Familiarize on the basics of engineering design process
- Acquire the concepts of benchmarking for quality improvement
- Gain knowledge on the systematic methods of creative designing
- Expertise in the various steps involved in automotive product design
- Expertise in the various processes involved in automotive product development

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

IV Year-I Semester		L	T	P	C
		4	0	0	4
ANALYSIS AND SYNTHESIS OF MECHANISMS					

Course Objectives:

- To understand the general concepts of kinematics of plane motion.
- To learn the concepts of advanced kinematics of plane motion.
- To understand graphical methods for synthesis with function and path generation.
- To analyze the graphical methods for synthesis with velocity
- To illustrate the synthesis of four-bar mechanisms for prescribed extreme values of the angular velocity of driven link.

UNIT – I
ADVANCED KINEMATICS OF PLANE MOTION- I: Introduction to plane motion. The Inflection circle, Euler – Savary Equation, Bobillier's Construction, Collinear axis, Hartmann's Construction , Inflection circle for the relative motion of two moving planes, Application of the Inflection circle to kinematic analysis.

UNIT – II
ADVANCED KINEMATICS OF PLANE MOTION – II: Polode curvature, Hall's Equation, Polode curvature in the four-bar mechanism, coupler motion, relative motion of the output and input links, Determination of the output angular acceleration and its Rate of change, Freudenstein's collineation –axis theorem, Carter –Hall circle, The circling – point curve for the Coupler of a four-bar mechanism.

UNIT – III
INTRODUCTION TO SYNTHESIS-GRAPHICAL METHODS – I: The Four bar linkage, guiding a body through Two distinct positions, guiding a body through Three distinct positions, The Roto center triangle, Guiding a body through Four distinct positions, Burmester's curve.

UNIT – IV
INTRODUCTION TO SYNTHESIS-GRAPHICAL METHODS – II: Function generation- General discussion, Function generation: Relative – Roto center method, Overlay's method, Function generation-Velocity – pole method, Path generation: Hrones's and Nelson's motion Atlas, Roberts's theorem.

UNIT – V
INTRODUCTION TO SYNTHESIS – ANALYTICAL METHODS: Function Generation: Freudenstien's equation, Precision point approximation, Precision – derivative approximation, Path Generation: Synthesis of Four-bar Mechanisms for specified instantaneous condition, Method of components, Synthesis of Four-bar Mechanisms for prescribed extreme values of the angular velocity of driven link, Method of components.

TEXT BOOKS:
1. Kinematics and Dynamics of plane mechanisms/ Jeremy Hirsch horn/McGraw-Hill.
2. Theory of Machines and Mechanisms/ J. E Shigley and J.J. Uicker Jr. / McGraw-Hill.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

REFERENCES:

1. Design of machinery / Robert L Norton third edition/ McGraw-Hill 2004
2. Theory of Mechanisms and Machines/ Amitabh Ghosh and Ashok Kumar Mallik/ E. W. P. Publishers.
3. Kinematic Linkage Design/ Allen S.Hall Jr. / PHI.
4. Kinematics and Dynamics of Machinery/Charles E Wilson/Pearson/3rd Edition

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

- To understand the general concepts of kinematics of plane motion.
- To learn the concepts of advanced kinematics of plane motion.
- To understand graphical methods for synthesis with function and path generation.
- To analyze the graphical methods for synthesis with velocity
- To illustrate the synthesis of four-bar mechanisms for prescribed extreme values of the angular velocity of driven link.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

IV Year-I Semester		L	T	P	C
		4	0	0	4
GAS DYNAMICS					

Course Objectives: The student will acquire the knowledge

- To learn basic concepts of compressible fluid flow
- To learn the isentropic flow of an ideal gas and effects of back pressure on nozzles
- To learn the simple frictional flow in constant area duct of adiabatic and isothermal Flows
- To learn the conditions to form the shock waves due to the effect of heat transfer in convergent-divergent nozzle
- To understand the difference between finite difference, volume and element method.

UNIT-I

INTRODUCTION TO GAS DYNAMICS: control volume and system approaches acoustic waves and sonic velocity -Mach number - classification of fluid flow based on Mach number - Mach cone- compressibility factor - general features of one-dimensional flow of a compressible fluid - continuity and momentum equations for a control volume.

UNIT-II

ISENTROPIC FLOW OF AN IDEAL GAS: basic equation - stagnation enthalpy, temperature, pressure and density stagnation, acoustic speed - critical speed of sound- dimensionless velocity-governing equations for isentropic flow of a perfect gas - critical flow area - stream thrust and impulse function.
Steady one-dimensional isentropic flow with area change-effect of area changes on flow parameters chocking-convergent nozzle - performance of a nozzle under decreasing back pressure -De Lavel nozzle - optimum area ratio effect of back pressure - nozzle discharge coefficients - nozzle efficiencies.

UNIT-III

SIMPLE FRICTIONAL FLOW: adiabatic flow with friction in a constant area duct-governing equations – Fanno line limiting conditions - effect of wall friction on flow properties in an Isothermal flow with friction in a constant area duct-governing equations - limiting conditions.
Steady one-dimensional flow with heat transfer in constant area ducts- governing equations – Rayleigh line entropy change caused by heat transfer - conditions of maximum enthalpy and entropy.

UNIT-IV

EFFECT OF HEAT TRANSFER ON FLOW PARAMETERS: Intersection of Fanno and Rayleigh lines. Shock waves in perfect gas- properties of flow across a normal shock - governing equations – Rankine - Hugoniat equations - Prandtl velocity relationship - converging diverging nozzle flow with shock thickness - shock strength.

UNIT-V

Computational Fluid Dynamics: Conservation of mass, Newton's second law of motion, expanded forms of Navier-stokes equations (Derivation), conservation of energy principle, and special forms of the Navier-stokes equations. Difference between Finite Difference, Volume and Element Methods

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

Text Books:

1. Compressible fluid flow /A. H. Shapiro / Ronald Press Co., 1953
2. Fundamentals of compressible flow with aircraft and rocket propulsion/S. M. Yahya/New Age international Publishers
3. Fundamental of Gas dynamics-2nd edition/ M J Zucker/ Wiley publishers
4. Computationalfluiddynamics-Basics with applications/John.D.Anderson/McGraw-Hill

References:

1. Elements of gas dynamics / HW Liepman&A Roshko/Wiley
2. Aircraft & Missile propulsion /MJ Zucrow/Wiley
3. Gas dynamics / M.J. Zucrow& Joe D.Holfman / Krieger Publishers

Course Outcomes: The student at the end of the course will be able

- To learn basic concepts of compressible fluid flow
- To learn the isentropic flow of an ideal gas and effects of back pressure on nozzles
- To learn the simple frictional flow in constant area duct of adiabatic and isothermal Flows
- To learn the conditions to form the shock waves due to the effect of heat transfer in convergent-divergent nozzle
- To understand the difference between finite difference, volume and element method.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)

IV Year-I Semester		L	T	P	C
		4	0	0	4
GEAR ENGINEERING					

Course Objectives:

- To understand the principles of gear tooth action and spur gears.
- To illustrate the concepts of helical and bevel gears.
- To interpret the design considerations and methodology of worm gear teeth and gear failures.
- To analyze design of gear trains for various applications.
- To understand the optimization of gear design parameters

UNIT-I

Introduction: Principles of gear tooth action, Generation of Cycloid and Involute gears, Volutomitrid, gear manufacturing processes and inspection, gear tooth failure modes, stresses, selection of right kind of gears.
Spur Gears: Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of spur gear teeth considering Lewis's beam strength, Buckingham's dynamic load and wear load, Design of gear shaft and bearings, AGMA standards.

UNIT-II

Helical Gears: Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of helical gear teeth considering Lewis's beam strength, Buckingham's dynamic load and wear load, Design of gear shaft and bearings, AGMA standards.
Bevel Gears: Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of bevel gear teeth considering Lewis's beam strength, Buckingham's dynamic load and wear load, Design of gear shaft and bearings.

UNIT-III

Worm Gears: Tooth loads, Principles of Geometry, Design considerations and methodology, complete design of worm gear teeth considering Lewis's beam strength, Buckingham's dynamic load and wear load, Heat dissipation considerations. Design of gear shaft and bearings.
Gear failures: Analysis of gear tooth failures, Nomenclature of gear tooth wear and failure, tooth breakage, pitting, scoring, wear, overloading, gear-casing problems, lubrication failures

UNIT-IV

Gear trains: Simple, compound and epicycle gear trains, Ray diagrams, Design of a gear box of an automobile, Design of gear trains from the propeller shafts of airplanes for auxiliary systems.

UNIT-V

Optimal Gear design: Optimization of gear design parameters, Weight minimization, Constraints in gear train design-space, interference, strength, dynamic considerations, rigidity etc. Compact design of gear trains, multi objective optimization of gear trains. Application of Traditional and non-traditional optimization techniques

TEXT BOOKS:

1. Maleev and Hartman, Machine Design, C.B.S. Publishers, India.
2. Henry E.Merrit,Gear engineering, Wheeler publishing, Allahabad, 1992.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA - VIZIANAGARAM
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

REFERENCES:

1. Practical Gear design by Darle W. Dudley, McGraw-Hill
2. Earle Buckingham, Analytical mechanics of gears, Dover publications, New York, 1949.
3. G.M.Maitha, Hand book of gear design, Tata McGraw Hill publishing company Ltd., New Delhi,1994.

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

- Understand the principles of gear tooth action and spur gears.
- Illustrate the concepts of helical and bevel gears.
- Interpret the design considerations and methodology of worm gear teeth and gear failures.
- Analyze design of gear trains for various applications.
- Understand the optimization of gear design parameters.