Important Academic Rules

Scheme of Studies & Syllabus

B.Tech. Degree Programme
Automobile Engineering
(Effective from 2009-2010)

LINGAYA'S UNIVERSITY
choose to know

(u/s 3 of UGC Act 1956)
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ABBREVIATIONS/DEFINITIONS

- "AC" means, Academic Council of the University.
- "BOM" means, the Board of Management of the University.
- "BOS" means, the Board of Studies of the Department.
- "CAU/AUC-option" CAU/AUC means change from Credit to Audit option / change from Audit to Credit option.
- "Class/Course Committee" means, the Class/Course Committee of a class/course.
- "Course" means, a specific subject usually identified by its course-number and course-title, with a specified syllabus / course-description, a set of references, taught by some teacher(s) / course-instructor(s) to a specific class (group of students) during a specific academic-semester / term.
- "Course Instructor" means, the teacher or the Course Instructor of a Course.
- "Curriculum" means the set of Course-Structure and Course-Contents.
- "DAA" means, the Dean of Academic Affairs.
- "DAAB" means Departmental Academic Appeals Board.
- "DEC/PEC" means Dissertation Evaluation Committee / Project Evaluation committee.
- "Department" means a group in the University devoted to a specific discipline also called a School. Department and School are used interchangeably.
- "DSA" means, Dean Student Affairs.
- "ETE" means End Term Examination.
- "Faculty Advisor/Class Counsellor" means, the Faculty Advisor or the Panel of Faculty Advisors, in a Parent Department, for a group (admission-batch) of students. Also known as Class Counsellor.
- "Grade Card" means the detailed performance record in a term/programme.
- "He" means both genders “he” and “she”; similarly "his" and/or "him" includes "her" as well, in all the cases.
- "HOD" means, the Head of the Department.
- "MET" means Make-up End Term.
- "MLC" means Mandatory Learning Course.
- "MTE" means Mid Term Examination.
- "Parent Department" or "Degree Awarding Department" means, the department that offers the degree programme that a student undergoes.
- "Project Guide" means, the faculty who guides the Major Project of the student.
- "Regulations" means, set of Academic Regulations.
- "University" or “LU” means, Lingaya’s University, Faridabad
- "VC" means, the Vice Chancellor, Lingaya’s University, Faridabad.
B.Tech. Automobile Engineering (Regular)

CODE OF CONDUCT AND ETHICS FOR STUDENTS

1. Wear decent dress respecting his/her modesty as well as that of others.
2. Expected to respect and show regard for teachers, staff and fellow students.
3. Inculcate civic sense and sensitivity for environment protection.
4. Not to resort to collection of funds for any use without written permission of VC.
5. To exhibit exemplary behaviour, discipline, diligences, and good conduct and are a role model to other students.
6. Not to indulge in offences of cognizable nature.
7. Not to practice casteism, communalism.
8. Not to indulge in any other conduct unbecoming of a professional student of the University.
9. Not to outrage the status, dignity and honour of any person.
10. Not to get involved in physical assault or threat, and use of physical force against any body.
11. Not to expose fellow students to ridicule and contempt that may affect their self esteem.
12. Not to form any kind of student’s Union, etc.
13. Not to take active or passive part in any form of strikes/protests.
14. To observe all safety precautions while working.
15. Not to disfigure/damage the University property, building, furniture, machinery, library books, fixtures, fittings, etc. (Damage / loss caused shall have to be made good by the students).
16. Use of mobile/video camera phones is strictly prohibited inside the examination halls, class rooms, laboratories and other working places. LU has the right to confiscate the mobile phones in case of any violation.
17. Not to indulge in ragging/teasing, smoking, gambling, use of drugs or intoxicants, drinking alcohol, rude behavior, and use of abusive language.
18. Not to resort to violence, unruly travel in buses, bullying, threatening and coercing others for undesirable act, such as preventing from attending classes, writing exam. / tests, etc etc.
19. All the students of the LU shall be under the disciplinary control of the VC.
20. Students are deemed to be under the care and guidance of parents. It is obligatory for the former to appraise their progress (given by the CC) to the parents.
21. Fine, if ever imposed, is only to improve discipline and shall be paid promptly.
22. While on campus, students have to take care of their belongings and no responsibility for any loss or damage can be held by the University.
23. Every student shall produce the I-Card on demand, and if lost, get a duplicate issued.
24. The students must attend all lectures, tutorials and practical classes in a course punctually (The attendance will be counted course-wise).
25. To abide by the rules and regulations of the University stipulated from time to time.
### IMPORTANT ACADEMIC RULES

#### B.Tech. Degree Programme (Regular)

**GENERAL**
- The Regulations may evolve and get revised/refined or updated or amended or modified or changed through approvals from the Academic Council from time to time, and shall be binding on all parties concerned, including the Students, Faculty, Staff, Departments, University Authorities and officers. Further, any legal disputes shall be limited to the legal jurisdiction determined by the location of the University and not that of any other parties.
- If, at any time after admission, it is found that a candidate had not in fact fulfilled all the requirements stipulated in the offer of admission, in any form whatsoever, including possible misinformation etc., the matter will be reported to the AC, recommending revoking the admission of the candidate.
- The University reserves the right to cancel the admission of any student at any stage of his study if, in the opinion of the AC, the candidate.
- The student has to opt for the Internship Scheme in the University on the grounds of unsatisfactory academic performance or indiscipline or any misconduct.
- Medium of Instruction shall be English.

**PROGRAMME**
- The normal duration of the programme leading to B.Tech degree will be four years comprising twelve trimesters (or terms).
- The B.Tech. Degree programme consists of two modes i.e. (a) Project Mode and (b) with Internship.
- The total course package for a Regular B.Tech Degree Programme with Project Mode will typically consist of the following components.
  1. General courses
  2. Basic Science and Mathematics
  3. Engineering Science and Technical Arts
  4. Core Courses
  5. Elective Courses
     - An Elective Course can be any of the following:
       a) Departmental Elective
       b) Open Elective
  6. Project/Internship (Supervised)
  7. Major Project/Internship (Supervised)
  8. Industrial Training
  9. Mandatory Learning Courses
- The Regular B. Tech. Degree Programme with internship will typically consist of all the components of the Regular Project Mode as above, however with different weightage to industrial training and core courses.
- The student has to opt for the Internship Scheme in the ninth term which will not be revoked in any circumstances. In the absence of exercising the option, it will be presumed that option is for Project Mode.
- A student having registered for internship scheme of a programme cannot opt out of that scheme.
- The minimum credit requirement for the B.Tech. Degree programme is 190. However, considering a case for award of honours the minimum credits will be 195.
- The project will be assigned in tenth term. It may be extended to Major Project. The Major Project shall comprise of Phase-I and Phase-II, spread over eleventh and twelfth terms. Appropriate double-letter grade is awarded as per the evaluation scheme which will be considered for TGPA and CGPA calculations. It is recommended that an external expert from industry/academia may be a member of the evaluation team of four persons (two professors, external expert and respective project guide).
- MLC must be completed by a student at appropriate time or at his convenience. The ‘S’ grade is awarded for satisfactory completion of the course and ‘N’ grade is awarded for non-satisfactory completion of the course. In case ‘N’ grade is awarded, the student has to re-register for the same course if no alternative options are available. However, one can opt for other courses if provided with multiple options. The ‘S’ and ‘N’ grades do not carry grade-points and, hence, are not included in the TGPA and CGPA computations.
- Courses that come under this category are the following:
  a) Environment Science and Ecology
  b) Community Service Oriented Project
  c) Professional Development Courses
- Students admitted to the University will be required to take suitable additional Courses in Mathematics (5-0-0) and or Communication Skills (3-0-0), if found deficient.

**ASSOCIATION**
- Every under graduate student of the University shall be associated with Parent Department (degree awarding department) offering the degree programme that the student undergoes throughout his study period, right from the very first day of admission into the programme. However, in the first year class he may report to the Dept. of Applied Science and Humanities for administrative/academic purpose.
- A student will be placed in GROUP-A/B/C for all the three terms in an academic year.
- The schedule of academic activities for a term, including the dates of registration, mid-term examinations (MTE), end-term examination (ETE), inter-semester vacation, etc. shall be referred to as the Academic Calendar of the term, and announced at least two weeks before the closing date of the previous term.

**PRE-REGISTRATION**
- In order to facilitate proper planning of the academic activities of a term, it is essential for the students to declare their intent to register for a course well in advance, before the actual start of the academic
session, through the process of Pre-Registration, which is mandatory for all those students of second or subsequent term who propose to deviate from recommended scheme of studies.

- Pre-registration is an expression of intention of a student to pursue particular course(s) in the next term. It is information for planning for next term. Every effort will be made to arrange for a course opted by the student. However, it is not obligatory on the part of the university to offer the course(s) and no course may be offered if the number of students opting for the course is less than 15 or 25 percent of the admission strength whichever is less.

- If a student fails to pre-register it will be presumed that he will follow suggested normal scheme of studies provided that he is progressing at a normal pace. For remaining students the HOD of the parent department will plan for courses as per the convenience of the department.

REGISTRATION TO COURSES

- Every Student after consulting his Faculty-Advisor is required to register for the approved courses with the HOD of parent department at the commencement of each term on the days fixed for such registration as notified in the academic calendar.

- A student shall register for courses from amongst the courses being offered in the term keeping in mind the minimum and maximum credits allowed for a degree and other requirements i.e. pre-requisite if any, TGPA and CGPA after consulting the Faculty Advisor. No registration will be valid without the consent of HOD of the parent department.

- A student will be permitted to register in the next term as per the suggested normal scheme only if he fulfills the following Conditions:
  (a) Satisfied all the Academic Requirements to continue with the programme of studies without termination.
  (b) Cleared all university, library and hostel dues and fines (if any) of the previous term.
  (c) Paid all required advance payments of the university and hostel for the current term.
  (d) Not been debarred from registering on any specific ground by the University.

- The students will be permitted to register for course(s) being offered in a term other than his normal suggested scheme provided that the time table permits.

- The registration in the critical cases will be done as per the priority given below:
  (a) Fulfillment of minimum credit requirement for continuation,
  (b) The completion of programme in minimum period needed for degree, (Those who need to improve TGPA/CGPA)
  (c) The fulfillment of pre-requisite requirement of courses.

- Students who do not register on the day announced for the purpose may be permitted LATE REGISTRATION up to the notified day in academic calendar on payment of late fee.

- REGISTRATION IN ABSENTIA will be allowed only in exceptional cases with the approval of the DAA after the recommendation of HOD through the guardian of the student.

- Credits will be awarded in registered courses only.

CREDIT LIMITS

- A student of the B.Tech. degree programme must register for a minimum of 10 credits, and up to a maximum of 21 credits in a Term. However, the minimum / maximum credit limit can be relaxed by the DAA on the recommendation of the HOD, only under exceptional circumstances. The maximum credits that a student can register in a Summer Term are 8.

- Professional Development courses are one credit courses each, with multiple options, to be completed at student's convenience in each Term. Some of them may be mandatory and others two-letter grade category. However, registration has to be done for all courses.

CHANGE IN REGISTRATION

- A student has the option to ADD courses for registration till the date specified for late registration in the Academic Calendar.

- On recommendation of the Teaching Department as well as the Parent Department, a student has the option to DROP courses from registration until two weeks after the commencement of the classes in the term, as indicated in the Academic Calendar.

- A student can register for auditing a course, or a course can be converted from credit to audit or from audit to credit, with the consent of the Faculty Advisor and Course Instructor within two weeks after the commencement of the classes in the term as indicated in the Academic Calendar. However, CORE Courses shall not be available for audit.

ATTENDANCE REQUIREMENTS

- LU academic programmes are based primarily on the formal teaching-learning process. Attendance in classes, participating in classroom discussions and participating in the continuous evaluation process are the most essential requirements of any academic programme.

- Attendance will be counted for each course scheduled teaching days as per the academic calendar.

- The attendance requirement for appearing in end term examination shall be a minimum of 75% of the classes scheduled in each course.

LEAVE OF ABSENCE

- The leave of absence must be authorized as per regulations.

- A student short of attendance in a course (less than needed after leave of absence and condonation by VC) will be awarded 'FF' grade in the course.

- All students must attend all lecture, tutorial and practical classes in a course. The attendance will be counted course wise.

- To account for approved leave of absence e.g. representing the University in sports, games or athletics; professional society activities, placement
activities, NCC/NSS activities, etc. and/or any other such contingencies like medical emergencies, etc., the attendance requirement shall be a minimum of 75% of the classes scheduled in each course to appear in the examination.

• A student with less attendance in a course during a trimester, in lectures, tutorials and practicals taken together as applicable, shall be awarded 'FF' grade in that course, irrespective of his academic performance, and irrespective of the nature of absence.

• If the period of leave is more than three days and less than two weeks, prior application for leave shall have to be submitted to the HOD concerned, with the recommendation of the Faculty-Advisor, stating fully the reasons for the leave requested, along with supporting documents.

• If the period of leave is two weeks or more, prior application for leave shall have to be made to the DAA with the recommendations of the Faculty-Advisor, HOD concerned stating fully the reasons for the leave requested, along with the supporting documents. The DAA may, on receipt of such application, grant leave or decide whether the student be asked to withdraw from the course for that particular term because of long absence.

• If a student fails to apply and get sanction for absence as in (a) and (b) above, his parent/guardian may apply to the VC with reasons duly recommended by the faculty advisor, HOD and DAA and explain in person to the VC the reasons for not applying in time. The VC will consider on merit and decide to grant the leave or withdrawal from the course for that particular term subject to any condition that he may like to impose. The decision of the VC shall be final and binding.

ABSENCE DURING EXAMINATIONS

• A student who has been absent during MTE due to illness and/or any exigencies may give a request for make-up examination within one week after the MTE to the HOD with necessary supporting documents in person. The HOD may consider such requests depending on the merits of the case, and after consultation with the Course Instructor, may permit the Make-up examination for the student concerned. However, no makeup examination will be permitted if the attendance in the course is less than 60% till the date of examination.

• In case of absence from ETE of a course(s) on Medical ground and/or other special circumstances, the student can apply for award of 'I' grade in the course(s) with necessary supporting documents and certifications by an authorized person to the HOD within one week after the ETE. The HOD may consider the request, depending on the merit of the case, and after consultation with the Course(s) Instructor(s)/ Faculty Advisor permit the MET Examination for the student concerned. The student may subsequently complete all course requirements within the date stipulated by BOS (which may possibly be extended till first week of term under special circumstances) and 'I' grade will then converted to an appropriate Double-letter grade, as per Clause No: G5.9. All the details of such a decision with date of finalizing the grade shall be communicated to DAA. If such an application for the 'I' grade is not made by the student then a double-letter grade will be awarded based on his term performance.

COURSE CREDIT ASSIGNMENT

• Every course comprises of specific Lecture-Tutorial-Practical (L-T-P) schedule. The credits for various courses are shown in the Scheme of Studies & Syllabus.

• The Academic Performance Evaluation of a student shall be according to a Letter Grading System, based on the Class Performance Distribution.

• The double-letter grade (AA, AB, BB, BC, CC, CD, DD, FF) indicates the level of academic achievement, assessed on a decimal (0-10) scale.

Letter-Grades and Grade-Points:

<table>
<thead>
<tr>
<th>LETTER- GRADE</th>
<th>GRADE- POINTS</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>AB</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>BB</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>BC</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>CC</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>CD</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>DD</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>FF</td>
<td>0</td>
<td>Fail</td>
</tr>
<tr>
<td>I</td>
<td>-</td>
<td>Incomplete</td>
</tr>
<tr>
<td>U</td>
<td>-</td>
<td>Audited</td>
</tr>
<tr>
<td>W</td>
<td>-</td>
<td>Withdrawal</td>
</tr>
<tr>
<td>S</td>
<td>-</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>N</td>
<td>-</td>
<td>Unsatisfactory</td>
</tr>
</tbody>
</table>

DESCRIPTION OF GRADES

• An 'AA' grade stands for outstanding performance, relative to the class in which may include performance with previous batches. The Course Instructor is supposed to take utmost care in awarding of this highest double-letter grade.

• The ‘DD’ grade stands for marginal performance and is the minimum passing double-letter grade.

• The 'FF' grade denotes very poor performance, i.e. failure in a course, and the Course Instructor is supposed to take utmost care while awarding this lowest double-letter grade.

• A student, who obtains 'FF' grade in a core course, has to repeat (re-register) that core course, in subsequent terms/sessions whenever the course is offered, until a passing grade is obtained. However, for an elective course in which 'FF' grade has been obtained, the student may either repeat the same course, or register for any other elective course.

• An 'I' grade denotes incomplete performance in any course due to absence at the end term examination (see also Clause No: G7.4). When the 'I' grade is converted to a regular double
letter grade, a penalty of ONE Grade-Point is imposed, by awarding the double-letter grade that is immediately below the one that the student would have otherwise received except when the student has 95% attendance record in the subject concerned. For example, if on the basis of the performance including MET Examination, a student gets AB grade, he will be awarded BB grade if not under exception rule.

- ‘U’ grade is awarded in a course that the student opts to register for audit. It is not mandatory for the student to go through the entire regular process of evaluation in an audit course. However, the student has to go through some process of minimal level of evaluation and also the minimum attendance requirement, as stipulated by the Course Instructor and approved by the corresponding BOS, for getting the ‘U’ grade awarded in a course, failing which that course will not be listed in the Grade Card.

- A ‘W’ grade is awarded when the student withdraws from the course. Withdrawal from a course is permitted only under extremely exceptional circumstances (like medical emergencies, family tragedies and/or other unavoidable contingencies) and has to be recommended by the HOD and approved by the DAA. However, no withdrawal is permitted after the finalization of the grades in the term.

- ‘S/N’ grades are awarded for the Mandatory Learning Courses. The ‘S’ grade denotes satisfactory performance and completion of a course. The ‘N’ grade is awarded for non-completion of course requirements and the student will have to register for the course until he obtains the ‘S’ grade.

FEEDBACK TO STUDENTS

- A student requires feedback on the progress of his learning. For this purpose, the Instructor will conduct at least two quizzes for a theory course in a term-one before MTE and the other there after. The quizzes will form a component of class work, the other components being tutorials, home assignments or any other mode.

- For a laboratory course, the continuous assessment’s feedback will be given through the laboratory records which are required to be submitted after performing the experiment in the next laboratory class.

- The continuous feedback on project/major project will be through project diary and interim report.

- For Internship stream, the continuous assessment and feedback is to be through seminars, professional diary and interim reports at the place of work.

EVALUATION

Theory Course:

- The double-letter grade awarded to a student in a course other than a practical course, i.e. it shall be denoted by L-T-0 course for which he has registered, shall be based on his performance in quizzes, tutorials, assignments etc., as applicable, in addition to one MTE and ETE. The weightage of these components of continuous evaluation may be as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weightage</th>
</tr>
</thead>
<tbody>
<tr>
<td>End-term Examination</td>
<td>50%</td>
</tr>
<tr>
<td>Mid-term Examinations</td>
<td>30%</td>
</tr>
<tr>
<td>Quizzes, Tutorials, Assignments etc.</td>
<td>20%</td>
</tr>
<tr>
<td>(Several over the term)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
</tr>
</tbody>
</table>

Laboratory Course:

- The double letter grade awarded to the student in a practical course i.e. 0-0-P course will be based on his performance in regular conduct of experiments, viva voce, laboratory report, quizzes etc., in addition, to term practical examination. The weightage of the components of continuous evaluation may be as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weightage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conduct of Experiments (as per syllabus)</td>
<td>40%</td>
</tr>
<tr>
<td>Lab Record</td>
<td>10%</td>
</tr>
<tr>
<td>Quizzes/Viva Voice</td>
<td>20%</td>
</tr>
<tr>
<td>End-term Examination</td>
<td>30%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
</tr>
</tbody>
</table>

Project (Including Seminar):

- The double letter grade awarded to the student in Project (Includes Seminar) i.e. 0-0-P course will be based on his performance in technical work pertaining to the solution of a small size problem, project report, and presentation of work and defending it in a viva-voce. The weightage of the components of continuous evaluation may be as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weightage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Work</td>
<td>50%</td>
</tr>
<tr>
<td>Report</td>
<td>25%</td>
</tr>
<tr>
<td>Seminar, Presentation &amp; Viva-voce</td>
<td>25%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
</tr>
</tbody>
</table>

Major Project:

- The double letter grade awarded to the student in Major Project Phase-I and Phase-II i.e. 0-0-P course will be based on his performance in technical work pertaining to the solution of a problem, project report, presentation and defending in a viva-voce. The weightage of the components of continuous evaluation may be as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weightage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Work</td>
<td>50%</td>
</tr>
<tr>
<td>Report</td>
<td>25%</td>
</tr>
<tr>
<td>Presentation &amp; Viva-voce</td>
<td>25%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
</tr>
</tbody>
</table>

Internship:

- The Internship-II will be treated as Major Project for evaluation purpose. The double letter grade awarded to the student in Internship-II i.e. 0-0-P course will be based on his performance in technical work pertaining to the solution of a real-life problem, project report, presentation and defending in a viva-voce. The weightage of the components of continuous evaluation may be as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weightage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Work</td>
<td>50%</td>
</tr>
<tr>
<td>Report</td>
<td>25%</td>
</tr>
<tr>
<td>Presentation &amp; Viva-voce</td>
<td>25%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
</tr>
</tbody>
</table>

The continuous assessment and feedback is to be through seminars, professional diary and entering report at the place of work.
Seminar:
• The double letter grade awarded to the student in Seminar i.e. 0-0-P course will be based on his performance in oral presentation with emphasis on technical contents, presentation and ability to answer questions. The weightage of the components of continuous evaluation may be as follows:
  - Technical Contents: 40%
  - Presentation: 30%
  - Questions and answers: 30%
  - Total: 100%

Industrial/Field Training/Internship-I:
• The double letter grade awarded to the student in Industrial/Field Training/Internship-i.e. 0-0-P course will be based on Practical Training/Internship in an industry, professional organization/ research laboratory. The components of continuous evaluation with weightage may be as follows:
  - Training report: 40%
  - Presentation: 30%
  - Questions and answers: 30%
  - Total: 100%

Professional Development:
• There are 14 credits divided into 14 courses of one credit each. The evaluation process of these courses will be as per the nature, contents and delivery of these courses. Some of the common components of evaluation could be quizzes, viva-voce, practical test, group discussion, etc. Participation by students is to be given more weightage in Co-curricular courses.

SCHEME OF EXAMINATION
• The duration of examinations for a theory course will be 3 hours for ETE and 1½ hours for MTE.
• The pattern of question paper/examination will be as under:

  Theory Courses:
  The University shall conduct the ETE for all theory courses being taught in the term.
  (a) There will be eight questions in all distributed over all the units in a course syllabus. The question paper will be in three parts with weightage 20 percent, 40 percent and 40 percent respectively.
  (b) Part-A will be short answer type with multiple choice type in order to measure ability on comprehension / transparence / application. The relevant data will be made available. The student is required to answer any one. The external examiner may select the questions from the question bank supplied by the University.
  (c) The student will be given randomly an experiment to perform from within the list of experiments in the course.
  (d) No change in the experiment will be permitted after the draw, if the student had performed the same in the class.

  Mid-Term Examination:
  Question 1 is compulsory covering all topics taught till then. Question 2 and 3 will be essay type, out of which student will answer any one. Question 4 and 5 will be to measure ability of analysis / comprehension / synthesis / application. The student will answer any one.

TRANSPARENCY
• The answer books of all MTE and ETE will be shown to the students within three days of the last paper. It is the responsibility of the student to check this evaluation and affix his signature in confirmation.
• If the student finds some discrepancy, he should bring it to the notice of the Course Coordinator. The Course Coordinator will look into the complaint and remove the doubts of the student and proceed with the work of grading.
• The entire process of evaluation shall be transparent, and the course instructor shall explain to a student the marks he is awarded in various components of evaluation.

RESULT
• The final marks shall be displayed on the notice board for ONE day, (the date of which will be indicated in the academic calendar). A student can approach the Course Instructor(s) concerned for any clarification within Two days of display. The process of evaluation shall be transparent and the students shall be made aware of all the factors included in the evaluation. In case of any correction, the Course Instructor shall have to incorporate the same before finalization of the grades.
• The Student’s Grade Card shall contain the Letter-Grade for each registered course; along with the TGPA at the end of the term, and the CGPA at the completion of the programme.

APPEAL FOR REVIEW OF GRADE
• If a student is not satisfied with the award of the grade after the announcement of the grades, he may appeal on a Gnevance Form duly filled in along with the fee receipt for this purpose to the
HOD of the parent department within one week of the following term. The HOD will forward the form along with his recommendation based on the records of the case to DAAB within the date specified in the Academic Calendar.

- The fee for such an appeal will be decided from time to time. If the appeal is upheld by DAAB, then the fee amount will be refunded to the student without interest.
- VC shall have power to quash the result of a candidate after it has been declared, if
  (a) He is disqualified for using malpractice in the examination;
  (b) A mistake is found in his result;
  (c) He is found ineligible to appear in the examination

**AWARD OF DIVISIONS**

- The overall performance of a student will be indicated by two indices:
  (i) **TGPA** which is the Term Grade Point Average
  (ii) **CGPA** which is the Cumulative Grade Point Average

**TGPA for a Term is computed as follows:**

\[ TGPA = \frac{\sum CiGi}{\sum Ci} \]

Where,

- \( Ci \) denotes credits assigned to \( i^{th} \) course with double-letter grade, and \( Gi \) denotes the grade point equivalent to the letter grade obtained by the student in \( i^{th} \) course with double-letter grade, including all ‘FF’ grades in that term.

**CGPA is computed as follows:**

\[ CGPA = \frac{\sum CiGi}{\sum Ci} \]

Where,

- \( Ci \) denotes credits assigned to \( i^{th} \) course with double-letter grade, and \( Gi \) denotes the grade point equivalent to the letter grade obtained by the student in \( i^{th} \) course for all courses with double-letter grades, including all ‘FF’ grades in all terms at the end of the programme.

For CGPA calculation, the following grades are to be counted:

(i) Grades in all core courses,
(ii) The best grades in the remaining eligible courses to fulfill the minimum credits requirement for a programme.

- The degree will be awarded only upon compliance of all the laid down requirements for programme as under:
  (i) There shall be University requirement of earning a minimum credits for a degree, satisfactory completion of mandatory learning courses and other activities as per the course structure.
  (ii) There shall be a minimum earned credit requirement on all Departmental Core Courses, Elective courses and Major Project/Internship as specified by the BOS.
  (iii) There shall be a maximum duration for complying with the degree requirement.
  (iv) The candidate will be placed in First Division with Honours/First Division with Distinction/First Division/Second Division which will be mentioned on the degree certificate as under:

<table>
<thead>
<tr>
<th>DIVISION</th>
<th>CONDITIONS TO BE FULFILLED</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Division</td>
<td>CGPA ≥ 8.5</td>
</tr>
<tr>
<td>with Honours</td>
<td>No ‘FF’, N or W grade in any course during the programme and total 195 credits</td>
</tr>
<tr>
<td>First Division with Distinction</td>
<td>CGPA ≥ 8.5</td>
</tr>
<tr>
<td>First Division</td>
<td>CGPA ≥ 6.75</td>
</tr>
<tr>
<td>Second Division</td>
<td>CGPA ≥ 5.0 but &lt; 6.75</td>
</tr>
</tbody>
</table>

Note:
Although, there is no direct conversion from grades to marks, however, for comparison purposes percentage of marks may be assumed to be CGPA multiplied by nine.

**B. TECH. DEGREE REQUIREMENTS**

- The requirements of the award of B.Tech. Degree programme are as follows:

  (a)  **University Requirements:**
    (i) Minimum Earned Credit Requirement for Degree is 190 for regular programme. However, the credits required for consideration for honours degree will be 195.
    (ii) Satisfactory completion of all Mandatory Learning Courses.

  (b)  **Programme Requirements:**
    Minimum Earned Credit Requirements on all Core Courses, Elective Courses and Major Project/Internship as specified by the BOS.

  (c)  The CGPA at the end of programme is atleast 5.0.

  (d)  The Maximum duration for a student for complying with the Degree Requirement is SEVEN years from date of first registration for first Term.

**GRADE IMPROVEMENT**

- A student may be allowed to improve the TGPA in an appropriate Term, if his TGPA falls below 5.0. Similarly, any student may be allowed to improve performance in any course provided the course is being floated and available.

**TERMINATION FROM THE PROGRAMME**

- A student shall be required to leave the University without the award of the Degree, under one or more of the following circumstances:
  (1) If a student fails to earn the minimum credits specified below:

<table>
<thead>
<tr>
<th>CHECK POINT</th>
<th>CREDIT THRESHOLD**</th>
</tr>
</thead>
<tbody>
<tr>
<td>End of FIRST year</td>
<td>20*</td>
</tr>
<tr>
<td>End of SECOND year</td>
<td>50*</td>
</tr>
<tr>
<td>End of THIRD year</td>
<td>85</td>
</tr>
<tr>
<td>End of FOURTH year</td>
<td>125</td>
</tr>
</tbody>
</table>

- A student may also be terminated on grounds of moral turpitude, misbehavior, or for any other reason as the University may consider fit to terminate the student.
Note 1:
* A student may be given one more chance to cover the shortfall in the threshold during the following summer term as follows:
  (i) if a student earns 12 credits or more but less than 20 at the end of first year.
  (ii) if a student earns 42 or more credits but less than 50 at the end of second year.
    In case he fails to clear the threshold even after the summer term he has to leave the course.
** If at any stage, a student fails to cross the threshold with a TGPA of minimum 5.0 in any term, he will be treated as critical case and will be advised to improve the grades.

Note 2:
The period of temporary withdrawal is not to be counted for the above credit threshold.

(2) If a student is absent for more than 4 (four) weeks at a stretch in a term without sanctioned leave.
(3) Based on disciplinary action by the AC, on the recommendation of the appropriate committee.

Note:
Under any circumstances of termination, the conditions specified in permanent withdrawal shall also apply.

WITHDRAWAL FROM PROGRAMME

Temporarily:
• A student who has been admitted to a degree programme of the University may be permitted to withdraw temporarily, for a period of one term or more, on the grounds of prolonged illness or grave calamity in the family, etc., provided:
  (i) He applies to the University stating fully the reasons for withdrawal together with supporting documents and endorsement from his parent/guardian
  (ii) There are no outstanding dues or demands, from the Departments/ University / Hostels/Library and any other centers;
  (iii) Scholarship holders are bound by the appropriate Rules applicable to them.
  (iv) The decision of the VC of the University regarding withdrawal of a student is final and binding.
• Normally, a student will be permitted only one such temporary withdrawal during his tenure as a student and this withdrawal will not be counted for computing the duration of study.

Permanently:
• Any student who withdraws permanently admission before the closing date of admission for the academic session is eligible for the refund of fee as per the University rules. Once the admission for the year is closed, the following conditions govern withdrawal of admission:
  • A student who wants to leave the University for good, will be permitted to do so (and take Transfer Certificate from the University, if needed), only after clearing all the dues for the remaining duration of the course.
  • A student who has received any scholarship, stipend or other form of assistance from the University shall repay all such amounts, in addition, to clearing all the dues for the remaining duration of the course.
• The decision of the VC regarding all aspects of withdrawal of a student shall be final and binding.
Department of Automobile Engineering

DEGREE OBJECTIVE

The objective of this programme is to provide the student adequate knowledge of basic Automobile Engineering concepts, working principles related to design and manufacturing service and maintenance. The student will be able to understand and implement the procedure for pollution control, legal aspects such as motor vehicle act, fleet management, Insurance, registration of vehicles under different State Body control, emission standards.

By the application of knowledge from other branches of engineering such as electronics, electrical and computer science, students would be able to develop advanced technology in the development of automobiles. Broadly, the major courses covered through the segments/divisions of the programme are:

i) BASIC CONCEPTS
Motor Vehicle Technology, Electronics, Micro Processor, Automotive Electronics Engineering, Auto Engine

ii) THERMAL
Thermodynamics, Heat Transfer, Hydraulics & Pneumatics

iii) DESIGN
Machine Design, CAD, Theory of Machines, CATIA, Pro-E, Professional Development, Design of Auto Components

iv) MECHANICS

v) MAINTENANCE
Vehicle Maintenance, Auto Shop Repairs

vi) GENERAL & ENGG. SCIENCE
Mathematics, Physics, Chemistry, Economics, Management, Electrical & Electronics, Computer Programming, Optimization, Automotive Pollution & Control, Measurement & Instrumentation

After finishing the degree, students will be able to work and coordinate effectively with a team of experienced engineers in the design, production etc. departments of various automotive manufacturers taking into account the environmental issues such as pollution, emissions, Motor Vehicle Act, etc.

Achieving recognition as a leading global department wherein auto industries can look upon for solutions to their design, production and marketing problems is the aim of the department. It shall have unique learning opportunities for its students through a global approach to education and research, without losing the sight of Asian perspective and expertise.

The future of automobiles is focused on mainly design and development of a passenger vehicle giving a 100 kmpl of petrol also giving zero emission from its exhaust. April 2010 onwards the Govt. has enforced stringent emission control measures and hence the plan to develop state-of-the-art emission measurement and control laboratory. This pursuit of zero emission vehicles shall entail design and development of series and parallel hybrid vehicles.
## CATEGORY-WISE LIST OF COURSES

### General (Humanities, Soc Sc., Man) (GEN.)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>BA-225</td>
<td>Economics</td>
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<tr>
<td>BA-226</td>
<td>Principles of Management</td>
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</tr>
<tr>
<td>CE-101</td>
<td>Environmental Science &amp; Ecology</td>
<td>5-0-0</td>
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<tr>
<td>EN-101</td>
<td>Communication Skills</td>
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<tr>
<td>EN-151</td>
<td>Language Lab</td>
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### Basic Science & Mathematics including Computer (BSM)

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<td>CH-101</td>
<td>Applied Chemistry</td>
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<td>Applied Chemistry Lab</td>
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<tr>
<td>CS-101</td>
<td>Computer Programming</td>
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<td>CS-151</td>
<td>Computer Programming Lab</td>
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<tr>
<td>MA-101</td>
<td>Applied Mathematics-I</td>
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<tr>
<td>MA-102</td>
<td>Applied Mathematics-II</td>
<td>5-1-0</td>
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<tr>
<td>MA-202</td>
<td>Applied Numerical Methods</td>
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<td>MA-252</td>
<td>Applied Numerical Methods Lab</td>
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<tr>
<td>PH-101</td>
<td>Physics</td>
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<td>PH-102</td>
<td>Applied Physics</td>
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<td>PH-153</td>
<td>Applied Physics Lab</td>
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### Engineering Science & Technical Arts (ESTA)

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<th>Course Title</th>
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<tbody>
<tr>
<td>EC-201</td>
<td>Electronics Engineering</td>
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<td>EC-251</td>
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<tr>
<td>EL-101</td>
<td>Electrical Engineering</td>
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<td>Electrical Engineering Lab.</td>
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<td>ME-101</td>
<td>Engineering Mechanics</td>
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<td>Engineering Mechanics Lab</td>
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<td>ME-152</td>
<td>Workshop Practice</td>
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<tr>
<td>ME-153</td>
<td>Engineering Graphics</td>
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### Department Core (DC)

<table>
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<tr>
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<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>AE-201</td>
<td>Motor Vehicle Technology</td>
<td>5-0-0</td>
</tr>
<tr>
<td>AE-202</td>
<td>Machine Drawing &amp; CAD</td>
<td>1-1-0</td>
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<tr>
<td>AE-203</td>
<td>Automotive Technology</td>
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<tr>
<td>AE-204</td>
<td>Hydraulic &amp; Pneumatic Systems</td>
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<td>AE-251</td>
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<td>Machine Drawing &amp; CAD Lab</td>
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<td>AE-253</td>
<td>Automotive Technology Lab</td>
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<td>AE-254</td>
<td>Hydraulic &amp; Pneumatic Systems Lab</td>
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<td>AE-301</td>
<td>Auto Electricals &amp; Electronics</td>
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<td>AE-302</td>
<td>Introduction to Software – CATIA &amp; Pro-E</td>
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<td>AE-303</td>
<td>Production Engineering</td>
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<td>AE-304</td>
<td>Design of Auto Components - I</td>
<td>5-1-0</td>
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<td>AE-305</td>
<td>Automotive Engines</td>
<td>5-1-0</td>
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<td>AE-306</td>
<td>Automobile Maintenance</td>
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<td>AE-307</td>
<td>Finite Element Methods</td>
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<td>AE-308</td>
<td>Design of Auto Components – II</td>
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<td>AE-309</td>
<td>Automobile Service</td>
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<td>AE-315</td>
<td>Automotive Electricals &amp; Electronics Lab</td>
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<td>AE-352</td>
<td>Introduction to Software – CATIA &amp; Pro-E Lab</td>
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<td>AE-353</td>
<td>Production Engineering Lab</td>
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<td>AE-355</td>
<td>Automotive Engines Lab</td>
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<td>AE-391</td>
<td>Auto Shop Practice – I Lab</td>
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<td>AE-392</td>
<td>Auto Shop Practice – II</td>
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<td>Vehicle Dynamics</td>
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<td>Automotive Pollution &amp; Control</td>
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<td>AE-458</td>
<td>Thermodynamics</td>
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<td>Strength of Materials</td>
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<td>Theory of Machines – I</td>
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<td>Heat Transfer</td>
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<td>ME-351</td>
<td>Theory of Machines – II</td>
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<td>ME-359</td>
<td>Heat Transfer</td>
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<td>ME-359</td>
<td>Heat Transfer Lab</td>
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<td>ME-404</td>
<td>Mechanical Vibrations</td>
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<td>ME-454</td>
<td>Mechanical Vibrations Lab</td>
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### Department Elective (DE)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>AE-421</td>
<td>Fleet Management</td>
<td>5-0-0</td>
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<tr>
<td>AE-422</td>
<td>Automotive Air Conditioning</td>
<td>5-0-0</td>
</tr>
<tr>
<td>AE-431</td>
<td>Emerging Automotive Technology</td>
<td>5-0-0</td>
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<tr>
<td>AE-432</td>
<td>Fundamentals of Robotics</td>
<td>5-0-0</td>
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<tr>
<td>AE-441</td>
<td>Modern Manufacturing Systems</td>
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<tr>
<td>AE-442</td>
<td>Special Purpose Vehicles</td>
<td>5-0-0</td>
</tr>
<tr>
<td>AE-461</td>
<td>Fuels, Alternate Fuels &amp; Lubricants</td>
<td>5-0-0</td>
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<tr>
<td>AE-462</td>
<td>Two &amp; Three Wheelers</td>
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### Open Elective (OE)

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<th>Credits</th>
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<tbody>
<tr>
<td>AE-411</td>
<td>Transport Management</td>
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<tr>
<td>BA-271</td>
<td>Human Resource Management</td>
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<tr>
<td>BA-272</td>
<td>Entrepreneurship Development</td>
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<tr>
<td>CE-471</td>
<td>Advanced Traffic</td>
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<tr>
<td>CE-472</td>
<td>Elements of Town Planning and Architecture</td>
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<td>CH-471</td>
<td>Advanced Applied Chemistry</td>
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<td>CS-303</td>
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<td>Cryptography and Data Compression</td>
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<td>EC-401</td>
<td>Mobile Communication</td>
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<td>Programmable Logic Controllers &amp; SCADA</td>
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<td>Renewable Energy Source and Energy Conservation</td>
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<td>High Voltage Direct Current Transmission</td>
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<td>Business Communication</td>
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<td>IT-443</td>
<td>Information Storage &amp; Management</td>
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<td>Discrete Mathematics</td>
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# Scheme of Studies

## B. Tech. Degree Programme (Regular)

(Common to all Branches)

## 1st Year

### TERM – I

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### Note

A student will be placed in GROUP A/B/C for all the three terms in an academic year.

### Final Evaluation in Grades

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### Final Evaluation in Grades (L-T-P-Cr) – Lectures-Tutorials-Practicals-Credits

- CW – Class Work
- MTE – Mid-Term Exam
- ETE – End-Term Exam

* One credit to be earned in Term-III through Co-Curricular Activities outside contact hours. However, a student is to register for this course in all the three terms of first year.

** One hour for explanation/demonstration.

*** CE-101 is a Mandatory Learning Course.
# Scheme of Studies

**B. Tech. Degree Programme (Regular)**  
(Common to all Branches)

## 1st Year

### TERM – II

#### THEORY

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Note: A student will be placed in GROUP A/B/C for all the three terms in an academic year.

### GROUP TOTAL CONTACT HOURS TOTAL CREDITS

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**FINAL EVALUATION IN GRADES**

(L-T-P-Cr) - Lectures-Tutorials-Practicals-Credits  
CW - Class Work  
MTE - Mid-Term Exam  
ETE - End-Term Exam

* One credit to be earned in Term-III through Co-Curricular Activities outside contact hours. However, a student is to register for this course in all the three terms of first year.

** One hour for explanation/demonstration.

*** CE-101 is a Mandatory Learning Course.
# Scheme of Studies

## B. Tech. Degree Programme (Regular)

### (Common to all Branches)

## 1st Year

### TERM – III

#### THEORY

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#### PRACTICAL/DRAWING/DESIGN

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### Note:
A student will be placed in GROUP A/B/C for all the three terms in an academic year.

### GROUP TOTAL CONTACT HOURS TOTAL CREDITS

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**FINAL EVALUATION IN GRADES**

(L-T-P-Cr) – Lectures-Tutorials-Practicals-Credits

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<td>One hour for explanation/demonstration.</td>
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### Scheme of Studies

#### B. Tech. Degree Programme (Regular)

##### 2nd Year

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**16-2-10 (28)**

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**20-3-8 (31)**

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**20-1-8 (29)**

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**FINAL EVALUATION IN GRADES**

(L-T-P-Cr) - Lectures-Tutorials-Practicals-Credits

- One credit to be earned in Term-VI through Co-Curricular Activities outside contact hours. However, a student is to register for this course in all the three terms of second year.
- PD-292 is a Mandatory Learning Course.
Department of Automobile Engineering  
Scheme of Studies  
B. Tech. Degree Programme (Regular)  

### 3rd Year

#### TERM – VII

<table>
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20-1-8 (29)  

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20-2-8 (30)  

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20-3-6 (29)  

**SUMMER TERM – INDUSTRY TRAINING/FIELD TRAINING/INTERNSHIP**

FINAL EVALUATION IN GRADES
(L-T-P-Cr) - Lectures-Tutorials-Practicals-Credits

* One credit to be earned in Term-IX through Co-Curricular Activities outside contact hours. However, a student is to register for this course in all the three terms of 3rd year.
** PD-393 is a Mandatory Learning Course.
### TERM – X

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<td>6</td>
<td>AE-492</td>
<td>Project (Including Seminar)</td>
<td>0-0-4</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>AE-493</td>
<td>Industrial Training / Field Training**</td>
<td>0-0-2</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>PD-451</td>
<td>Automobile Integrated System Lab</td>
<td>0-0-2</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>PD-491</td>
<td>Co-curricular Activities</td>
<td>0-0-2</td>
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<td></td>
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<td></td>
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### TERM – XI

<table>
<thead>
<tr>
<th>SN</th>
<th>Course No;</th>
<th>Course Name</th>
<th>L-T-P</th>
<th>Cr;</th>
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<tbody>
<tr>
<td>1</td>
<td></td>
<td>Dept. Elective – II</td>
<td>5-0-0</td>
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<td>Open Elective</td>
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<td>3</td>
<td>AE-481</td>
<td>Major Project Phase – I***</td>
<td>0-0-10</td>
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<td>Department Lab</td>
<td>0-0-2</td>
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<td>AE-494</td>
<td>Seminar-I****</td>
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<td>Co-curricular Activities</td>
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### TERM – XII

<table>
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<tr>
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<tbody>
<tr>
<td>1</td>
<td>ME-404</td>
<td>Mechanical Vibrations</td>
<td>5-1-0</td>
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<td>Dept. Elective-III</td>
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<td>Dept. Elective-IV</td>
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<td>4</td>
<td>ME-454</td>
<td>Mechanical Vibrations Lab</td>
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<td>5</td>
<td>AE-482</td>
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<td>Seminar-II*****</td>
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<td>Co-curricular Activities</td>
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</table>

**FINAL EVALUATION IN GRADES**

(L-T-P-Cr) – Lectures-Tutorials-Practicals-Credits

# CSOP is a mandatory learning course.

* One credit to be earned in Term-XII through Co-Curricular Activities outside contact hours. However, a student is to register for this course in all the three terms of 4th year.

** To be evaluated based on the work done during Summer Term after Term-IX.

*** Marks of Major Project Phase-I to be added to marks of Major Project Phase-II for award of final grade.

**** To be based on Major Project Phase-I.

***** To be based on Major Project Phase-II.
Department of Automobile Engineering  
Scheme of Studies  
B. Tech. Degree Programme (Regular)  

(INTERNSHIP MODE)

### 4th Year

#### TERM – X

<table>
<thead>
<tr>
<th>SN</th>
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<tbody>
<tr>
<td>1</td>
<td>AE-401</td>
<td>Vehicle Dynamics</td>
<td>5-1-0</td>
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<td>2</td>
<td>AE-402</td>
<td>Automotive Pollution &amp; Control</td>
<td>5-0-0</td>
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<tr>
<td>3</td>
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<td>Dept. Elective-I</td>
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<td>4</td>
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<td>Automotive Pollution &amp; Control Lab</td>
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<td>Community Service Oriented Project (Audit)</td>
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<td>AE-483</td>
<td>Internship-I**</td>
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<td>Automobile Integrated System Lab</td>
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<td>PD-491</td>
<td>Co-curricular Activities</td>
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**15-1-12 (28)**

#### TERM – XI

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<th>Cr</th>
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<tr>
<td>1</td>
<td>AE-494</td>
<td>Seminar - I (to be given in Term-XII)***</td>
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<td>Internship - II (in industry)</td>
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**0-0-26 (26)**

#### TERM – XII

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<td>4</td>
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<tr>
<td>2</td>
<td></td>
<td>Dept. Elective-III</td>
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<td>Dept. Elective-IV</td>
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<tr>
<td>4</td>
<td>ME-454</td>
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<td>1</td>
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<td>AE-485</td>
<td>Internship Documentation</td>
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<td>Seminar-II*****</td>
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<td>PD-491</td>
<td>Co-curricular Activities</td>
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**15-1-10 (28)**

**15+1**

**FINAL EVALUATION IN GRADES**  
(L-T-P-Cr) - Lectures-Tutorials-Practicals-Credits  
# CSOP is a mandatory learning course.  
* One credit to be earned in Term-XII through Co-Curricular Activities outside contact hours. However, a student is to register for this course in all the three terms of 4th year.  
** To be evaluated based on the work done during Summer Term after Term-IX.  
*** To be based on Internship-II and to be given in the beginning of Term-XII.  
**** To be based on Internship Documentation.
# LIST OF DEPT. ELECTIVES

## Dept. Elective - I

<table>
<thead>
<tr>
<th></th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AE-421</td>
<td>Fleet Management (Logistics)</td>
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</tr>
<tr>
<td>2</td>
<td>AE-422</td>
<td>Automotive Air Conditioning</td>
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## Dept. Elective - II

<table>
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<tr>
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<tbody>
<tr>
<td>1</td>
<td>AE-431</td>
<td>Emerging Automotive Technology</td>
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</tr>
<tr>
<td>2</td>
<td>AE-432</td>
<td>Fundamentals of Robotics</td>
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## Dept. Elective - III

<table>
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<tr>
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<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>AE-441</td>
<td>Modern Manufacturing Systems</td>
<td>5-0-0</td>
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<tr>
<td>2</td>
<td>AE-442</td>
<td>Special Purpose Vehicles</td>
<td>5-0-0</td>
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## Dept. Elective - IV

<table>
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<tr>
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<th>Course Code</th>
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<th>Credits</th>
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<tbody>
<tr>
<td>1</td>
<td>AE-461</td>
<td>Fuels, Alternate Fuels &amp; Lubricants</td>
<td>5-0-0</td>
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<tr>
<td>2</td>
<td>AE-462</td>
<td>Two &amp; Three Wheelers</td>
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</tbody>
</table>
IMPORTANT NOTES

1. Laboratory Courses are being offered as distinct courses (0-0-2) without being mixed with lecture components.
2. Conduct of Lab Courses:
   a. At least ten experiments/programs/exercises are to be performed in a term.
   b. It is expected that more experiments/programs/exercises are designed and set as per the scope of the syllabus, which may be added to the above list.
   c. One or more than one experiments/programs/exercises may be performed in one lab period in order to utilize the time properly.
   d. The scheme of operation is to be approved by HOD.
3. Students admitted through Lateral Entry Scheme will be required to take a Bridge Course on Mathematics (5-0-0) as an Audit Course.
4. Assessment of Industrial/Field Training and Internship-I will be based upon certificate of Industry/Field training obtained by the student, report, seminar and viva-voce examination. A student who is awarded ‘FF’ Grade is required to repeat Industry/Field training.
5. The choice of the students for any elective shall not be a binding for the department to offer, if the department does not have expertise.
6. For open elective, all students will be permitted to opt for any one elective run by another department. However, the departments will offer only those elective for which they have expertise. Further, the students will not be allowed to opt for any course under this category, which has already been done. An open elective opted during the end of tenth term, allotted list of which will be displayed on notice board and taught in the eleventh term.
7. The choice of students for the Internship stream shall not be a binding for the department to offer.
8. Elective-II is not required to be done by the students pursuing the degree through Internship Mode.
9. Students are allowed in the examination the use of single memory, non-programmable calculator. However, sharing of calculator is not permitted.
10. The B. Tech. degree programmes in Mechanical Engineering, Automobile Engineering and Civil Engineering and Bachelor of Architecture constitute one group for the purpose of deciding core courses.
11. For the students admitted in 2009-10 the sequence of PD Courses is given in the table below:

<table>
<thead>
<tr>
<th>Professional Development (PD) – Gen.</th>
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<tbody>
<tr>
<td>1st Year</td>
</tr>
<tr>
<td>PD-251 MATLAB</td>
</tr>
<tr>
<td>PD-191 Co-curricular Activities</td>
</tr>
<tr>
<td>PD-292 Effective Communication</td>
</tr>
<tr>
<td>PD-393 Advanced Professional Development</td>
</tr>
<tr>
<td>2nd Year</td>
</tr>
<tr>
<td>PD-151N* Basics of Computer Fundamentals</td>
</tr>
<tr>
<td>PD-291 Co-curricular Activities</td>
</tr>
<tr>
<td>PD-192 Personality Skills</td>
</tr>
<tr>
<td>PD-193 Entrepreneurial &amp; Professional Skills</td>
</tr>
<tr>
<td>3rd Year</td>
</tr>
<tr>
<td>PD-351 Finite Element Analysis Lab</td>
</tr>
<tr>
<td>PD-391 Co-curricular Activities</td>
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<tr>
<td>PD-392 Problem Solving Skills</td>
</tr>
<tr>
<td>PD-293 Intra &amp; Inter-personal Skills</td>
</tr>
<tr>
<td>4th Year</td>
</tr>
<tr>
<td>PD-451 Automobile Integrated System Lab</td>
</tr>
<tr>
<td>PD-491 Co-curricular Activities</td>
</tr>
</tbody>
</table>

* The contents for PD-151N are the same as for PD-151.
At the end of the course the students will be able to acquire basic knowledge about the working cycles involved and components of an automobile and overview of their working.

1. **I.C ENGINES (INTRODUCTION):** Working and difference between SI and CI Engines; Two and four stroke cycles; Theoretical heat cycles : ideal and actual Otto and diesel cycle, mixed cycle; Numerical; Working of two and four stroke SI and CI engines; Scavenging methods of two-stroke petrol engines; Comparison of two and four stroke cycle engines.; Auto engines classifications – arrangement of cylinders, valves and camshaft : Types of fuels used, engine speed, methods of cooling, engine balance; Principle of combustion, detonation and pre-ignition – differences.; Valve timing diagrams – SI and CI, two and four stroke engines.

2. **ENGINE PERFORMANCE:** Bore and stroke, swept and clearance volume, compression ratio, effect of C.R, engine torque, mean effective bmeP, bhp, lhp, fhp; Engine efficiencies – air standard, mechanical, thermal, indicated thermal, brake thermal, volumetric, requirements of high volumetric efficiency, Factors.; Specific fuel consumption; Numerical

3. **ENGINE COMPONENT PARTS:** Cylinder block : Types; Crankcase, liners : wet and dry; Gaskets, Timing covers, oil pan, cylinder head; SI engines combustion chambers : types and comparison; CI engine combustion chambers : Direct and Indirect injection, Intake & exhaust ports; lubricating passages; Intake & Exhaust valves and mechanisms; Camshafts: Side & overhead, advantages and disadvantages; Valve seat and conical angles, Valve seat insert, Valve springs, locks, Rocker-shaft, rocker arm, push rod, Cam followers-types; Timing of valves; Intake and exhaust manifold; Mufflers-types; Crankshaft : Nomenclature; Flywheel-functions; Oil seals; Engine Bearings : Thrust, ball, taper roller, needle, split, journal; Bearing materials, properties; Connecting rod; Piston : function, types, materials, piston rings: types, design details, Piston Pins, Component material chart : All engine components.

4. **CHASSIS AND BODY:** Types – unitized and separate body and chassis, Advantages, Designs: chassis frame; Chassis side and cross member, sections and joints; Body: requirements, main parts, Material composition, Body shape-aerodynamic design, CD for different types of vehicles; Vehicle component’s attachments, Front and Rear wheel drive component locations: advantages and disadvantages; Rear mounted engine and rear wheel drive: advantages; Definitions: wheel base, wheel track, minimum radius, front and rear overhang, ground clearance, gradeability, laden and unladen weight; Car seat and seat belt mounting and adjustment.

5. **CLUTCH SYSTEM:** Principle, requirements, operation, components of conventional single plate clutch, diaphragm clutch, multiple plate wet clutch, centrifugal clutch; Fluid coupling-characteristics, principle, velocity diagrams, efficiency and torque capacity curves; Comparison of conventional and diaphragm clutch and fluid coupling.

Clutch operating systems: rod, cable, hydraulic; Clutch Plate: requirements, construction, material, linings : required properties, types; Numerical; Clutch faults and diagnosis, Clutch pedal free play.

6. **GEAR BOX, PROPELLER SHAFT and DIFFERENTIAL:** Necessity of gearbox, types of gear wheels, function, construction and working details of sliding mesh, constant mesh, synchronesh and epicyclic gearbox: application and advantages; Overdrive, torque converter: principle and performance curves; Automatic gearbox; Gear selector mechanisms, synchronizing rings : materials and construction; Continuously variable transmission (CVT); Numericals.

Gear box lubrication : Grade of oil, topping : up procedure, leakage prevention : static and dynamic seals; Final drive :Hotch Kiss and Torque tube; Propeller shaft : requirement, construction, maintenance, critical speed vibration, double propeller shaft, Maruti half shafts; Universal Joints : types, rubber doughnut, hookes, constant velocity (Birfield), speed variation of hookes coupling, coupling with driven shaft; Numericals; Differential : requirements, principle, construction and working; Bevel gears, hypoid gear, worm and warm wheel, Differential lock, limited slip differential, double reduction. Numericals

7. **REAR AXLES AND TYRES:** Axle Casing, types, rear axle shafts – stresses and load taken, semi floating, ¾ floating and fully floating; Comparitive data : axles; Automobile wheel : loads, torques and stresses, types of wheels, requirements, specifications; Types of rims, Advantages of smaller wheels; Requirement of tyres. Types : conventional, radial and tubeless, Inner tubes; Merits of tubeless tyres over pneumatic tyres; Pneumatic tyres: constructional details: plies, tread designs, characteristics, aspect ratio, inflation pressure : comfort, braking, cornering, cost, fuel consumption, tyre materials; Tyre specifications; Points to increase tyre life : load, vehicle handling, speed, wheel balancing, wheel rotation, wheel alignment Procedure: Tyre retreading.
TEXT BOOK

REFERENCE BOOKS

SYMBOLIC REPRESENTATION AS PER BIS:
- lock nuts and bolts with washers.
- square headed nuts and bolts. Assemblies of Nuts, bolts, washers and locknuts.
- Flanged coupling, knuckle joint and cotter joints.

OBJECTIVE
At the end of the course, the students are expected to acquire comprehensive knowledge about the working cycles and components of an automobile and overview of their working.

1. BRAKING SYSTEM: Fundamentals, frictional forces, braking terms – stopping distance, braking efficiency, brake fade, weight transfer, brake torque, work done. Safe deceleration, road adhesion, Forces acting on vehicle when on a level road, while cornering; Calculation of normal reaction when all wheels are braked; Numericals; Principle, construction working of Parking brakes, Hydraulic brakes, pneumatic brakes, compressed air brakes, air hydraulic brakes, Drum brakes – Principle, leading and trailing shoes twin leading shoes; Hydraulic brakes – brakes shoes, brake lining, brake drums, back plate; Conventional and tandem master cylinder, wheel cylinder, component parts and working; Disc brakes: Types swinging ; sliding caliper, two and four cylinder caliper, principle, double disc; Construction and working; Advantages over drum brakes; Properties of friction lining & pad material, hydraulic brake oil; Procedure for bleeding of brakes, trouble and diagnosis; Electronic ABS system – Layout, working details.

2. SUSPENSION SYSTEM: Vehicle dynamics and suspension system; Requirements. Springs – types, coil, leaf, torsion bar, rubber and pneumatic; Laminated - classification, fully - elliptic, Semi-elliptic, transverse, three quarter, elliptic. Design features – grading, nipping, Constant and variable rating, cambering, uniform stress distribution, inter leaf inserts; Types: Conventional and independent suspension system: component parts and working details; Shackles, rubber bushes, metal bushes, advantages of coil springs; Torsion bar suspension system, Hydro elastic suspension, Air suspension : component parts and working; Design of laminated springs; Numericals; Hydraulic dampers: Shock Absorbers : construction and working details; Mc – Pearson strut, Independent rear suspension, Suspension Service.

3. FRONT AXLE AND STEERING SYSTEM: Front axles : types, Elliot and Lemoine, Hub assembly, calculation of bearing loads; Numericals: Front wheel alignment – Need caster, camber, KPI, toe – in, toe-out adjustments; Centre-point steering; Steering mechanism – Ackermann & Davis; Condition for true rolling; Over steer, under steer, slip angle; Turning circle radius; Steering systems: Function and requirements; Steering linkages, steering components – column, steering gearbox: rack and pinion, re-circulating ball, Cam and peg, Worm and roller, worm and sector : Construction and working details; Power steering : Hydraulic and electronic- working and component parts details; Four wheel steering; Effects of wrong steering geometry on tyres

4. AUTOMOBILE AIR-CONDITIONING: Requirements, Theoretical vapour compression cycle; Components: Dehydrator, Desiccant, Fitter, Strainer, sight glass, accumulator, Thermostatic Expansion Valve, Evaporator, compressor, types Driving system, Condenser, Hoses and fitting, valves, refrigerant and oil, Heater: Heater core, Vacuum motors, Heater control, blower, time-delay relay, heat switch;
Two and three wheeled vehicles: Idea of two and four stroke SI, CI and CNG engines used in two and three wheelers. Component parts and working of: Fuel system; Mikuni and Zenith carburetors; lubrication system; cooling system; magnetic coil; capacitive discharge ignition (CDI) system, AC generator; clutch system; transmission system; starting system: kick and battery; drive train systems; Engine tuning data; Frames: types; backbone, tubular and double cradle type; Component parts of brake, suspension and steering systems; Panel meters and controls on handle bar, connection of brake, clutch and accelerator cables.

Automotive safety: Types of automotive body work-monocoque, semi-monocoque tube frame, space frame. Body design for safety: engine location, concept of crumple zone, safety sandwich construction; Definitions: Front floor side, reinforcement C-pillar, seat cross beam, accusitional cross beam, Body style: Sedan, Hard top, coupe and limousine. Roadster, convertible and cabriolet, Station wagon, hatch back; Collapsible steering column, tilttable steering, seat adjustment, collision warning device, air bags (SRS) circuit, head lamps, fog lamps, speedometer, odometer, GPS, seat belt system; Auto Safety and Crash Testing: NCAP (New Car Assessment rating), Frontal: Impact tests, offset, side impact, roll-over, roadside hardware, old Vs new full width frontal tests, Head restraints rating.

Modern fuel injection technology: Gasoline MPFI and diesel CRDI systems; Petrol and diesel engine emission norms – EURO V and BS – III, Construction and function of: ECM, ALDL, CALPAK, manifold vacuum sensor, oxygen sensor, VSS, TBI, TPS, MAF, CTS, MAP, ECM input and output diagram; Computer controlled carburetor systems: Air fuel ratio control, throttle body injection systems, idle air control (IAC) reactor; injectors; Fuel system components, operation. Electronic diesel injection pump and control system, Pressure valve and injection lines. Injection nozzles, glow plug circuits.

Text book

Reference book

AE-204

| HYDRAULIC & PNEUMATIC SYSTEMS | L | T | P | C | r
|------------------------------|---|---|---|---|---
|                              | 5 | 1 | 0 | 4 | 4

Objective
At the end of the semester students will be understand the structure and the properties of the fluid, to understand and appreciate the complexities involved in solving the fluid flow problems. To understand the mathematical techniques already in vogue and apply them to the solutions of practical flow problems, To understand the energy exchange process in fluid mechanics handling incompressible fluids.

1. Basic concept and properties: Fluid: definition, distinction between solid and fluid: nits and Dimensions: Properties of fluids: density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapour pressure, capillary and surface tension – Fluid statics: concept of fluid static pressure, absolute and gauge pressure measurements by manometers and pressure gauges, problems.


3. Dimensional analysis: Dimensional numbers, their application: Buckingham’s π theorem: applications: similarity laws and models; problems.

4. Incompressible fluid flow: Navier, Stoke’s equation (statement only) : Shear stress, pressure gradient relationship laminar flow between parallel plates; Laminar flow through circular tubes (Hagen Poiseulle’s), Hydraulic and energy gradient; flow through pipes: Darcy-Weisback’s equation; pipe roughness; friction factor; Moody’s diagram; minor losses; flow through pipes in series and in parallel; power transmission; Boundary layer flows, boundary layer thickness, boundary layer separation; drag and lift coefficients, problems.

5. Hydraulic turbines: Impact of jet on flat, curved and moving plates; Fluid machines: definition and classification; exchange of energy; Euler’s equation for turbo machines; Construction of velocity vector diagram’s; head and specific work; component of energy transfer; degree of reaction, performance curves.

6. Hydraulic pumps: Pumps: definition and classifications; Centrifugal pump: classifications, working principles, velocity triangles, specific speed, efficiency and performance curves; reciprocating pump: classification, working principles, indicator diagram, work saved by air vessels and performance curves; cavitations in pumps rotary pumps: working principles of gear and vane pumps.

7. Compressor and fans: Definition – Classification; difference, efficiency, performance curves special application in Auto mobile Industries, working and construction of reciprocating, volumetric efficiency, performance curves, inter-cooling, two stage compression optimum inter-cooling pressure, applications of compressors and fans in automobile industry.

Text book
REFERENCE BOOKS

LIST OF EXPERIMENTS
1. Identify, write specifications and draw sketches of i) General Tools ii) Measuring Tools iii) Special Tools used in an automobile workshop and Practice to use them.
2. Identify various assemblies and sub assemblies of an automobile chassis. Draw layout and explain function of each unit.
4. Study of 2 stroke S.I engine. Draw Sketch and explain the function of each component.
5. Study the Cooling System of an Automotive Engine sketch the various components and explain function of each.
6. Identification of components of single plate, multi plate clutch system. Draw sketch and explain function of each component.
7. Identifications of components of sliding mesh constant mesh and synchronesh gear box. Draw power flow diagrams at various speeds.
8. Identify and give functions of each component of differential and rear axle assembly.
9. Study construction of different types of Automobile wheels and tyres and draw their sketches.
10. Study the propeller Shaft, Slip joint and universal Joints of a Vehicle. Draw sketches and label various components parts.

OBJECTIVE
At the end of the course, the students are expected to acquire comprehensive knowledge about the graphics and application of drawing in various fields.

1. INTRODUCTION: Orthographic from isometric (with dimensioning and sectioning practice) of simple components -Blocks Polyhedron (regular and irregular) Generative solids (Cone, cylinder, sphere), Flanged coupling, knuckle joint and cotter joints.
2. SCREWED FASTENING: Screw threads, form, Profile, representation of threads, screws and locking devices, orthographic projection of hexagonal and square headed nuts and bolts. Assemblies of Nuts, lock nuts and bolts with washers.
3. SYMBOLIC REPRESENTATION AS PER BIS: Different types of gears, surface finish symbols, fits and tolerance, welded joints, riveted joints and bearings.
4. FREE HAND SKETCHING OF AUTO COMPONENTS: Piston, crankshaft, camshaft, valve and valve assembly, differential, clutches, gear box, universal joint, slip joint, ball and socket pulleys, spark plug.

LIST OF EXPERIMENTS
1. Study and function of each component of Drum, Disc, Girling Multiplate Disc and ABS brake system.
2. Study of mechanical, hydraulic and pneumatic brake system.
3. Identification and function of each component of front and rear Suspension System.
4. Study of manual and power assisted steering mechanism.
5. Evaluate steering systems and steering linkage geometry.
6. Study and function of each component of different types of front axles with hub.
7. Layout of A.C system of a car. Identify and give functions of its each unit.
8. Study of 3-wheeler chassis frame and power transmission system and comparison of their various parameters.
9. Study the carburetor of motor cycle/ scooter. Set mixture screw for idle running
10. Study motor cycle drive train system and adjust (a). Clutch play (b). Gears Play (c). Front & rear brakes
11. Study capacitive discharge ignition system for engine of a motor cycle/scooter.
12. Study of MPFI System for a gasoline engines along with sensors and catalytic converter.
13. Study of diesel injection system, reciprocating F.I.P, rotary pumps and injectors used in TDI and CRDI system.

LIST OF EXPERIMENTS
1. Determine the Coefficient of discharge of given Orifice meter.
2. Determine the Coefficient of discharge of given Venturi meter.

TEXT BOOK

REFERENCE BOOKS

OBJECTIVE
At the end of the course, the students are expected to acquire comprehensive knowledge about the graphics and application of drawing in various fields.

1. INTRODUCTION: Orthographic from isometric (with dimensioning and sectioning practice) of simple components -Blocks Polyhedron (regular and irregular) Generative solids (Cone, cylinder, sphere), Flanged coupling, knuckle joint and cotter joints.
2. SCREWED FASTENING: Screw threads, form, Profile, representation of threads, screws and locking devices, orthographic projection of hexagonal and square headed nuts and bolts. Assemblies of Nuts, lock nuts and bolts with washers.
3. SYMBOLIC REPRESENTATION AS PER BIS: Different types of gears, surface finish symbols, fits and tolerance, welded joints, riveted joints and bearings.
4. FREE HAND SKETCHING OF AUTO COMPONENTS: Piston, crankshaft, camshaft, valve and valve assembly, differential, clutches, gear box, universal joint, slip joint, ball and socket pulleys, spark plug.
3. Determine friction factor of given set of pipes.
4. Determine the co-efficient of impact for vanes.
5. Study the constructional details of a centrifugal pump and draw its characteristic curves.
6. Study the constructional details of a reciprocating pump and draw its characteristic curves.
7. Study the constructional details of gear pump and draw its characteristics curves.
8. Study the constructional details of Pelton wheel and draw its characteristics curves.
9. Study the constructional details of Francis turbine and draw its characteristic curves.
10. Study the constructional details of Kaplan turbine and draw its characteristic curves.
11. Verify Bernoulli’s theorem.
12. Study the constructional details of centrifugal / reciprocating compressor.
13. Study the constructional details of fan.

OBJECTIVE
In an automobile the electrical systems are important. It has number of subsystems like starting, charging system etc. Most of the control systems are being converted from mechanical to electronics. The components and systems are described.

1. AUTOMOTIVE ELECTRICAL SYSTEM: Electro magnetism ; Electromagnetic induction; Electrical symbol; combination of symbols and marks; Classification of Automotive Electrical System- Generation storage, distribution, starting, ignition, lighting; Accessories; Electrical system; Earth and insulated return system; positive & negative earthing.

2. CIRCUITS & BATTERIES: Electrical Circuit Diagram; Wiring harness circuits and vehicle Systems; Cables; colour coding, wire sizes, current ratings, application and circuit numbering, terminals and connectors; Fuses, multiple wiring system, controller area network (CAN) and earth return; Batteries; Requirements; Lead acid batteries; chemical reactions; construction, charging and discharging; Characteristics, capacity, charging in series and parallel; Battery testing, specific gravity; Battery installation; Faults & remedies; Alkaline battery, advantages over lead acid Battery Construction of nickel hydride battery, nickel cadmium battery, lithium battery; Fuel cells.

3. STARTING AND CHARGING SYSTEM: Requirements, starting motor circuits, principle, characteristics and construction, specifications; Drives-inertia, pre-engaged starter motor, axial starter motor, coaxial type; Testing procedures; Maintenance ; Faults and diagnosis; New developments; Charging system-requirements, principles, total electrical load, limitations. Dynamos- Principle, Commutation, regulation, cut-out, current control, voltage control; Alternators; Principle, construction, rectification, transistorized regulation, protection, advantages of an alternator over dynamo, alternator-characteristics; Tests, charging circuits; New developments in charging systems; Cables used in starting and charging systems; colour code, core and wire sizes.

4. IGNITION SYSTEM: Requirements, types. High tension generation; Conventional ignition system; battery, coil and magneto; Coilignition; circuit diagram, Ignition coil, contact breaker, dwell cam, capacitor, automatic advance mechanism, spark timing ; factors, load, speed, throttle opening; Rotor and distributor, H.T lead and coil, ballast resistor; Magneto ignition ;rotating magnet, magneto coils; Draw backs in conventional system; Capacitive discharge ignition; triggered and transistors assisted contacts, breaker less systems; Advantages ; Pulse generators, Inductive storage ignition, pulse shaping, dwell period control, switching, pulse processing, Honda electronic ignition; Programmed ignition; Sensors and inputs; ECM; Factors affecting spark timing; Spark plug; requirements, construction, types, heat ranges, gap; Maintenance ; ignition timing, gap adjustments.

5. SENSORS, ACTIVATORS, CONTROLS: Types of sensors ; location in a vehicle, their constructional details and working; Sensors ; speed, throttle position, oxygen level, manifold pressure, crankshaft, camshaft coolant temperature, exhaust temperature, air mass flow, VSS, IAC motor, intake air temperature; Solenoids, stepper motor, relay; ECM control functions, micro controllers for automobile, electro chemical capacitors, electronic stability control, air bag electrical diagram, seatbelt sensors, cruise control, defogger circuit, 42 volt batteries, electric valve actuaters, integrated starter alternator. Cruise control, tyre pressure monitor, electronic stabilization programme. Electronic brake pressure stabilization. Power window and automatic lock controls.

6. ELECTRONIC ENGINE MANAGEMENT: Engine system, system function and performance, system modelling, control systems ; open loop and closed loop, engine mapping; Three-dimensional maps; Fuel mixture map; Open loop control systems; ignition and fuel mixture control, combined ignition and fuel control supply systems ; Closed loop engine control system; ignition control, dwell angle control, fuel control, lambda sensor; Artificial intelligence and engine management.

7. LIGHTING SYSTEM: Standard lighting sources; energy demand; headlight and its construction; head light beam; headlight dazzle; anti-dazzle devices; bulbs and wattages; headlight adjustments; fog lamps; side and tail light; brake warning lights; LED lighting system; horn; wiper system; trafficator; electrical switches; indicating and wiring devices; electrical pumps; heater and defrosters; latest trends; wiring and installation; auto cables; cable colours; cable connectors; wiring harnesses; circuit breakers; fuses; printed circuits; plastic fibre optics; trouble shooting.

TEXT BOOK

REFERENCE BOOKS
B.Tech. Automobile Engineering (Regular)


OBJECTIVE
At the end of the course, the students will be able to acquire basic knowledge on automobile part designing using design software apart from automobile production.

1. INTRODUCTION: Introduction to Automobile CAD software’s; Generation of software’s ; History of CAD/CAM/CAE; industrial looks on CAD software’s; Introduction to CIM ; Historical development.

2. SKETCHER & AUTO CONSTRAINTS: Introduction to Sketching tools like Line; Rectangular; Circle; Arc; Splines; and Fillet etc to build complex profiles; general concept and best process to constrain (Auto and Manually) a profile in Pro/E and CATIA.

3. PART DESIGN FUNDAMENTALS: Introduction to Design tools like Extrude; Revolve; Shell; Pad etc needed to generate solid models using various software; Material addition and subtraction about axis and plane; types of geometrical dimensional limits; numerous approaches to specify solid feature creation.

4. ASSEMBLY DESIGN FUNDAMENTALS: Design tools needed to create and manage assemblies and sub assemblies; analyzing and modeling an assembly; designing in context; process to insert parts from given and maintained catalogue.

5. GENERATIVE SURFACING AND OPERATION: Introduction to Surface; Surface modeling tools like Datum points; Datum curves; Splines etc; Surface operation tools like boundary; trim; split etc used to create final surface products.

6. SHEET METAL DESIGN: Introduction to sheet metal; sheet metal bending; bend allowance; creating walls; creating flange; Hem; Tear; Drop; Swept; Folded and Un-Folded view; creating a cut out; splitting geometry; stamping features; creating a punch wish a die.

7. COMPUTER AIDED PROCESS PLANNING: Introduction to FMS components; Type of FMS; planning for FMS; advantages and applications for conventional process planning; type of CAPP; steps in variant process planning for CAPP.

TEXT BOOK

REFERENCE BOOKS


3. Shyam and Tickoo Maini., “CATIA V5 R17 Engineers Designing”.

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OBJECTIVE
To provide knowledge on mechanism of material cutting; cutting tools casting; sheet metal; metal working and after completion of the course. The student to select the proper manufacturing and sequence for given components.

1. MECHANISM OF METAL CUTTING: Mechanics of chip formation; types of chips; mechanism of orthogonal and oblique cutting; merchant cutting force circle and shear angle relationship in orthogonal cutting; factors affecting tool forces; cutting speed; feed; depth of cut and surface finish temperature distribution at tool chip interface; Numericals on cutting forces and merchant circle.

2. CUTTING TOOL MATERIAL AND MACHINABILITY: Cutting Tool Materials; Characteristics of cutting tool materials; various types of cutting tool material; tool coating; Cutting Fluids; Purpose and type of cutting fluids; Effect of cutting fluids on tool life; Tool wear and Machinability; Type of wear; types of tool wear; tool life; Machinability: evaluation of machinability; factors affecting machinability; Numerical on tool life; Economics of Machining; Optimizing cutting parameters for minimum cost; optimizing cutting parameters for max. Production.

3. METAL WORKING: Hot working; Cold Working; Plastic deformation and fluid criteria relationship between tensile and shear field stress; Various forming operations; Rolling; forging; drawing; deep drawing; bending; extrusion; punching and blanking; high energy; rate forming process.

4. CASTING TECHNOLOGY: Sand casting; Pattern making; Mould making; Mould process and their tests; Shell moulding; Precision investment casting; Permanent mould casting; Die casting; Centrifugal casting; Continuous casting.

5. METAL FORMING PROCESSES: Forging operations-Smith forging; drop forging; press forging; forging defects; Forging of different automobile components and selection of suitable material for them.

6. SHEET-METAL COMPONENTS: Different methods of manufacturing sheet metal components: body components; wheel disc; covers; fuel tank; and chassis frame components; Selection of material; protection of surfaces.

7. PLASTIC; RUBBER AND GLASS COMPONENT MANUFACTURING: Different methods of manufacturing dash board; handles; knobs; door panels; semi transparent components; bumpers; fan grill; rubber seals; bushes; packing; hoses; tubes and tyres. Glass-wind shield; door glasses; lamps.

TEXT BOOK
Hazare, S.K., “Elements of Workshop”, Vol I & II

REFERENCE BOOKS


5. Heldt, P. M., “Automotive Chassis”, Chilton Co.,

6. Heldt, P. M., “Automobile Mechanics”, Khanna Publisher

OBJECTIVE
At the end of course; the students are expected to acquire comprehensive knowledge about the construction and working of petrol and diesel engine and component parts.

1. I.C. ENGINE & ITS PERFORMANCE: Engine operation : basic engine nomenclature; basic engine operation : two and four stroke cycle engines; Cylinder arrangement: inline, vertical twin, three cylinder, four cylinder, six-cylinder inline engines, V-engine, horizontally opposed engines; Technology and Constructional details and principle of working of: SI, CI, CNG / LPG, MPFI and CRDI engines; Comparison of SI and CI; MPFI and CRDI; CNG & LPG engines; Performance curves-Torque vs. speed; bhp vs. rpm; fhp vs. rpm; sfc vs. rpm; Morse test; Numericals; Engine ratings; DIN; RAC; Multi-cylinder engines: introduction, classifications, Firing order and interval; power balance : Single, two, four and six cylinder engines.

2. ENGINE LUBRICATION AND COOLING SYSTEM: Purposes; functions; Principles: hydrodynamic; Elasto hydrodynamic; Boundary and hydrostatic; Bearing lubrication; functions of lubrication system; Properties : Viscosity; viscosity index; pour point; Flash point; S.G; Carbon residue; oiliness; oxidation stability; cleanliness; colour; acidity and neutralisation number; Oil ratings; oil deterioration; oil additives; oil classifications; Lubrication Systems: Petrol and Diesel Engines; Component parts: construction and working; oil pumps; types of oil pumps; oil pump drives; oil filters; Prevention of oil leakage; oil seals; types; Oil indicators; oil level indicator; System maintenance; Engine cooling : Purpose; types: air cooling, liquid cooling; Coolant: water, synthetic coolant, antifreeze; Coolant flow; Forced circulation: Water pump, radiators, construction, heat transfer, Pressure filler caps, thermostats, Fan and drives, variable: pitch fans, electric fans, thermo-syphon, Water cooling system, Temperature indicators, Indicator gauges.

3. SI ENGINE FUEL SYSTEM: Requirements; Tanks; filters; fuel lines: metallic and flexible; Fuel pumps: mechanical and electrical; Fuel filters: inline; sediment bowl; Air cleaner: types; functions; thermoostatically controlled fuel gauge; Carburation and carburetor; air-fuel ratios: stoichiometric Effect of air-fuel ratio on efficiency and fuel consumption; Factors for fuel carburetion; Carburetor: requirements; limitation; construction and operation; Numerical on carburetion; Carburetor systems : float; idle slow speed; high speed; power; accelerator pump choke; Types: one; single stage two barrel; Two-stage two barrel; four barrel;

TEXT BOOK
Giri, N. K., “Automobile Mechanics”, Khanna Publisher

REFERENCE BOOKS

AE-304 DESIGN OF AUTOMOBILE COMPONENTS - I

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AE-305 AUTOMOTIVE ENGINES

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Additional systems hot: idle compensator valve; idle enrichment valves; altitude compensating; SU Carburetor; Zenith Carburetor; Solex; variable venturi; MPFI: Electronic fuel injection system; Subsystems: air intake system; fuel delivery system; Electronic control system; Engine management; open and close loop control systems; Fuel System Components : Fuel pump; fuel pressure regulator; Bosch Injectors; fuel feed and return pipe; fuel and vapour hoses; fuel pump relay; fuel gauge sending unit.

4. CI ENGINES FUEL SYSTEM: Fuel system layout; Fuel tank; fuel lines; high pressure lines; fuel filters: coarse and fine; Feed pumps : diaphragm type and plunger type; Injection pumps : inline and rotary : description and working; Governors : mechanical; pneumatic and hydraulic; Injectors: types; pintle; single hole; pintaux : functions; Spray patterns : swirling pattern; description of component parts; Fuel system trouble and diagnosis; Supercharger: types: roots; Vane compressor and centrifugal; Turbocharger: requirements; design; Intercooler : Design details and working.

5. COMBUSTION – SI ENGINES: Theory of combustion; Combustion reaction requirements; Types of CC; shapes: hemispherical; wedge; precombustion chamber; squish or quench area; Advantages and disadvantages of Such shapes; Supercharging SI engines: Advantages; Detonation; pre-ignition: Differences and Prevention; Affect of compression ratio on knock; Stages of combustion: flame propagation; rate of pressure rise; Required characteristic of gasoline rating: HUCR; octane number; performance number; Dieseling; Causes of abnormal Combustion.

6. COMBUSTION – CI ENGINES: Chemistry of Diesel combustion; Requirements of diesel fuel combustion; Ignition Delay: pressure; time diagram: factors causing ignition delay; Phases of normal Combustion; Properties of diesel fuel; Effects of high or low Centane number; Diesel knock and Centane Number; Diesel engine combustion chambers: direct and indirect injection; comparison.

7. NON-CONVENTIONAL ENGINES: Wankel Rotary CI engine: Principle; geometry; swept volume; C; Rand rotor contour; sealing; lubrication; cooling; Ignition system; advantages and disadvantages; Applications; Gas turbine engines: classification, regenerative cycle, major components: compressor, turbine, regenerator, combustor, transmission. Fuel requirements; performance; Advantages; Stratified charge engine: methods of charge stratification: Fuel injection and positive ignition; swirl stratification: characteristics of stratified charge engines; Applications; Advantages and; disadvantages.

TEXT BOOK

REFERENCE BOOKS


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connectors; ALDL read-out scan tool; test light; ohmmeter; digital volt meter; jumper wires; vacuum gauge; Tachometer; computerized automotive maintenance system. Knowledge of diagnostic codes; service engine soon (SES) light; ECM; CALPAK. Study of important components: name; location and functions: TPS; IAC valve; ECM; MAP sensor; engine coolant temp sensor; IAT sensor; VSS; camshaft and Crankshaft – position sensor; start signal; PSP switch; Oxygen sensor; Fuel Vapour; Cannister; Catalytic Converter; Particulate filter; Troubles and diagnosis MPFI engines.

6. CLUTCH; DRIVE LINE; SUSPENSION; STEERING AND BRAKES: Disassembly; cleaning; visual inspection; inspection by measurement and assembly of clutch; gearbox; universal joints; propeller shaft; differential; axles; steering and suspension system (leaf spring and Mc-Phearson strut); Drum and disc Brakes; bleeding of brakes: Gaps and Clearances; Tire maintenance and wheel balancing; service limits and wheel alignment.

7. ENGINE: Procedure for engine removal from vehicle; disassembly; cleaning of parts; cleaning procedures; agents; method of decarburizing; Top overhauling; Visual inspection of component parts; inspection by measurement; preparation of engine inspection sheets: engine; crankshaft main and big end journals; connecting rod bearing and parents bores; camshaft journal and parent bores; service limits; machining of component parts: boring and honing of cylinder bores; cylinder head; crankshaft; connecting rod; big-end Journals; camshaft grinding and lapping of engine valves; Fitting valve seat inserts and guides; Idea of oversize pistons and under size split bearings; testing of cylinder heads and valve springs; Cooling system: maintenance and Service; troubles and diagnosis.

**TEXT BOOK**
Shrivastava, Sushil Kumar., "Industrial Maintenance Management", S Chand & Company Ltd., 2005

**REFERENCE BOOKS**
2. Maruti Suzuki Manuals

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<tr>
<th>AE-307</th>
<th>FINITE ELEMENT METHODS</th>
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**OBJECTIVE**
To understand the principles involved in discretization and finite element approach. To learn to form stiffness matrices and force vectors for simple elements.

1. INTRODUCTION: Fundamental concepts; introduction; historical background; stresses and equilibrium; boundary conditions; strain-displacement; relations; stress-strain relations; temperature effects; potential energy and equilibrium; the Raleigh-Ritz method; Galerkin's method; Saint Venant's principle; matrix algebra; Gaussian elimination.

2. ONE -DIMENSIONAL PROBLEMS: Introduction; finite element modelling; coordinates and a shape functions; the potential energy approach; the Galerkin approach; assembly of the global stiffness matrix and load vector; properties of stiffness matrix; the finite element equation; treatment of boundary conditions; quadratic shape functions; temperature effects.

3. TWO-DIMENSIONAL PROBLEMS USING CONSTANT STRAIN TRIANGLES: Introduction; finite element modelling; constant strain triangle; problem modelling and boundary conditions: axis symmetric solids subjected to axis symmetric loading; introduction; axis symmetric formulation; finite modelling; triangular element; problem modelling and boundary conditions.

4. TWO DIMENSIONAL ISOPERMETRIC ELEMENTS: Two dimensional isoperimetric elements and numerical integration; introduction; the four node quadrilateral; numerical integration; stress calculations; high-order element; nine-node quadrilateral; eight-node quadrilateral; six node triangle; comment on mid-side node; problems.

5. BEAMS AND FRAMES: Introduction; finite element formulation; lead vector; boundary considerations; shear force and bending moment; beams on elastic supports; plane frames; simple numerical.

6. SCALAR FIELD PROBLEMS: Introduction; one-dimensional; heat condition; heat transfer in thin fins; two-dimensional, steady-state, heat conduction; potential flow; seepage; fluid flow in ducts.

7. DYNAMIC CONSIDERATIONS: Introduction; formulation; element mass matrices; evaluation of Eigen values and Eigen vectors; interfacing with previous finite element programs and a program for determining critical speed of shafts.

**TEXT BOOK**

**REFERENCE BOOKS**

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<th>AE-308</th>
<th>DESIGN OF AUTO COMPONENTS - II</th>
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**OBJECTIVE**
At the end the course the student will be able to understand the fundamental principles involved in design of components of automotive chassis; the complete design exercise and arrive at important dimensions of chassis components.
1. INTRODUCTION: Variable Loading: Different type of fluctuating/variable stresses; fatigue strength considering stress concentration; factor; surface factor; size factor; reliability factor etc.; Fatigue design for finite and infinite life against combined variable stresses using Goodman and Soderberg's criterion; fatigue design using Miner's equation; problems.

2. SHAFTS: Detailed design of shafts for static and dynamic loading; Rigidity and deflection consideration.

3. SPRINGS: Type of springs; design for helical springs against tension and their uses; compression and fluctuating loads; design of leaf springs; surging phenomenon in springs; design problem.

4. BEARINGS: Selection of ball and roller bearing based on static and dynamic load carrying capacity using load life relationship; selection of bearings from manufacturer's catalogue; type of lubrication: boundary; mixed and hydrodynamic lubrication; design of journal bearings using Raimondi and Boyd's charts; design of pivot and collar bearing; lubricants and their properties; selection of suitable lubricants; design problems.

5. SPUR and HELICAL GEARS: Force analysis; selection of material for gears; beam and wear strength of gear tooth; form or Lewis factor for gear tooth; dynamic load on gear teeth; Barth equation and Buckingham equation and their comparison; gear lubrication; design problems.

6. DESIGN OF CYLINDER; PISTON and CONNECTING ROD: Choice of material for cylinder and piston; piston friction; piston slap; design of cylinder; piston; piston pin; piston rings; piston failures; lubrication of piston assembly; material for connecting rod; determining minimum length of connecting rod; small end and big end design; Shank design; design of big end cap bolts; connecting rod failures.

7. DESIGN OF CRANKSHAFT; VALVES and FLYWHEEL: Material for crankshaft; design of crankshaft under bending and twisting; balancing weight calculations; design aspects of intake and exhaust manifolds; inlet and exhaust valves; valves springs; tappets; valve train. Materials and design of flywheel.

TEXT BOOK

REFERENCE BOOKS

OBJECTIVE
A student shall acquire hands on experience of maintenance and repairs of various component parts of a vehicle. Improvement in component parts design shall follow.

1. EQUIPMENTS NECESSARY FOR TESTING
   ELECTRICAL ACCESSORIES: Specifications and range; Electric test bench; growler; coil tester; distributor test bench; ignition timing light; digital multi-meter; wiring harness tester; hydrometer; battery ampere hour tester; cam dwell angle tester; feeler gauge; ohmmeter; ammeter; voltmeter and connecting wires.

2. MAINTENANCE SCHEDULE: Batteries-Charging; Faults; Care and Maintenance; Starter motor; dynamo; ignition system; wiper motor; electrical fuel pump; alternator; horn; flasher unit; Diagnosis chart: Ignition system; cranking system; charging system; power door lock control system; headlight; turn signal light; brake light; fuel meter and fuel gauge unit; engine coolant meter and sensor; oil pressure light; wind shield wiper and washer; interior light and horn.

3. SERVICE; OVERHAUL and TESTING: Starter Motor; Dynamo; alternator; ignition system; wiper motor; electrical solenoid switch; fuel pump; horn; flashing unit; wiring harness; distributor condenser; H.T coil; Spark plug; power door lock control system; electrical power steering; Air Bag Circuit.

4. DIESEL COMPONENTS OVERHAUL and TESTING: Grind and lapping of injector; needle Valves; Troubles and diagnosis; multi cylinder inline and rotary fuel injection pump; single cylinder F.I Pump; hoses and pipe lines; jerk pumps; priming unit and tanks; fuel injector spray tests and pressure testing; Calibration and phasing of in-line and rotary fuel injection pumps on test m/c; trouble and diagnosis chart for injectors; F.I Pumps; CRDI Engine: troubles; diagnosis and testing: fuel system; injectors; particulate filters and sensors.

5. DIESEL ENGINE RECONDITIONING and TESTING MACHINES: Injector tester; fuel injection pump phasing and calibrating m/c; Nozzle grinding m/c; Injector spray pattern tester. Boring and honing m/c; Crankshaft grinder; cylinder head grinding m/c.

6. AUTOMOBILE AIR CONDITIONING SYSTEM and REPAIRS: Specifications; Functions and General layout of the components: Evaporator; compressor; thermostatic expansion valve; low and high pressure; condenser; dehydrator receiver and sight glass; Possible troubles and remedies; Procedure for discharging and recharging the Auto A/c System; Use of vacuum pump; Function and inspection of compressor relay; A/c relay; dual pressure switch vacuum switch; magnetic clutch; thermostat; H.P switch; cooling fan relay; A/c relay; Troubles and Diagnosis of A/c system.

7. LAYOUT PLANS: Car or Truck dealerships (Showroom workshops). Diesel FIP and injector repairs centre; stores; diesel or petrol engine
machining shop; auto electrical shop; Car washing and lubrication bay; Denting and painting workshop.

TEXT BOOK

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LIST OF EXPERIMENTS
1. Study and draw sketches for different electrical symbols used in automotive electrical system.
2. Identification and Function of various units of electrical charging circuit. Draw a line diagram of the same.
3. Study construction; specification and capacity of lead acid battery and its maintenance.
4. Identification and functions of components of Generator and Alternator.
5. Identification and function of solenoid Switch and starting motors.
6. Study voltage regulators and cutout; its components and their functions.
7. Study construction of Horns. Horn relays and adjustments in horn assly.
8. Study of electrical wiring harness for lighting system an automobile vehicle.
9. Identification and functions of each unit of ignition system of maruti engine
10. Study of electrical circuit showing wiper motor; defogger; power window; power Steering and functions their of.
11. Study of rectifiers and filters.
12. To check location of sensors & check the sensor circuit namely VSS; IAT; MAP; IAC motor; oxygen sensor etc.
13. Study of SCR and IC timer.
15. Micro controller Programming and Interfacing.

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LIST OF EXPERIMENTS
1. Complete Modeling of cotter and knuckle joint and its assembly drawing
2. Computer aided design of leaf springs; coil spring and torsion bar springs using CATIA/PRO.
3. Design of propeller shaft and its assembly drawing by using drafting software.
4. Modeling of collar bearings assembly using CATIA/PRO.
5. Modeling piston-cylinder assembly and drawing its assembly using CATIA/PRO.
6. Modeling a flywheel and drawing it by using CATIA/PRO.
7. Modeling a connecting rod and draw it by using CATIA/PRO.
8. Modeling a connecting rod and crankshaft assembly using CATIA/PRO.
9. Computer aided design of frame for passenger using CATIA/PRO.
10. Computer aided design of frame for commercial vehicle using CATIA/PRO.
11. Computer aided design of front axle using CATIA/PRO.

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LIST OF EXPERIMENTS
1. Prepare a pattern for given casting with all the necessary allowances.
2. Make a green sand mold and prepare it for the casting; investigate the casting defects and suggest the remedies.
3. Make a casting by shell molding process.
4. Make a component involving horizontal and vertical welding (Arc welding)
5. Cut a sheet with gas welding and investigate the defects.
6. To join two sheets using resistance spot welding.
7. Make a job using turning; taper turning and facing and boring operations on lathe.
8. Prepare a job on surface grinder.
9. Development and manufacture of sheet metal component such as elbows and transition pieces.
10. Cut external threads on a lathe
11. Manufacture and assembly of a unit concept of tolerances and fits (shaft and bush assembly or shaft; key and bush assembly)
12. Multi slot cutting on milling machine by indexing.

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LIST OF EXPERIMENTS
1. Identification and function of each component of lubrication system of an automotive engine.
4. Morse test on multi cylinder S.I engines and find BHP.
6. Study of P-θ and PV diagrams for IC engine with piezoelectric pick up; charge amplifier; angle encoder.
7. Draw a line diagram of fuel system of petrol and diesel engine and explain function of each component.
8. Identification and function of each component of different types of Injectors.
9. Identification and functions of each component of in-line fuel injection pumps.
B.Tech. Automobile Engineering (Regular)

10. Identification and functions of each component of rotary fuel injection pumps.
11. Study of turbo chargers and draw its layout line diagram.
12. Study of super chargers and draw its layout line diagram.

AE-391 AUTO SHOP PRACTICE-I LAB L T P Cr 0 0 2 1

LIST OF EXPERIMENTS
1. Identification of standard and non standard tools and garage equipments used in an Automobile repair workshop.
2. Wet / Dry servicing of a vehicle which includes washing; cleaning; changing engine oil; oil filter; air filter and engine tuning.
3. Dismantle clutch assembly from a vehicle; Inspect and replace defective parts; reassemble and adjust clutch free play.
4. Overhaul gear box and propeller shaft with U J Cross of Maruti vehicle.
5. Study the steering geometry of a vehicle. Carry-out wheel balancing and wheel-alignment of vehicle.
6. Remove punctured tyre from vehicle; repair the puncture; and do tyre rotation.
7. Overhaul master cylinder (Single and Tandem) of hydraulic brake system of vehicle and do bleeding operation.
8. Overhaul front suspension of Maruti Vehicle.
9. Remove engine from Maruti vehicle; dismantle engine; clean its components and (A) Inspect engine for damaged/defective and worn out parts.
   (i) Water jackets; (ii) oil galleries; (iii) cracks;(iv) main and big end bearings; (v) crankshaft (vi) cam shaft;(vii) connecting rod(viii) timing gears etc. 
   (B) Measurement and recording of:
   (i) Cylinder bore dimensions; its ovality; taper and wear (ii) Ovality; taper and wear of crankshaft; (iii) Connecting rod alignment; inspect the components for wear and tear; (iv) Engine cylinder ridge cutting; boring and honing.
10. Reassemble the Engine and mount engine on the vehicle.
11. Top overhauling of an engine i.e. remove cylinder head from engine. Dismantle; inspect; for defective/ damaged/ worn out- valves; push rods; tappets; valve springs; valve seats; valve guides. Carry out valve grinding; valve seat cutting; valve lapping and cylinder head resurfacing and reassemble cylinder head and fit it on engine block.
12. Overhaul differential; rear axle and hub of a vehicle.

AE-401 VEHICLE DYNAMICS L T P Cr 5 1 0 4

OBJECTIVE
A vehicle in dynamic condition gives rise to all modes of vibrations. Encountering a pot hole; braking or while cornering different forces come into play. To improve the comfort of passengers and to increase the life span of various component parts entails a through study of this subject.

1. PERFORMANCE OF AUTOMOBILES: Vehicle drag; wheel deformation; ground deformation; Power for propulsion; air resistance; rolling resistance; grade resistance; traction and tractive effort. Road performance curves: acceleration; gradeability and drawbar pull; Numericals calculation of equivalent weight; gear ratio for maximum acceleration; Distribution of weight : three wheeled vehicle four wheeled vehicle; Stability of a vehicle on a slope; Calculation of maximum acceleration; tractive effort and reactions for front wheel; rear wheel drive and four wheel drive : with third differential and without third differential; Dynamics of a vehicle running on a banked track; Stability of vehicle taking a turn; Reaction at wheels – due to weight; due to gyroscopic effect and due to centrifugal force; Numericals
2. **RIDE CHARACTERISTICS:** Vehicle dynamics and suspension requirements; Spring characteristics; leaf spring design; torsion; bar spring design; Mechanics of an independent suspension system; roll axis and status of vehicle due to side forces; Single and two degree freedom; Vehicle ride model; two degree freedom model for pitch and bounce for sprung and unsprung masses; Vibrations due to road roughness motion of vehicle an undulating road and compensated suspension system; Numericals.

3. **HANDLING CHARACTERISTICS:** Pitching; bouncing; yawing and rolling; wheel wobble. Steering geometry. Fundamental condition for true rolling. Ackermann's Davis steering mechanism; slip angle; cornering power-steer; over-steer; under-steer; yaw velocity lateral acceleration; curvature response and directional stability. Numericals.

4. **NUMERICAL METHODS:** Approximate methods for determining fundamental frequency; Dunkerleys lower bound; Rayleigh’s upper bound; Holzer method for closed system and branched system and branched system.

5. **BRAKING PERFORMANCE:** Braking of vehicle: braking applied to rear wheels; front wheels and all the four wheels on straight and curved path; Mass transfer and its effect; braking efficiency and stopping distance; reaction time and stopping time; brake locking; Antilock drives; Calculation of mean lining pressure and heat generation during braking; Numericals.

6. **FINAL DRIVE LINE:** Calculation of Critical speed; design torque and maximum diameter of propeller shaft; axle shaft. Speed variation of a hookes : type joint due to drive and driven shaft inclination. Numericals on inertia torque; velocity ratio (double hookes joint); Forces acting on Hotchkiss drive and torque tube drive; Differentials : Calculation of number of revs by inner and outer wheels while taking a turn; Rear axles : max tensile and shear stress calculations Bearing loads due to lateral forces on rear front axles; Numericals.

7. **VEHICLE AERODYNAMICS and BODY DESIGN:** Tractive force on driving wheels; vehicle drag and types; various types of forces and moments; road and air resistance; 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. Body materials steel; plastic; GRP; Selection of paints and process; Types of car body – saloon; convertibles; limousine; estate car; racing and sports car. Safety equipments in cars.

**TEXT BOOK**

**REFERENCE BOOKS**
1. Ellis, J. R; “Vehicle Dynamics”
2. Giles, J. G.; “Suspension and Tyres”
B.Tech. Automobile Engineering (Regular)

TEXT BOOK
Robert, E. F., “I. C Engines and Air Pollution”, 1988

REFERENCE BOOKS
2. Automobiles Emission by SAE Transactions-1982 (3Vols)

OBJECTIVE
The course has been designed such that the student can own a fleet of buses, trucks etc. and manage the same. He also gets familiar with provisions of motor vehicle act and vehicle insurance.

1. INTRODUCTION: Necessity for making Acts and rules on motor vehicles; Procedure for enactment and implementation of these Acts by Central and State Govts; Formats of the acts; rules and titles; Definitions: articulated vehicle; axle weight; certificate of registration; driver; conductor; licence; contract carriage; stage carriage; dealer; educational institution bus; goods; goods carriage; gross vehicle weight; heavy goods vehicle; invalid carriage; learners licence; HMV; LMV; motor cabs etc.

2. DRIVING LICENCE: Necessity; age limit to obtain D.L.; learners D.L; permanent D.L: grant; restrictions; renewal; endorsement; disqualification; suspension; fees; documents; educational qualifications required for driving trucks; buses; oil tankers; missile carriers; driving on hills; Driving schools: requirements; Effectiveness of different DLs; Maintenance of state registers of D.L.; conductors licence; necessity; grant; age limit; disqualifications; revocation; disqualification; uniforms.

3. VEHICLE REGISTRATION: Necessity; area of registration; time given for registration; format and documents to be attached and fees; period of registration; renewal; suspension; Temporary and permanent registration; vehicle fitness; refusal; NOC; registration for embassy vehicles; production of vehicle at the time of registration; Migration of vehicle from one state to other; Hire purchase; lease or hypothecation; transfer of registration on sale; removal of hypothecation clause; Transfer of ownership; Change of residence or place of business; death of owner; sale or purchase; Alteration in motor vehicle; age limit of vehicles; attachment of trailers; Maintenance of state registers of motor vehicles.

4. PERMITS: Necessity; route allotments; state Govts. powers; provisions for application of permits; Procedure of R.T.A to grant permits; limits of issuance of permits and rules; documents to be attached; preferences while issuing permits; Types of permits: Private service; all India goods carriage; temporary; national; composite etc. Renewal; duration; cancellation; suspension of permits and transfer of permits; Rules for replacement of vehicles; colour schemes; general conditions attached; Validation of permits for use in outside region; Issue of permits to state transport undertakings: restrictions

5. CONSTRUCTION; EQUIPMENT; MAINTENANCE AND TRAFFIC REGULATION: General provisions; Central Govt. rules and provisions regarding construction; maintenance of vehicle; emissions and safety provisions. Control of traffic – limits of speed; weight; length and height; power to restrict and erect traffic signs; design of traffic signs and its colour scheme; Signals; driving test; Driving regulations; signaling devices; Definitions: Pass; ticket; removal of vehicle obstructing traffic; Safety measures for drivers and pillion riders; Precautions at unguarded railway crossings

Schemes for investigation of accidents and wayside amenities; Traffic navigation; global positioning system.

6. LOGISTICS: Definition of fleet; types of fleet-luxury cars; buses; trucks; cash vans; fire-fighting vehicles etc; Management; supervisory; training and staffing; Driver; conductor and Mechanics hiring – duties; Vehicle operations-productivity and control; Fleet maintenance programs; tyre maintenance; productivity and control; Budget activity; Fleet management and data processing; Procurement and disposal; labour relations; energy management; Loss prevention management; control and predicting costs; Fitness of vehicles; Stores-definition; management; storing methods; inventory control; Duties and responsibilities of store manager; purchase manager; Storing methods-Bin card; requisition card; Inventory control procedures; Vendor development; Stores-layout; spare parts flow chart; Store documentation; store organization.

7. MOTOR INSURANCE: Types; scope; limitations; liability of insurance Cos; insurance documents-claim form; estimate and bills; Necessity for insurance against third party risk; Requirements and limits of liability of insurance polices; Procedure to be followed for settlement of a claim after an accident; Surveyor and loss assessor; Surveyors report; Certificate of insurance: transfer; Compensation to third party deaths; Motor accident claims tribunal (MACT); Transit insurance.

TEXT BOOK
The Motor Vehicle Act,1988, Govt. of India Publication

REFERENCE BOOKS
1. Patankar, P. G., “Road Passenger Transport in India”, CIRT Pune
2. Srivastav, S. K., “Economics of Transport”

OBJECTIVE
This course aims at providing adequate knowledge about air conditioning system in automobiles since it has now become an integral part of a vehicle and the whole of South India and parts of the North witness intense heat during summers.
1. **REFRIGERATION:** Introduction; methods of refrigeration; vapour compression refrigeration system; vapour absorption refrigeration system; applications of refrigeration and air conditioning; Automobile air conditioning; air conditioning for passengers; isolated vehicles; transport vehicles; applications related with very low temperatures.

2. **REFRIGERANT:** Classification; properties; selection criteria; commonly used refrigerants; alternative refrigerants; eco-friendly refrigerants; applications of refrigerants; refrigerants used in automobile air conditioning.

3. **PSYCHOMETRY:** Psychometric properties; tables; charts; psychometric process; comfort charts; factors affecting comfort; effective temperature; ventilation requirements.

4. **AIR CONDITIONING SYSTEMS:** Classification; layouts; central / unitary air conditioning systems; components like compressors; evaporators; condensers; expansion devices; fan blowers; heating systems etc.

5. **LOAD ANALYSIS:** Outside and inside design consideration; factors forming the load on refrigeration and air conditioning systems; cooling and heating load calculations; load calculations for automobiles; effect of air conditioning load on engine performance.

6. **AIR DISTRIBUTION SYSTEMS:** Distribution duct system; sizing supply / return ducts; type of grills; diffusers; ventilation; air noise level; layout of duct systems for automobiles and their impact on load calculations.

7. **AIR ROUTINE and TEMPERATURE CONTROL:** Objectives: evaporator care air flow through the dash re-circulating unit; automatic temperature control; controlling flow; control of air handing systems.

**TEXT BOOK**
Paul Lung., “Automotive Air Conditioning”, C.B.S Publisher and Distributor

**REFERENCE BOOKS**

1. **EMERGING AUTOMOTIVE TECHNOLOGIES**

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**OBJECTIVE**
At the end the course the student will be able to understand about the latest technology and development in areas of automobile engineering.

1. **FUTURE OF AUTOMOTIVE INDUSTRY and FUEL CELL TECHNOLOGY:** Challenges and concepts for the 21st century; Crucial issues facing the industry and approaches to meet these challenges; what is fuel cell; types; advantages; current state of the technology; potential and challenges; advantages and disadvantages of hydrogen fuel.

2. **LATEST ENGINE TECHNOLOGY FEATURES:** Advances in diesel engine technology; direct fuel injection gasoline engine; diesel particulate emission control; throttling by wire; variable valve timing; method used to effect variable valve timing; electromagnetic valves; cam less engine actuation.

3. **42 VOLT SYSTEM:** Need; benefits; potentials and challenges; technology implications for the automotive industry; technological evolution due to adoption of 42 volt systems.

4. **ELECTRICAL AND HYBRID VEHICLES:** Types of hybrid systems; objective and advantages of hybrid systems; current status; future developments and prospects of hybrid Vehicles.

5. **INTEGRATED STARTER ALTERNATOR:** Starts stop operation; power assist; regenerative braking; advanced lead acid batteries; alkaline batteries; lithium batteries; development of new energy storage systems; deep discharge and rapid charging ultra capacitors.

6. **X-BY WIRE TECHNOLOGY:** What is X-By wire; advantage over hydraulic systems; use of automotive micro controllers; use of actuators in an automobile environment.

7. **VEHICLES SYSTEMS:** Constantly variable transmission; benefits; brake by wire; advantages over power braking system; electrical assist steering; steering by wire; advantages of steering by wire; semi-active and fully-active suspension system; advantages of fully active suspension system.

**TEXT BOOK**

**REFERENCE BOOKS**

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**OBJECTIVE**
At the end the course the student will be able to understand about the importance & use of robots in the manufacturing process of vehicles in big way.

1. **FUNDAMENTALS OF ROBOT:** Definition; robot anatomy; co-ordinate systems; work envelope; types and classification: specifications: pitch; yaw; roll; joint notification; speed of motion; payload: robot parts and their functions: need for robots: different applications;

2. **ROBOTS DRIVE SYSTEMS and END EFFECTORS:** Pneumatic Drives: hydraulic drives: mechanical drives: electrical drives: D.C Servo
B.Tech. Automobile Engineering (Regular)

Motors; stepper motor; A.C Servo motors: salient features; application and comparison of all these drives.

3. **SENSORS**: Requirements of sensor; principles and applications of sensors: Position sensors: Piezo electric sensor, LVDT, resolvers, optical encoders, pneumatic position sensors; range sensors: triangulation principle, structured, lightning approach, time of flight, range finders, laser range meters, proximity sensors: inductive, hall effect, capacitive, ultrasonic, optical proximity sensors; touch sensors: binary sensors, analog sensors, wrist sensors, compliance sensors, slip sensors.

4. **MACHINE DESIGN**: Camera; frame; grabber; sensing and digitizing image data: signal conversion; image storage; lighting techniques; image processing and analysis: data reduction; segmentation; feature extraction; object recognition; other algorithms; application: inspection; identification; visual serving and navigation.

5. **ROBOT KINEMATICS**: Forward kinematics; inverse kinematics and differences; forward kinematics and reverse kinematics of manipulators with two; three degree of freedom (in 2 dimensional); four degree of freedom (in 3 dimensional): deviations and problems.

6. **ROBOT PROGRAMMING**: Teach pendant programming; lead through programming; robot programming; languages: VAL programming; motors commands, sensors commands, end effector commands and simple programs.

7. **IMPLEMENTATION and ROBOT ECONOMICS**: RGV; AGV: implementation of robots in industries: various steps; safety considerations for robots operations; economic analysis of robots: payback method; EUAC method; rate of return method.

**TEXT BOOK**

**REFERENCE BOOKS**

**OBJECTIVE**
This course aims at imparting theoretical and practical aspects of the basic techniques of flexible manufacturing systems and provides an overview of the basics of FMS techniques and allied/supporting techniques; this course is very useful for present upcoming manufacturing industries.

1. **AUTOMATION**: Types of automation; reasons for automating; automation strategies; Detroit-type automation: Automated flow lines; methods of work part transport; Transfer mechanisms; buffer storage; automation for machining operations.

2. **AUTOMATED ASSEMBLY SYSTEMS**: Design for automated assembly; types of automated assembly systems; part feeding devices; quantitative analysis of the delivery system operation; analysis of a single-station assembly machine; numericals.

3. **GROUP TECHNOLOGY**: Part families; parts classification and coding; types of classification and coding systems; machine cell design: The composite part concept; types of cell designs; determining the best machine arrangement; benefits of group technology.

4. **FLEXIBLE MANUFACTURING SYSTEMS**: Components of an FMS; types of systems; where to apply FMS technology; FMS work stations; material handling and storage system: functions of the handling system; FMS layout configurations; material handling equipment; computer control system: computer function; FMS data file; system reports; planning the FMS; analysis methods for FMS; applications and benefits.

5. **CNC MACHINE TOOLS**: Introduction; types of CNC systems; numerical control Machine tools: CNC types; constructional details; special features; part programming fundamentals: manual programming and computer assisted part programming.

6. **CONTROL ELEMENTS**: Single and multi axis CNC controllers; hydraulic control; pneumatic control: limit switches; proximity switches; sequencing control using hard wired and PLC systems.

7. **CONTROL METHODS**: Standalone; PC based (Real Time Operating Systems Graphical User Interface; Simulation); applications: SPM; robot; CNC; FMS; CIM.

**TEXT BOOK**

**REFERENCE BOOKS**

**OBJECTIVE**
Such vehicles are used for agricultural work and land excavation work; Study of such vehicles is imperative

1. **INTRODUCTION**: Classification of special purpose vehicles; wheel type and track type; applications;

2. **SYSTEMS OF SPECIAL VEHICLES**: Study of working principles and design considerations of different systems involved like power system;
transmission; final drive; lubrication; electrical; braking; steering; pneumatic and hydraulic control circuits;
3. EARTH MOVING MACHINERY: Constructional and working features of different types of earth moving machinery such as rippers; shovels; loaders; excavators; dumpers; dozers; fork lift;
4. INSTRUMENTATION: Study of instrumentation applied to such machines;
5. FARM TRACTOR AND EQUIPMENTS: Layout; load distribution; engine; transmission and drive line; steering; braking system; wheels and tyres; hydraulic system; auxiliary systems; draw bar; PTO shaft; Harrow disc; leveller; sprayer; seeder.
6. MOBILE CRANES: Basic characteristics of truck cranes; stability and design features; control systems and safety devices.
7. MISCELLANEOUS VEHICLES: Tracked vehicles; articulated vehicles; multi-axle vehicles.

TEXT BOOK

REFERENCE BOOKS

LIST OF EXPERIMENTS

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OBJECTIVE
To understand the properties of fuels and lubricants for the design and operation of the IC engines

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<th>AE-461</th>
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OBJECTIVE
1. MANUFACTURE OF FUELS AND LUBRICANTS:
Structure of petroleum; refining process; fuels; thermal cracking; catalytic cracking; polymerization; alkylation; isomerisation; blending; products of refining process; Manufacture of lubricating oil base stocks; manufacture of finished automotive lubricants
2. THEORY OF LUBRICATION: Engine friction: introduction; total engine friction; effect of engine variables on friction; hydrodynamic lubrication; elasto hydrodynamic lubrication; boundary lubrication; bearing lubrication; functions of the lubrication system; introduction to design of a lubricating system
3. LUBRICANTS: Specific requirements for automotive lubricants; oxidation deterioration and degradation of lubricants; additives and additive mechanism; synthetic lubricants; classification of lubricating oils; properties of lubricating oils; tests on lubricants; Grease; classification; properties; test used in grease
4. PROPERTIES AND TESTING OF FUELS:
Thermo-chemistry of fuels; properties and testing of fuels; relative density; calorific value; distillation; vapour pressure; flash point; spontaneous ignition temperature; viscosity; pour point; flammability; ignitability; diesel index; API gravity; aniline point; cetane and octane nos; Additive: mechanism; requirements of an additive; petrol fuel additives and diesel fuel additives : specifications of fuels
5. ALTERNATE FUELS: Need for alternate fuel; availability and properties of alternate fuels; general use of alcohols; LPG; hydrogen; ammonia; CNG and LPG; vegetable oils and biogas; merits and demerits of various alternate fuels;
Introduction to alternate energy sources; like EV; hybrid; fuel cell and solar cars; Alcohols: properties as engine fuel; alcohols and gasoline blends; performance in SI engine; methanol and gasoline blends; combustion characteristics in CI engine; emission characteristics; DME; DEE properties; performance analysis; performance in SI and CI engines.

6. **NATURAL GAS; LPG; HYDROGEN AND BIOGAS:** Availability of CNG; properties; modification required to use in engines; performance and emission characteristics of CNG using in SI and CI engines; performance and emission of LPG; Hydrogen; storage and handling; performance and safety aspects.

7. **VEGETABLE OILS:** Various vegetable oils for engines; sunflower; soyabean; peanut; rape side; palm oil; Mahua; jatropha and neem; Esterification; performance in engines; performance and emission characteristics; bio-diesel and its characteristics.

**TEXT BOOK**

**REFERENCE BOOKS**
1. Francis, W., "Fuels and Fuel Technology", Vol;-I and II.

**OBJECTIVE**
Providing sound knowledge about the principles of operation of various electrical machines; study of two and three wheelers is imperative as sales and service of these vehicles is on the increase in India

1. **INTRODUCTION:** Development; Classification and layout of two wheelers (Motorcycles; scooters; mopeds) and Three wheelers; applications and capacity – goods and passengers; study of technical specifications of Two and Three wheelers;

2. **POWER PLANT:** Selection of engine for two wheeler and three wheeler; Design considerations for two wheeler and three wheeler power plants; special systems; requirements for lubrication; cooling; starting; Recent engine developments;

3. **TRANSMISSION SYSTEMS:** Clutch – special requirements; different types used in two and three wheelers; need of primary reduction; selection of transmission – gear transmission; gear shift mechanism; belt transmission; automatic transmission (Continuous Variable Transmission – CVT; Epicycle); final drive and differential for three wheeler; wheel drive arrangement.

4. **STEERING and SUSPENSION:** Steering geometry; steering column construction; steering system for three wheelers; suspension requirements; design considerations; trailing and leading link; swinging arm; springs and shock absorbers.

5. **BRAKE; WHEEL and TYRES:** Design consideration of brake; types of brakes : disc; drum; braking mechanism : mechanical; hydraulic and servo; wheel types : spokes; disc; split; special tyre requirements for two and three wheelers;

6. **FRAMES and BODY:** Types of frame; construction; loads; design consideration; materials; types of three wheeler bodies; layout; RTO regulations; aerodynamic; aesthetic and ergonomics considerations for body work; side car;

7. **ROAD PERFORMANCE:** Handling characteristics; driver and pillion seating arrangement; ergonomics and comfort; road holding and vehicle stability; riding characteristics; safety arrangements; Racing bikes – special requirements.

**TEXT BOOK**

**REFERENCE BOOKS**

**OBJECTIVE**
The project involves in-depth study on the topic, design, development, analysis fabrication and/or experimental work – Hardware and/or Software. It is intended to give an opportunity to a student to apply his knowledge to solve real-life problem. The student has to select a project work based on a topic of interest.

**OPERATION**
Major Project shall comprise of Phase-I and Phase-II, spread over Term-XI and Terms-XII respectively. The students may work jointly (small group) or individually.

**OBJECTIVE**
The Internship course is a formal method of linking university with the world of work and essentially takes the class room for 20-22 weeks to a professional location where the student and faculty solve real-life problems, of course, with the help of professional experts. Resident University faculty will supervise the education of the students.
OPERATION

The Internship course has two components, namely Internship-I of 6-8 weeks duration (Summer-term following 9th Term) and Internship-II of 13-14 weeks duration (11th Term). After the Internship-II, in 12th term the student will document internship work in detail and deliver colloquium. However, the student may contact industry during this period.

(a) Internship-I: Internship-I is conducted at large industrial complexes during Summer Term after Term-IX and exposes the students to real-life situations.

(b) Internship-II: This component is conducted at various production and manufacturing units, Design, Development and Consulting Agencies, National Laboratories, R&D Centers, etc. The students solve real-life problems of interest to the host organizations. The professional expert acts as a consultant while resident University faculty supervises the work.

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OBJECTIVE

The students are required to prepare comprehensive report on the problem(s) solved in industry and suitably extend the work wherever required so as to help the industry implement the solution. For this purpose the student can interact with the industry.

The seminar is to cover the details regarding Major Project Phase-I/Major Project Phase-II and Internship-II viz. problem definition, literature survey, concepts and methodology employed, analysis, design and development, conclusions and future work.

The purpose of this course is to
- Acquaint the students in the basic economic concepts and their operational significance and
- Stimulate him to think systematically and objectively about contemporary economic problems.

1. INTRODUCTION: Definition of economics; difference between micro and macro economics; central problems of economy including PP curve; factors of production
2. UTILITY: concept and measurement of utility; Law of Diminishing Marginal Utility (DMU); derivation of Law of Demand from Law of DMU; Law of Equimarginal Utility (EMU) – its practical applications
3. DEMAND: What is demand and supply; shift in demand and extension of demand; law of demand and law of supply; demand function; demand schedule; elasticity of demand; measurement of elasticity of demand; factors affecting elasticity of demand; role of demand and supply in price
determination and effect of changes in demand and supply on prices
4. **PRODUCTION FUNCTIONS:** Meaning of production and production functions; Law of Variable Proportion; returns to scale, internal and external economies and diseconomies of scale.
5. **COSTS:** Various concepts of costs: fixed cost, variable cost, average cost, marginal cost, opportunity cost; shape of average cost, marginal cost, total cost etc. in short run and long run.
6. **MARKET STRUCTURES:** What is market; main features of perfect competition; monopoly; oligopoly; monopolistic competition.
7. **MACRO ECONOMICS:** Macro economics: brief concepts of GDP, GNP, NI, per capita income; inflation; privatization; globalization (merits & demerits); elementary concepts of VAT, WTO, GATT and TRIPS

**TEXT BOOK**

**REFERENCE BOOKS**

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<th>BA-226</th>
<th>PRINCIPLES OF MANAGEMENT</th>
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dams; mineral resources: dereliction of mines, environmental effects of extracting and using mineral resources; Food resources, modern agriculture and its impact, problem associated with fertilizer and pesticide, water logging, salinity; energy resources, renewable, non-renewable energy sources, solar energy, wind energy, hydro energy, biomass energy, geothermal energy, nuclear energy and its associated hazards; land as a resource, land degradation, man induced landslides, soil erosion and desertification.

3. 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; characteristic features, structure and function of the following ecosystem - forest ecosystem, grassland ecosystem desert ecosystem and aquatic ecosystems.

4. BIODIVERSITY AND ITS CONSERVATION: Biogeographical classification of India; biodiversity at global, national and local levels, India as a mega-diversity nation, hot-spots of biodiversity; value of biodiversity-consumptive use, productive use, social, ethical aesthetic and option values; threats to biodiversity; conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

5. ENVIRONMENTAL POLLUTION: Causes, effects and control measures of air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution, solid waste management, e-waste management; disaster management – floods, earthquake, cyclone and landslides.


7. HUMAN POPULATION AND THE ENVIRONMENT: Population growth, population explosion – family welfare programmes; role of information technology in environment and human health; case studies, Chipko movement, Saradar Sarovar dam, mining and quarrying in Udaipur, salinity and water logging in Punjab, Haryana and Rajasthan, Bhopal gas tragedy, Chernobyl nuclear disaster, arsenic pollution in ground water.

TEXT BOOK

REFERENCE BOOKS

OBJECTIVE
To introduce to the students the latest topics of interests of the new generation science with the accomplishment of various technological advancements of biochemistry and texture of advanced photochemistry.

1. PHASE RULE: Terminology of phases; components and degree of freedom; derivation of Gibbs phase rule equation; one component system (water system); application of reduced / condensed phase rule; two component system; eutectic (Pb-Ag) system; congruent (Zn-Mg) system; Incongruent system (Na-K) system; merits and demerits of phase rule.

2. THERMODYNAMICS: Entropy; entropy change for an ideal gas; free energy and its physical significance; variation of free energy with temperature and pressure; work function and its significance; relation between Gibb’s free energy and work function; second law of thermodynamics; Gibbs Helmholtz equation; Its application and significance; chemical potential; Gibbs Duhem equation; Clausius Clapeyron equation and its application.

3. WATER AND ITS TREATMENT: Specification of water for different uses; hardness of water; equivalent of calcium carbonate; units of hardness; disadvantages of hard water and determination of hardness; alkalinity of water and its determination; related numerals; scale and sludge formation in boilers and its prevention; caustic embrittlement; water softening; Zeolite process; Ion exchange process and mixed bed demineralization; disinfection of water; desalination; reverse osmosis; electrodialysis.

4. CORROSION AND ITS PREVENTION: Introduction; classification; dry and wet corrosion; electrochemistry theory of corrosion; galvanic, pitting and waterline corrosion; differential aeration corrosion; stress corrosion; factors affecting corrosion; preventive measures; material selection; proper designing; barrier protection; sacrificial protection; cathodic; anodic protection.

5. LUBRICATION AND LUBRICANTS: Friction; mechanism of lubrication; classification of lubricants; additives of lubricants; synthetic lubricants; properties of lubricants; consistency; drop point; fire and flash point; cloud point; pour
point; viscosity; viscosity index; iodine no.; aniline no.; saponification no.; steam emulsion no.; neutralization no.; decomposition stability and their significance.

6. **PHOTOCHEMISTRY**: Photochemical and dark reactions; laws of photochemistry; quantum efficiency; classification of photochemical reactions on the basis of their quantum efficiencies; non-radiative processes (ISC and IC); fluorescence; phosphorescence (Jablonski diagram); chemiluminiscence; photosensitization; technology based on photochemical processes.

7. **BIOMOLECULES**: Structure; function; diversity and distribution; general composition of living matter. carbohydrates; monosaccharides and their inter-relationship; structure of sugars; glucose; fructose; maltose; lactose, sucrose; stereoisomerism and optical isomerism of sugars; ring structure and tautomeric form and mutarotation; lipids: definitions; classification of lipids; fatty acids; glycerol; building block of lipid; proteins and amino acid; classification and formulae; proteinous and non-proteinous; essential and non-essential amino-acids; primary, secondary, tertiary, quaternary structure of proteins; N and C terminal determination.

**TEXT BOOK**

**REFERENCE BOOKS**

**OBJECTIVE**
To provide sound conceptual understanding of the fundamental concepts of computing hardware, software, networking and services; build programming logic and developing skills in problem solving using C/C++; Introduce the concept of object orientation and how to handle data in different forms; Emphasize the concepts and constructs rather than on language features.

1. **AN OVERVIEW OF COMPUTER SYSTEM**: Anatomy of a digital computer; memory units; main and auxiliary storage devices; input devices; output devices; classification of computers; computer hardware; computer software; data representation – bits and bytes and operations of data; radix number system – decimal, binary, octal, hexadecimal numbers and their inter-conversions; representation of information inside the computers.

2. **OPERATING SYSTEM BASICS**: The user interface; running programs; managing files; introduction to PC operating systems: Unix/Linux, DOS, MacOS and Windows, file system; file formats.

3. **INTERNET BASICS**: Introduction to computer networks; what is internet and WWW; basic WWW concepts; surfing the web; web multimedia; internet applications and features.

4. **PROGRAMMING LANGUAGES**: Machine level language; assembly level language; high level language; system software: assembler, compiler, interpreters, linker and loader, and their inter-relationship, debuggers, IDE; programming fundamentals – problem definition, algorithms, flow charts and their symbols.
5. **C PROGRAMMING LANGUAGE CONSTRUCTS:**
   An overview of C; expressions – data types, identifiers names, variables, type qualifiers, storage class specifiers, operators, type conversion in expression, type casting; console I/O: I/O functions; the C standard library; problem solving process algorithm: pseudo code and flowchart; statements – true and false in C, selection statements, iteration statements, jump statements, expression statements and block statements; arrays – single dimensions arrays, generating a pointer to an array, passing 1D array to functions; string: 2D arrays, multidimensional array, indexing pointers, array initialization, variable-length array

6. **DATA HANDLING:** Pointers – Pointer variables, pointer operators, pointer expressions, pointers and arrays, multiple indirectation, initializing pointers, C's dynamic allocation functions, restrict-qualified pointers, problems with pointers; functions: the general form of a function, scope of a function, function arguments, argc and argv — arguments to main( ), the return statement, purpose of main( ), recursion, function prototypes, the "implicit int" rule; structures, unions, enumerations, and typedef – structures, arrays of structures, passing structures to functions, structure pointers, arrays and structures within structures, unions, bit-fields, enumerations, using sizeof to ensure portability, typedef; important differences between C and C++.

7. **ADVANCED DATA HANDLING:** Basic file I/O – C vs. C++ File I/O, standard C Vs. Unix file I/O streams and files, file system basics, fread() and fwrite(), fseek() and random-access, fprintf() and fscanf(); the preprocessor and comments – the preprocessor, conditional compilation directives, using defined, the # and ## preprocessor operators, predefined macro names, comments.

**TEXT BOOK**

**REFERENCE BOOKS**

**WEB REFERENCES**

**LIST OF EXPERIMENTS/EXERCISES**
1. Basic/Simple logic building
2. Handling mathematical data
3. Use of control structures
4. Use of Function
5. Handling mathematical problems
6. Array and Pointer
7. Searching and Sorting
8. String Manipulation
9. Use of Structure and Union
10. File handling

**REFERENCE BOOKS**

**EC-201 ELECTRONICS ENGINEERING**

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**OBJECTIVE**
The purpose of this course is to give basic electronics concept; their operational significance and its basic application.

**PRE-REQUISITES**
Knowledge of electricity, solid state physics

**HISTORICAL BACKGROUND:** Vacuum tubes; working of vacuum tube and their characteristics; vacuum diode; triode; tetrode and pentode

**PN JUNCTION:** Depletion layer; Barrier potential; Forward and reverse bias; Breakdown voltage; PIV; switching characteristics of p-n junction diode; knee voltage; load line; and operating Point Ideal p-n junction diode; junction capacitance; zener diode.

**RECTIFIERS AND FILTERS:** Half wave: centre tap full wave and bridge rectifier; percentage of regulation; PIV; ripple factor; C; RC and PI filter; voltage doubler; clipping and clamping circuit; voltage regulation.

**BIPOLAR JUNCTION TRANSISTOR:** Introduction; basic theory of operation of PNP ad NPN transistor-l characteristics; CB; CE and CC configuration; different biasing techniques.
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5. **FET**: Introduction; Theory of operation; JFET Parameters; and JFET Amplifiers. MOSFET: Introduction; theory of operation; MOSFET parameters; application; graphical analysis of BJT and FET circuits; linear models of BJT and FET; pulse and large signal models of BJT and FET

6. **BIASING TECHNIQUES OF FET**: Introductory idea of multistage and feedback amplifiers; base bias; emitter feedback bias; collector voltage divider bias; Load line and operating point.

7. **INTEGRATED CIRCUIT**: Analysis of principle of integration. Introduction to Digital Integrated circuits; THYRISTORS: Introduction to thyristor family; SCR theory of operation; SCR characteristics and triggering; TRIAC: Theory of operation; Characteristics and control by SCR and TRIAC Introduction to op-amp; UJT: Introduction; Basic theory of operation characteristics and structure; Complementary and programmable UJT relaxation oscillator.

**TEXT BOOK**

**REFERENCE BOOKS**

**LIST OF EXPERIMENTS**
1. Study V-I characteristics of diode; and its use as a capacitance.
2. Study of the characteristics of transistor in Common Base configuration.
3. Study of the characteristics of transistor in Common Emitter configuration.
4. Study of V-I characteristics of a photo-voltaic cell.
5. Study of characteristics of MOSFET/JFET is CS configuration.
6. Plot characteristics of thyristor.
7. Plot characteristics of UJT.
8. Plot characteristics of diac and Triac.
9. Introduction to OrCAD PSpice Software.
10. Simulation of semiconductor device circuits using OrCAD PSpice.

**REFERENCE BOOKS**


**OBJECTIVE**
To provide basic knowledge and understanding of fundamental concepts of Electrical Technology, explaining various basic laws governing the circuit configurations and evaluation and its applications to electrical circuits.

1. **DC NETWORKS**: EMF, potential difference; current, resistance; Ohm’s law; effect of temperature on resistance; source conversion; KCL, KVL; mesh analysis, nodal analysis; network theorems – superposition, Thévenin’s, Norton, reciprocity, maximum power transfer theorem; star-delta conversion.

2. **SINGLE PHASE AC CIRCUIT**: Generation of AC voltages, frequency, cycle, period, instantaneous, Peak, RMS and average value, peak factor, form factor, phase and phase difference, polar, rectangular, exponential and trigonometric representation of phasors; R, L and C components, behavior of these components in A.C. circuits, series and parallel A.C. circuits and their phasor diagrams, concept of impedance and admittance, power and power factor, Complex power; resonance-Series and parallel resonance, Q factor; bandwidth.

3. **THREE PHASE CIRCUITS**: Phase and line voltages and currents, balanced star and delta circuits; phasor diagram, power equation, measurement of three phase power by two wattmeter method; comparison of single phase, three phase and DC system and their relative advantages.

4. **MAGNETIC CIRCUITS**: Magnetic effect of electric current; concept of MMF; flux, flux density, reluctance, permeability; B-H curve; hysteresis loop, hysteresis and eddy current loss; comparison of electrical and magnetic circuits.

5. **TRANSFORMER**: Construction, principle, working of ideal and practical transformer; equivalent circuit, phasor diagram; OC and SC tests, regulation and efficiency; autotransformer.

6. **ROTATING ELECTRICAL MACHINES**: DC MACHINES – construction, principle of operation and classification of dc machines, EMF equation and characteristics of dc generator, starting and speed control of dc motor.

**INDUCTION MACHINES**: Construction and principle of operation of three phase induction motor, concept of slip and its importance.

7. **MEASURING INSTRUMENTS**: Voltmeter; ammeter; wattmeter; energy meter.

**TEXT BOOK**
Gupta, J.B. “Electrical Technology”, Katson Publication

**REFERENCE BOOKS**

<table>
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<th>EL-151</th>
<th>ELECTRICAL ENGINEERING LAB</th>
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**LIST OF EXPERIMENTS**
1. To verify KCL and KVL.
2. To verify Thevenin’s and Norton’s Theorems.
3. To verify maximum power transfer theorem in D.C Circuit and A.C Circuit.
4. To verify Reciprocity and Superposition theorems.
5. To study frequency response of a series R-L-C circuit and determine resonant frequency and Q-Factor for various Values of R, L, C.
6. To study frequency response of a parallel R-L-C circuit and determine resonant frequency and Q-Factor for various values of R, L, C.
7. To perform direct load test of a transformer and plot efficiency Vs load characteristic.
8. To perform open circuit and short circuit tests on a single-phase transformer determine the losses and efficiency.
9. To perform direct load test of a DC shunt generator and plot load voltage Vs load current curve.
10. To study various types of meters.
12. Measurement of power in a 3 phase system by two watt meter method.
13. Connection and testing of a single-phase energy meter (unit power factor load only).

**REFERENCE BOOKS**

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**OBJECTIVE**
By doing this course the students will be acquiring reasonable level of oral and in writing proficiency in English language ultimately they will be able to communicate with their counter parts in business/industry in the country and abroad effectively.

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**LIST OF EXPERIMENTS/EXERCISES**
1. Vocabulary; Use of Words; Synonyms; Homophones; Homonyms; Forms and Functions of Words
2. Sentence Structure; Verb patterns; Simple; Complex and Compound Sentences
3. Remedial English Grammar; Common Errors and Rules of Concord
4. Phonetics; Basic Concepts; Vowels; Consonants; Syllables; Manner of Articulation and Place of Articulation; Speech Sounds; Transcription of Words; Word Stress and Intonation
5. Comprehension; Interpretation of Seen/Unseen Passages
6. (A) Oral Communication: Practicing short dialogues; Group Discussions; and Debates
   (B) Technical Writing:
      (i) Business Letters (Format of Business Letters and Business Letter Writing)
      (ii) Email Writing
      (iii) Reports and types of reports and Press reports
7. Book Review (for internal assessment)

**TEXT BOOK**

**REFERENCE BOOKS**

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B.Tech. Automobile Engineering (Regular)

(a) 1st syllable stress
(b) 2nd syllable stress
(c) 3rd syllable stress

2. Sentence intonation: Simple day to day sentences will be repeated by the students.
3. Public speeches and debates: Recorded debates and public speeches will be heard by the students to enhance their knowledge on the pitch and tone.
4. Conversation: Regular conversations will be heard and later practiced in the lab.
5. Listening comprehension: Students will hear the text and answer the questions that follow.
6. Reading comprehension: Text at par with international standard will be read by the students. Questions will than be answered.
7. Speaking: Text conversation, debates & lecturers will be heard by the students. The students will be used their aptitude and language to give their on them
8. Error correction: Grammatically incorrect sentences will be given to the students to correct.
9. Listening and speaking exercises will be practiced for the improvement of the language.
10. Added exercise on reading comprehension.

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OBJECTIVE
To acquaint the students with the various concepts and tools of applied mathematics which will be very basic and the very soul and guide of various engineering subjects.

1. MATRICES & ITS APPLICATIONS: Rank of a matrix; elementary transformations; elementary matrices; inverse using elementary transformations; normal form of a matrix; linear dependence and independence of vectors; consistency of linear system of equations; linear and orthogonal transformations; Eigen values and Eigen vectors; properties of Eigen values; Cayley - Hamilton theorem and its applications.

2. INFINITE SERIES: Convergence and divergence; comparison; D’ Alember’s ratio; Integral; Raobes; De Morgan & Bertrand’s; logarithmic and Cauchy root tests; alternating series; absolute and conditional convergence.

3. APPLICATIONS OF DIFFERENTIATION: Taylor’s and Maclaurin’s series; asymptotes; curvature.

4. PARTIAL DIFFERENTIATION: Functions of two or more variables; partial derivatives; total differential and differentiability; derivatives of composite and implicit functions; Jacobian’s; higher order partial derivatives.

5. APPLICATION OF PARTIAL DIFFERENTIATION: Homogeneous functions; Euler’s theorem; Taylor’s series for functions of two variables (without proof); maxima-minima of function of two variables; Lagrange’s method of undetermined multipliers; differentiation under integral sign.

6. FOURIER SERIES: Euler’s formula; conditions for a Fourier expansion; change of interval; Fourier expansion of odd and even function; Fourier expansion of square wave; rectangular wave; saw-toothed wave; half and full rectified wave functions; half range sine and cosine series.

7. ORDINARY DIFFERENTIAL EQUATIONS & ITS APPLICATIONS: Exact differential equations; equations reducible to exact differential equations; applications of differential equations of first order and first degree to simple electric circuits; Newton’s law of cooling; heat flow and orthogonal trajectories.

TEXT BOOK

REFERENCE BOOKS

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OBJECTIVE
To acquaint the students with the various concepts and tools of applied mathematics which will be very basic and the very soul and guide of various engineering subjects.

1. DIFFERENTIAL EQUATIONS OF HIGHER ORDER AND ITS APPLICATION: Linear differential equations of second and higher order; complete solution; complementary function and particular integral; method of variation of parameters to find differential particular integral; Cauchy’s and Legendre’s linear equations; simultaneous linear equations with constant coefficients; applications of linear differential equations to simple pendulum; oscillatory electric circuits.

2. LAPLACE TRANSFORMS AND ITS APPLICATIONS: Laplace transforms of elementary functions; properties of Laplace transforms; existence conditions; transforms of derivatives; transforms of integrals; multiplication by t; division by t.

3. EVALUATION OF INTEGRALS BY LAPLACE TRANSFORMS: Laplace transform of unit step function; unit impulse function and periodic function; inverse transforms; convolution theorem; application to linear differential equations and simultaneous linear differential equations with constant coefficients.

4. FOURIER TRANSFORMS: Fourier integral transforms; shifting theorem (both on time and frequency axes); Fourier transforms of derivatives; Fourier transforms of integrals; convolution theorem; Fourier transform of Dirac-delta function.
5. **CURVE TRACING:** Applications of single integration to find volume of solids and surface area of solids of revolution; double integral; change of order of integration; double integral in polar coordinates.

6. **APPLICATIONS OF MULTIPLE INTEGRALS:** Applications of double integral to find area enclosed by plane curves and volume of solids of revolution; triple integral; volume of solids; change of variables; beta and gamma functions and relationship between them.

7. **VECTOR CALCULUS:** Differentiation of vectors; scalar and vector point functions; gradient of a scalar field and directional derivative; divergence and curl of a vector field and their physical interpretations; integration of vectors; line integral; surface integral; volume integral; Green’s, Stoke’s and Gauss’ theorems (without proof) and their simple applications.

**TEXT BOOK**

**REFERENCE BOOKS**
1. Ross, S. L., "Differential Equation", Wiley India Publishers

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5. **NUMERICAL DIFFERENTIATION AND INTEGRATION:** Derivatives from differences tables; numerical differentiation formulas, Newton-Cotes integration formulae; trapezoidal rule; Simpson’s rule; Bool’s rule; Weddle’s rule; Romberg’s rule.

6. **SOLUTION OF DIFFERENTIAL EQUATIONS:** Taylor’s series method; Euler and modified Euler’s method; Runge-Kutta method; Milne’s prediction corrector method, Adams–Bashforth method.

7. **SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS:** Finite difference approximation; solution of Laplace equation (standard 5 point formula) one-dimensional heat equation (Schmidt method, Cranck-Nicolson method; Dufort & Frankel method and wave equation.

**TEXT BOOK**
Grewal B. S., "Numerical Methods in Engineering and Sciences", Khanna Publisher

**REFERENCE BOOKS**

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**MA-202 APPLIED NUMERICAL METHODS**

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**OBJECTIVE**
To provide a foundation for numerical computing for scientific and engineering applications

**PRE-REQUISITE**
Knowledge of Basic Mathematics involving differentiation, integration, differential equations, linear equations, etc.

1. **ERRORS IN NUMERICAL CALCULATIONS:** Introduction; numbers and their accuracy; absolute; relative and percentage errors and their analysis; truncation errors; general formula; error calculation for inverse problem.

2. **SOLUTION OF NON-LINEAR EQUATIONS:** Bisection method; Regula-Falsi method; Secant method; Newton-Raphson method; fixed point method; initial approximation and convergence criteria.

3. **SOLUTION OF LINEAR SYSTEMS:** Gauss elimination method; Gauss-Jordan method; UV factorization, Jacobi’s method; Gauss-Seidal method.

4. **INTERPOLATION & CURVE FITTING:** Introduction to interpolation; Newton’s forward and backward formula; Sterling formula; Lagrangian polynomials; divided differences; least squares method.

**LIST OF EXPERIMENTS**
1. To find the roots of non-linear equation using Bisection method.
2. To find the roots of non-linear equation using Secant method.
3. To find the roots of non-linear equation using Newton’s method.
4. To solve the system of linear equations using Gauss-Elimination method.
5. To solve the system of linear equation using Gauss-Seidal iteration method.
6. To find the values of function at a particular point using Newton’s forward formula.
7. To find the values of function at a particular point using Newton’s backward formula.
8. To find the values of function at a particular point using Lagrange’s interpolation formula.
9. To integrate numerically using Trapezoidal rule.
10. To integrate numerically using Simpson’s rule.
11. To find the solution of o.d.e (ordinary differential equation) by Euler’s method.
12. To find the solution of o.d.e by Runge-Kutta method.
13. To find the numerical solution of Laplace equation.
14. To find the numerical solution of heat equation.
15. To find the numerical solution of wave equation.
B.Tech. Automobile Engineering (Regular)

REFERENCE BOOKS

OBJECTIVE
Engineering Mechanics is one of the core subjects that introduces the student to analysis of forces and motion and prepares the student for studying strength of materials and theory of machines.

1. FORCE SYSTEMS: Basic concepts of space, time, mass, force, particle and rigid body; scalars and vectors; conventions for equations and diagrams; external and internal effects of a force; principle of transmissibility; force classification; rectangular components of two and three dimensional force systems; resultant of two and three dimensional and concurrent force systems; moment about a point and about an axis; Varignon’s theorem; resultant of non-concurrent force systems; couple; equivalent couples; force couple systems.

2. EQUILIBRIUM: Equilibrium in two and three dimensions; system isolation and the free-body-diagram; modeling the action of forces; equilibrium conditions; applications including plane trusses; frames and machines.

3. PROPERTIES OF SURFACES/CROSS SECTIONS: Centre of mass; determining the centre of gravity; centre of mass versus centre of gravity; centroids of lines, areas and volumes including composite sections; moments of inertia; MI of plane figures; MI with respect to axis in its plane and with respect to an axis perpendicular to the plane of figure; parallel axis theorem; moment of inertia of a rigid body – of a lamina and of three dimensional body; MI of composite figures.

4. SIMPLE STRESSES AND STRAINS: Resistance to deformation; Hook’s law and stress-strain diagram; types of stresses; stresses and strains in bars of varying sections; stresses in composite bars; lateral strain and Poisson’s ratio; volumetric strain, modulus of rigidity and bulk modulus; relation between elastic constants.

5. TORSION OF CIRCULAR SHAFTS, TORSION FORMULA POWER TRANSMISSION

6. SHEAR FORCE AND BENDING MOMENTS: Definitions: SF and BM diagrams for cantilevers, simply supported beams with or without overhang and calculation of max. BM and SF and point of contra-flexure under i) concentrated loads, ii) uniformly distributed loads over whole span or part of it iii) combination of concentrated and uniformly distributed loads, iv) uniformly varying loads and application of moments; relationship between rate of loading, shear force and bending moments.

7. KINEMATICS / KINETICS OF PARTICLES: Velocity and acceleration under rectilinear and circular motion; Newton’s Second Law; D’Alembert principle; Inertial system; Newton’s Second Law applied to bodies under rectilinear and circular motion; solutions of problems using D’Alembert Principle and free-body diagrams.

TEXT BOOK

REFERENCE BOOKS

WEB REFERENCES
www.eCourses.ou.edu

LIST OF EXPERIMENTS
1. To study various forces and moments.
2. Prove polygon law of coplanar forces, experiments with pulley systems.
3. Find support reactions for simply supported beam
4. Find Forces in Truss elements
5. Measuring forces in members of jib crane.
6. Finding C.G. and MOI of various parts like connecting rod. Flywheel using various methods
7. To find mechanical advantage and mechanical efficiency of compound screw jack.
8. To study various simple machines including gear trains e.g. Wedge; clock; sewing machine, etc.
9. To conduct tensile test and determining ultimate tensile strength percentage elongation of steel specimen
10. To conduct compression test and determine compressive strength of specimen
11. To calculate VR, MA and efficiency of single, doubles and triple start worm and worm wheel
12. To study slider crank mechanism of 2 stroke and 4 stroke IC engine models
13. To study and analyze gear trains

MECHANICS LAB

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ME-151 | ENGINEERING MECHANICS LAB | L T P | Cr |
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WORKSHOP PRACTICE

ME-152 | WORKSHOP PRACTICE | L T P | Cr |
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OBJECTIVE
To provide an overview of the basic production techniques and allied / supporting techniques used to produce finished products from raw materials. In addition to theory, students will be given practical training on various basic production techniques. After going through this course, the students will be in a position to understand the working of a mechanical workshop.
1. **INTRODUCTION:** Basic manufacturing processes and safety in workshop.

2. **ENGINEERING MATERIALS:** Classification of materials—their general mechanical properties and their selection.

3. **CASTING PROCESSES:** Sand casting process; pattern making; types of moulding sands, cores, mould making, melting and pouring of metal; Casting defects.

4. **MACHINING PROCESSES:** Production of components involving turning; facing; taper turning; milling; shaping; planning and drilling operations.

5. **METAL FORMING PROCESSES:** Sheet metal forming operations; shearing, bending, punching and blanking, forging processes as upsetting, drawing down, bending etc.

6. **JOINING PROCESSES:** Metal arc welding; gas welding; resistance welding; soldering and mechanical fastening processes.

7. **FITTING AND MAINTENANCE:** Study of fitting tools, marking tools and measuring instruments like micrometer, vernier calipers and height gauge; introduction to some basic maintenance techniques/processes.

**TEXT BOOK**

**REFERENCE BOOK**

**NOTES**
1. In all sections of workshop, students will study about the tools used, different operations performed and main parts of the machine
2. Term final evaluation will be done on the basis of doing a practical job and viva-voce. There will be no theory paper on this subject.

**JOBS TO BE DONE**

**A. Machine Shop**
1. To prepare a job on a lathe involving facing, turning, taper turning, step turning, radius making and parting off.
2. To prepare horizontal surface/vertical surface/curved surface/slot or v-grooves on a shaper/planer.
3. To prepare a job involving side and face milling on a milling machine.
4. To prepare a job involving drilling and tapping of holes.

**B. Sheet Metal Work**
1. To draw layout, do marking and prepare a rectangular tray of sheet metal.
2. To draw layout, do marking and prepare a funnel of sheet metal.

**C. Foundry**
1. To prepare a single piece pattern mould, put metal in the mould and fettle the casting.
2. To prepare a split piece pattern mould.

**D. Welding**
1. To prepare joints (Lap and butt) by metal arc welding.
2. To prepare welded joint by resistance welding.

**E. Fitting and Maintenance Jobs**
1. Fitting jobs involving, chipping, filing, marking and measuring with precision instruments.
2. Maintenance and repair of common domestic appliances such as desert cooler, LPG stove, room heater, water tap, flush system, electric iron, scooter etc.

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<th>ENGINEERING GRAPHICS</th>
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**OBJECTIVE**
Engineering graphics is the primary medium for development and communicating design concepts. Through this course the students are trained in engineering Graphics concepts through manual drafting. The ISI code of practice is followed. With this course students can improve the visual concepts in all engineering streams.

1. **INTRODUCTION:** Need drawing instruments; geometrical drawing, conventional representation—indicating welds, Joints, surface texture, structural work etc.; various types of projections; first and third angle systems of orthographic projections.

2. **SIMPLE PROJECTS:** Projection of points in different quadrants; projections of lines parallel to or inclined to one or both reference planes, true length of a line and its inclination with reference planes; traces of a line; concept of auxiliary plane.

3. **PROJECTIONS OF PLANES:** Parallel to one reference plane; inclined to one plane but perpendicular to the other, inclined to both reference planes.

4. **PROJECTIONS OF SOLIDS AND SOLIDS OF REVOLUTION:** In simple positions with axis perpendicular to a plane; with axis parallel to both planes; with axis parallel to one plane and inclined to the other.

5. **SECTIONS OF SOLIDS:** Prisms; pyramids; cylinders and cones; section plane is parallel, perpendicular and inclined to both reference planes; true shape of sections.

6. **DEVELOPMENT OF LATERAL SURFACES OF REGULAR SOLIDS:** Rectangular block; cylinder; cone; pyramid.

7. **ISOMETRIC VIEWS OF PLANES:** circle, square, rectangle; Isometric views of solids- prisms, pyramids and cylinders; principle of perspective projection, perspective of planes and solids.

**TEXT BOOK**

**REFERENCE BOOKS**
3. SP 46-1988, Bureau of Indian Standards (BIS), New Delhi
WEB REFERENCES
1. www.technologystudent.com
2. www.animatedworksheets.co.uk
3. www.ider.herts.ac.uk/school/courseware

LIST OF SHEETS TO BE MADE:

<table>
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<tr>
<th>Sl. No.</th>
<th>Details of the sheet</th>
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<tbody>
<tr>
<td>1.</td>
<td>Basic Geometrical Constructions including the curves, ellipse, parabola, Hyperbola, and cycloidal curves.</td>
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<tr>
<td>2.</td>
<td>Projection of Lines including traces.</td>
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<td>3.</td>
<td>Projection of Planes.</td>
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<td>4.</td>
<td>Projection of Solids.</td>
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<td>5.</td>
<td>Section of solids.</td>
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<td>6.</td>
<td>Developments of surfaces</td>
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<tr>
<td>7.</td>
<td>Isometric and Perspective views.</td>
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Notes:
The students will Practice/Draw at least one sheet from each Unit. The Examiner will set one question from each unit and the student will attempt four questions in all.

OBJECTIVE
This course introduces the student to the fundamental laws of thermodynamics, the interaction between energy and matter, the quantitative and qualitative aspects of energy and its transformations, the properties of the working substance and their relationship.

1. BASIC CONCEPT: Thermodynamic systems; Surrounding and Boundary; Thermodynamic Property – Intensive and Extensive; Thermodynamic Equilibrium; State; Path; Process and Cycle; Quasi-static; Reversible and Irreversible Processes; Working Substance; Concept of Thermodynamic Work and Heat; Equality of Temperature; Zeroth Law of Thermodynamics and its utility; Numericals

2. FIRST LAW OF THERMODYNAMICS: Internal Energy and 1st Law Applied to Non-flow process; PMMFK; Enthalpy; Steady flow energy equation; Steady and unsteady Flow Process; Throttling Process and Free Expansion Process; Numericals

3. SECOND LAW OF THERMODYNAMICS: Limitations of First Law; Heat Source and Heat Sink; Heat Engine; Refrigerator and Heat Pump; Kelvin-Planck and Clausius Statements and their Equivalence; PMMSK; Carnot Cycle; Carnot Theorem; and its Corollaries; Thermodynamic Temperature Scale; Entropy; Clausius Inequality; Principle of Entropy Increase; Entropy Change in Different Processes; Introduction to Third Law of Thermodynamics; Numericals

4. AVAILABILITY AND IRREVERSIBILITY: High and Low Grade Energy; Availability and Unavailable Energy; Loss of Available Energy Due to Heat Transfer Through a Finite Temperature Difference; Dead state of a system; Availability of a Non-Flow or Closed System; Availability of a Steady Flow System; Helmholtz and Gibb’s Functions; Effectiveness and Irreversibility; Numericals

5. IDEAL AND REAL GASES: Concept of an Ideal Gas; Basic Gas Laws; Characteristic Gas Equation; and Universal Gas Constant; Vander Waal’s Equation of state; Reduced Co-ordinates; Compressibility factor and law of corresponding states; Mixture of Gases; Mass; Mole and Volume Fraction; Gibbs Dalton’s law; Gas Constant and Specific Heats; Entropy for a mixture of non-reactive gases; Numericals

6. PURE SUBSTANCE: Pure Substance and its Properties; Phase and Phase Transformation; Vaporization; Evaporation and Boiling; Saturated and Superheat Steam; Solid – Liquid – Vapour Equilibrium; T-V; P-V and P-T Plots; Properties of Dry; Wet and Superheated Steam; Property Changes During Steam Processes; Use of steam tables and Mollier Diagram for Process calculation; Throttling And Measurement of Dryness Fraction of Steam; Numericals

7. THERMODYNAMIC RELATIONS: Maxwell Relations; Clapeyron Equation; Relations for changes in Enthalpy and Internal Energy & Entropy; Specific heat capacity Relations; Joule Thomson coefficient & inversion curve;

TEXT BOOK

REFERENCE BOOKS

WEB REFERENCES
1. www.mdpo.org/entropy
2. www.nptel.iitm.ac.in

OBJECTIVE
The strength of materials is one of the core subjects and aim is to provide a sound foundation to design various elements of mechanical equipment

PRE REQUISITES
Knowledge of Engineering Mechanics

1. BENDING: Bending stress in beams (straight members) with loading in the plane of symmetry (rectangular; circular; I. T. sections); Flexural formula; Unsymmetrical bending: Pure bending of a beam having an arbitrary cross section; Components of moment along principal axes; Generalized flexural formula; Curved beams: stresses in bars of initial small radius of curvature; (cross sections – circular; rectangular; trapezoidal)
2. **TRANSVERSE SHEAR:** The shear formula; shear stress in beams (rectangular cross section; I section); shear flow in thin-walled members (I. C. L sections); shear centre

3. **Bi-axial stress:** Thin walled pressure vessels; plane stress transformation; general equations; principal stresses; plane strain transformation; principal strains; Mohr’s circle – plane stresses; plane strains; Stresses in shaft due to combined bending and axial loads; bending and torsion

4. **SLOPE AND DEFLECTION OF BEAMS & SHAFTS:** Relationship between bending moment; slope and deflection

Calculations of slope and deflection by method of integration; Macauley’s method; moment area method; method of superposition

5. **STRAIN ENERGY:** Expression for strain energy and various types of loadings; axial force; bending moment; transverse shear; torsional moment Castigliano’s theorem to find slope; deflection of beams; rings; Theories of elastic failure with derivations and graphical representation

6. **COLUMNS AND STRUTS:** Column under axial load; concept of instability and buckling; slenderness ratio; Euler’s formula for elastic buckling load; Rankine-Gordon Formula

7. **THICK CYLINDERS:** Derivations of Lame’s equations; radial and hoop stresses and strains in thick and compound cylinders; hub shrunk on solid shaft

**TEXT BOOK**

**REFERENCE BOOKS**

**WEB REFERENCES**
1. www.mdsolids.com
2. www.ecourses.ou.edu

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**ME-208**

<table>
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<th>THEOREY OF MACHINES-I</th>
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**OBJECTIVE**
The primary purpose of this course is to make student understand and develop skill to predict the effect of force and motion while carrying out design function. It is foundation for design of various mobile devices

**PRE REQUISITES**
Knowledge of Engg Mechanics

1. **KINEMATICS OF PARTICLES:** Particle motion; velocity and acceleration in path and cylindrical coordinates; relative motion; motion of constrained particles
2. **KINETICS OF PARTICLES:** Force; mass and acceleration; Newton’s Law for rectangular coordinates and cylindrical coordinates; Equations of motion and solution of problems; work energy equations; work energy equations for system of particles; linear and angular momentum equations for system of particles

3. **PLANE KINEMATICS OF RIGID BODIES:** Plane motion; translation and rotation of rigid bodies; instantaneous center of zero velocity; relative acceleration; Coriolis acceleration

4. **PLANE KINETICS OF RIGID BODIES:** Force; mass and acceleration; general equations of motion; Translation; fixed axis rotation; general plane motion

5. **INTRODUCTION TO 3-DIMENSIONAL DYNAMICS OF RIGID BODIES:** Kinematics-translations; fixed axis rotation; parallel plane motion; general motion; Kinetics-angular momentum; gyroscopic motion

6. **STATIC & DYNAMIC FORCE ANALYSIS:** Static force analysis of planer mechanisms; dynamic force analysis including inertia and frictional forces of planar mechanisms

7. **DYNAMIC FORCE ANALYSIS**
Dynamic force analysis of reciprocating engines

**TEXT BOOK**

**REFERENCE BOOKS**
2. “Vector Mechanics for Engineers Dynamics” 8th ed; Ferdinand P Beer; E Russel Johnston

**WEB REFERENCES**
www.nptel.iitm.ac.in

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**ME-207**

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**OBJECTIVE**
The course provides the knowledge on the composition; testing and applications of materials; It also provides knowledge about the structure of materials and the effect of temperature; composition and time on various metallurgical processes. The study of this course will help the students to identify and select suitable materials for various engineering applications

**PRE REQUISITES**
Knowledge of Applied Physics; Applied Chemistry; Manufacturing Practice

1. **STRUCTURE OF MATERIALS:** Crystal structure; Crystal imperfections and their classifications; point defects; line defects; edge and screw dislocations; surface defects; volume defects and effects of imperfections on metal properties
2. **SOLID SOLUTIONS AND PHASE DIAGRAM:**
Solid solution and its types; importance and objectives of phase diagram; systems; phase and structural constituents; cooling curves; Gibbs’s phase rule; Lever rule; Iron Carbon equilibrium diagram and TTT diagram
3 **HEAT TREATMENT**: Principles; purpose; classification of heat treatment processes; annealing; normalizing; hardening; tempering; carburizing; nitriding; cyaniding; flame and induction hardening; Allotropy of iron; Martempering and Austempering

4 **DEFORMATION OF METALS**: Elastic and plastic deformation; mechanism of plastic deformation; yield point phenomena; strain ageing; work hardening; Bauschinger effect; season cracking; Recovery; re-crystallization and grain growth

5 **CORROSION CREEP & FATIGUE**: Phenomenon of Corrosion; Creep concept and creep curve; mechanism of creep; creep testing and prevention against creep; fatigue; fatigue limit; mechanism of fatigue; factors affecting fatigue; fatigue testing and SN curve

6 **METALS AND ALLOYS**: Ferrous Metals: Plain carbon steel; high speed steel and cast iron; Effect of alloying elements on steel and stainless steel; Properties and applications of non ferrous metals – Aluminium; Copper and their common alloys

7 **NON DESTRUCTIVE TESTING OF MATERIALS**: Purpose and challenges; techniques: visual aids – bioscopes; fibre optics scanner; magnetic particles inspection; liquid penetrants; eddy currents; ultrasonic; radiography; Selection of NDT techniques; Merits; demerits

**TEXT BOOKS**

**REFERENCE BOOKS**

**ME-209**

**MEASUREMENT & INSTRUMENTATION**

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**OBJECTIVE**
To enable students to understand the construction and operation of instruments for measurement of pressure; level; flow and temperature; describe a suitable calibration procedure for a particular measurement instrument; identify and quantify errors from calibration graphs and describe correction procedures for selected instruments; select a suitable measurement instrument for a given process measurement; solve numerical problems involving equations pertaining to pressure; level; temperature and flow measurements

1 **INTRODUCTION TO INSTRUMENTATION**: Role of instruments in industrial processes; block representation of measurement systems; Need for calibration and Standards; Instrument parameters: Sensitivity; accuracy; resolution; span; range; Static errors: zero error; proportionality error; hysteresis; maximum non linearity error

2 **TRANSUCERS**: Introduction; Analog and digital transducers: electromechanical; potentiometric; Inductive; Self generating and Non-self generating types; Electromagnetic; Electrodynamic; Eddy current; Magnetostriuctive; variable inductance; LVDT; variable capacitance; piezo-electric transducer and associated circuits; unbonded and bonded strain gauges; strain gauge bridge circuits; single; double and four active arm bridge arrangements; Temperature; compensation; Balancing and calibration; Ionisation Transducers; Mechno-electronic transducers; Opto-electrical transducers; photo conductive transducers; photo voltaic transducers; digital transducers; frequency domain transducer; vibrating string transducer

3 **MOTION FORCE AND TORQUE MEASUREMENT**: Relative motion measuring devices; electromechanical; optical photo electric; Moire-Fringe; Absolute motion devices; calibration; hydraulic load cell; pneumatic load cell; elastic force devices; separation of force components; electro mechanical methods; strain gauge; torque transducers

4 **PRESSURE MEASUREMENT**: Definition and units; Relationship between absolute atmospheric and gauge pressures; use of manometers for pressure measurement; principle of operation of following pressure gauges; diaphragm gauges; bellows gauges; Bourden gauges; strain gauges; Gauge calibration using manometers dead weight gauge; gauges for high pressure and low pressure measurement

5 **LEVEL MEASUREMENT**: Direct level measuring systems: dipsticks; float systems pressure measuring devices; capacitive devices; ultrasonic level gauges; radiation methods; hot-wire elements; radar methods; laser methods; fiber optic level sensors
Flow measurement: Volume and mass flow rate; Bernoullis equation and applications to differential pressure devices; differential pressure primary elements; Orifice plate; venturi tube; dahl tube; flow nozzle and pilot tube; positive displacement flow meters; reciprocating piston; rotating impeller; calibration of flow meters

6 **TEMPERATURE MEASUREMENT**: Introduction; Non electrical methods: Bimetallic thermometer; liquid in glass thermometer; pressure thermometer; electrical resistance sensors; resistance thermometers and thermistors; thermosto; radiation methods; pyrometry and pyrometers

7 **BASIC STATISTICAL CONCEPTS**: types of measure and quantities (discrete and continuous) central tendency of data; mode; median; arithmetic mean; best estimate of true value of data; measures of dispersion; range; mean deviation; variance; standard deviation; normal distribution; central limit theorem; significance test; method of least squares; graphical representations and curve fitting of data

**TEXT BOOK**

**REFERENCE BOOKS**

**ME-254**

**STRENGTH OF MATERIALS LAB**

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**LIST OF EXPERIMENTS**

1. To perform the Brinell Hardness Test
2. To perform the Rockwell Hardness Test
3. To study the Impact Testing Machine and perform the Impact Tests (IZOD & CHARY)
4. To study UTM and Torsion Testing Machine
5. To perform the Tensile Test on UTM
6. To perform the Shear Test on UTM
7. To perform the torsion test on Torsion Testing Machine
8. To determine the Moment of Inertia of a Flywheel about its own axis of rotation
9. To study the Erichsen Sheet Metal Testing Machine and Perform the Erichsen Sheet Metal Test;
10. To verify support reactions for different types of loads at different locations on the beam

**ME-258**

**ENGINEERING MATERIALS LAB**

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**LIST OF EXPERIMENTS**

1. To study the creep deformation of the solder wire
2. To study the Bravais Lattices
3. To study the arrangement of atoms in simple crystal with the aid of models
4. To study the chemical methods of corrosion
5. To normalize a given specimen and check its toughness
6. To temper the given hardened steel specimen at 300°C and measure hardness
7. To temper the given hardened steel specimen at 500°C and measure hardness
8. To study the microstructure of heat treated steel
9. To harden a given specimen and check its hardness
10. To anneal a given specimen and check its hardness

**ME-259**

**MEASUREMENT AND INSTRUMENTATION LAB**

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**LIST OF EXPERIMENTS**

1. To study a linear variable differential transformer (LVDT) and use it in a simple experimental set up to measure small displacement
2. To measure strain using strain gauges mounted on a cantilever beam
3. To measure torque using strain gauge torque transducer
4. To measure temperature using a thermocouple
5. Temperature measurement by a resistance – temperature device and to draw its characteristic curve;
6. To draw the characteristic curve for the given thermister;
7. To measure the speed of a motor shaft with the help of (non contact type magnetic pick up)
8. To measure the speed of a motor shaft with the help of a proximity sensors;
9. To measure load using load cell
10. Measurement of pressure using pressure cell

**ME-301**

**THEORY OF MACHINES-II**

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**OBJECTIVE**

The course aims to acquaint students with tools required to synthesize / analyze various mechanisms used in different mechanical devices

**PRE REQUISITES**

Knowledge of Theory of Machines - I

1. **INTRODUCTION:**
   - Mechanisms and Machines: Kinematics links; pairs; chains; Kinematics inversions; Four bar planer mechanisms; mobility and range of movement; Miscellaneous mechanisms; (straight line; steering; pantograph)

2. **KINEMATIC SYNTHESIS OF MECHANISMS:**
   - Type; number and dimensional synthesis; function generation /Path generation/position generation; two and three position synthesis of four bar/Slider crank mechanisms by graphical and analytical methods; Freudenstein’s equation; precision positions; structural error; Chebychev’s spacing; Transmission angle

3. **CAMS:**
   - Classification of cams and followers; disc cam nomenclature; Construction of displacement/velocity/acc; for different types of follower motions; Synthesis of cam profile by graphical and analytical approaches; Cams with specified contours/ tangent and circular arc cams

4. **GEARS:**
   - Fundamental law of gearing ; involute spur gears; characteristics of involute action; Interference and undercutting; center distance variation; Involutometry; Nomenclature of Helical/ Bevel/ Worm gears

5. **GEAR TRAINS:**
   - Synthesis of simple; compound and reverted gear trains; Analysis of epicyclic gear Trains

6. **BALANCING OF ROTATING COMPONENTS:**
   - Static/dynamic balancing; Balancing of rotating masses; Two plane balancing-graphical and analytical methods; balancing of rotors; field balancing; balancing machines

7. **BALANCING OF RECIPROCATING PARTS:**
   - Balancing of single cylinder engine; balancing of multicylinder - inline/radial/V-type engines; firing order

**TEXT BOOK**


**REFERENCE BOOKS**


WEB REFERENCE
www.nptel.iitm.ac.in

**ME-309**

**HEAT TRANSFER**  
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**OBJECTIVE**
This course imparts basic knowledge of heat transfer and the knowledge imparted will enable him to reduce or increase heat transfer in existing equipment as the need may be and be able to go for preliminary design of heat exchanger

**PRE REQUISITES**
Knowledge of Thermodynamics

1. **BASICS AND LAWS:** Modes of heat transfer  
   Steady State Heat Conduction: Boundary conditions in heat transfer; I-D heat conduction through a plane wall; long hollow cylinder; hollow sphere and composite structures; Overall h t c.  
   Conduction equation in Cartesian; polar and spherical co-ordinate systems; Initial and Boundary conditions; Numericals

2. **STEADY STATE CONDUCTION WITH HEAT GENERATION:** Introduction; 1 – D heat conduction with heat sources; Plane wall; hollow cylinder and sphere; Current carrying conductor; Extended surfaces (fins); Fin effectiveness Numericals

3. **TRANSIENT HEAT CONDUCTION:** Systems with negligible internal resistance; Transient heat conduction in plane walls; cylinders; spheres with convective boundary Conditions; Chart solutions only; Periodic heat transfer in one dimension; Numericals

4. **CONVECTION:** Forced convection-Thermal and hydro-dynamic boundary layers; Equation of continuity; Momentum and energy equations; some results for flow over a flat plate and flow through tube; Fluid friction and heat transfer (Colburn analogy); Use of; Empirical relations for free convection from vertical and horizontal planes and cylinders; Numericals

5. **THERMAL RADIATION:** Absorptivity; Reflectivity; Transmissivity; Black body; emissive power; radiosity; laws of thermal radiation; intensity of radiation; Shape factor and its properties; Hottel’s Method; Radiation exchange between black and gray surfaces; Two body; three body enclosures; Radiation shielding; Numericals

6. **HEAT EXCHANGERS:** Classification; Performance variables; Analysis of a parallel and counter flow heat exchanger using LMTDand NTU; Heat exchanger effectiveness; Use of charts for multipass exchanger; Numericals

7. **HEAT TRANSFER WITH CHANGE OF PHASE:** Laminar film condensation on a vertical plate; Drop-wise condensation; Boiling regimes; Free convective; Nucleate and film boiling; Numericals

**TEXT BOOK**

**REFERENCE BOOKS**
1. Arpasi, VS., “Conduction Heat Transfer”, Addison Wesley
2. Domkundwar., “Heat Transfer”,

**WEB REFERENCES**
2. nptel.iitm.ac.in

**ME-351**

**THEORY OF MACHINES- II LAB**  
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**Cr**  
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**LIST OF EXPERIMENTS**
1. To study various types of links; pairs; chains and mechanisms
2. To study planar four bar mechanism and its inversions (four bar mechanism; single and double slider crank mechanism
3. Graphical synthesis of i) 4 bar mechanism ii) radial cam with roller follower
4. Kinematic study of mechanisms i) shaper machine mechanism ii) power hacksaw mechanism
5. To study various types of cam and follower arrangement and plot follower displacement v/s cam rotation for various cam follower systems
6. To study various types of gears and generate spur gear involute tooth profile using simulated gear shaping process and study standard and non standard involute gear tooth profile
7. To study various types of gear laws; simple; compound; reverted; epicyclic and differential
8. To perform experiment for static balancing / dynamic balancing on balancing apparatus
9. Determine M O I of connecting rod by compound pendulum method and tri filer suspension pendulum
10. Determine gyroscopic couple on motorized gyroscope

**ME-359**

**HEAT TRANSFER LAB**  
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**LIST OF EXPERIMENTS**
1. To determine the thermal conductivity of a metallic Rod
2. To determine the thermal conductivity of an insulating power
3. To find out the heat transfer and effectiveness of a pin fin under natural convection condition
4. To calculate the heat transfer and effectiveness of a pin fin under forced convection condition
5. To determine the emissivity of a given specimen body
6. To verify the Stefan Boltzman constant for thermal radiation
7. To determine the overall heat transfer coefficient and effectiveness of a given heat exchanger under parallel flow condition
8. To determine the overall heat transfer coefficient and effectiveness of a given heat exchanger under counter flow condition
9. To determine the convective heat transfer coefficient for a horizontal rod
10. To determine the overall thermal resistance of a composite wall

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**OBJECTIVE**
The objective of the course is to teach the fundamentals of vibrations in lumped and distributed systems with emphasis on the underlying theory, assumptions, modeling and their response.

1. **INTRODUCTION:** Types of vibrations; S; H; M; principle of superposition applied to Simple Harmonic Motions; Beats; Fourier theorem and simple problems.
2. **UNDAMPED FREE VIBRATIONS:** Single degree of freedom systems; Mass Undamped free vibration-natural frequency of free vibration; stiffness of spring elements; effect of mass of spring; Compound Pendulum.
3. **DAMPED FREE VIBRATIONS:** Single degree freedom systems; different types of damping; concept of critical damping and its importance; study of response of viscous damped systems for cases of under damping; critical and over damping; Logarithmic decrement.
4. **FORCED VIBRATION:** Single degree freedom systems; steady state solution with viscous damping due to harmonic force; Solution by Complex algebra; Reciprocating and rotating unbalance; vibration isolation transmissibility ratio due to harmonic excitation and support motion; Vibrometer and accelerometer; Whirling of shafts with and without air damping; Discussion of speeds above and below critical speeds.
5. **SYSTEMS WITH TWO DEGREES OF FREEDOM:** Introduction; principle modes and Normal modes of vibration; co-ordinate coupling; generalized and principal co-ordinates; Free vibration in terms of initial conditions; Geared systems; Forced Oscillations-Harmonic excitation; Applications: a) Vehicle suspension; b) Dynamic vibration absorber; c) Dynamics of reciprocating Engines.
6. **CONTINUOUS SYSTEMS:** Introduction; vibration of string; longitudinal vibration of rods; Torsional vibration of rods; Euler's equation for beams.
7. **NUMERICAL METHODS FOR MULTI DEGREE FREEDOM SYSTEMS:** Introduction; Influence coefficients; Maxwell reciprocal theorem; Dunkerley's equation; Orthogonality of principal modes; Method of matrix iteration-Method of determination of all the natural frequencies using sweeping matrix and Orthogonality principle; Holzer's method; Stodola method.

**TEXT BOOK**

**REFERENCE BOOKS**

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<th>ME-454</th>
<th>MECHANICAL VIBRATIONS LAB</th>
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**LIST OF EXPERIMENTS**
1. To verify the relation of a simple pendulum.
2. To verify the relation of a compound pendulum.
3. To determine the radius of gyration of a given bar by using bi-filer suspension.
4. To determine the radius of gyration of a given bar by using bi-filer suspension.
5. To study the torsional vibrations of single rotor system.
6. To study the free vibration of two rotor system and to determine the natural frequency of vibration thematically and experimentally.
7. To study the damped torsional oscillation and to determine the dampening coefficient.
8. To verify Dunkerley's rule.
9. To study the longitudinal vibrations of helical spring and to determine the frequency and time period of oscillation thematically and actually by experiment.
10. To study the undamped free vibration of equivalent spring mass system.
11. To study the forced damped vibration of equivalent spring mass system.
12. To study the forced vibration of the beam for different damping.
13. To study analytically and experimentally the vibrations of a base stationed as flexible springs.
14. To study the absorber system and its turning for a fixed-fixed beam.
15. To study whirling phenomenon in a shaft

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**OBJECTIVE**
To educate the students with the present day physical sciences through concepts like optics, acoustics, EM theory, etc.

1. **INTERFERENCE:** Interference by division of wave front; Fresnel's biprism and its application to find wavelength; interference by division of amplitude; Newton's rings and its applications; determination of wavelength and refractive index of liquids; Michelson interferometer and its applications; determination of wavelength; resolution of spectral lines (difference in wavelength); determination of refractive index of thin sheet.
2. DIFFRACTION: Difference between interference and diffraction; difference between Fraunhofer and Fresnel diffraction; Fraunhofer diffraction through single slit; variation of intensity (analytical); plane transmission diffraction grating; absent spectra; maximum order spectra; dispersive and resolving power of grating.

3. POLARIZATION: Polarised and unpolarized light; double refraction; Nicol prism; quarter and half wave plates; optical activity; Dextro and Leavo rotatory; specific rotation; biquartz and Laurent's half-shade polarimeters.

4. LASER AND FIBRE OPTICS: Spontaneous and stimulated emissions; laser action (pumping and population inversion); characteristics of laser beam-concepts of coherence; solid state (Ruby) laser; gas (He-Ne) laser; applications; basic principles; fiber construction; propagation of light in fibers; numerical aperture; single mode and multi mode fibers; applications of optical fibers.

5. SPECIAL THEORY OF RELATIVITY: Inertial frames of reference; Galilean transformations; non-inertial frames of reference; Michelson-Morley experiment; postulates of special theory of relativity; Lorentz's transformations; length contraction; time dilation; variation of mass with velocity; mass energy equivalence.

6. ELECTRO MAGNETIC THEORY and ELECTROSTATICS: Review of basic concepts of electrodynamics; Maxwell's modification of Ampere’s law, equation of continuity; Maxwell's equations and its simple plane wave solution in free space; Poynting's theorem; dielectric polarization; electric displacement; susceptibility and permittivity and various relations between these; Gauss law in dielectrics; electrostatic energy stored in dielectrics; behaviour of dielectrics in A.C. field: simple concepts; dielectric losses.

7. ULTRASONICS: Production of ultrasonics by magnetostriction and piezoelectric oscillator methods; detection of ultrasonics by Kundt's tube and acoustic grating method.

**TEXT BOOK**

**REFERENCE BOOKS**
1. Sears, F.W., “Electricity and Magnetism”, Narosa
7. Wehr, Richards and Adair, “Physics of the Atom”, Narosa

**PH-102**
**APPLIED PHYSICS**

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**OBJECTIVE**
To educate the students with the present day physical sciences through concepts like nanotechnology, quantum physics, thermal physics, super conductivity, etc.

1. CRYSTAL STRUCTURE: Space lattice; unit cell and translation vector; Miller indices; simple crystal structure (sc; bcc; fcc; hcp); principle of X-ray diffraction; Bragg's law; experimental X-ray diffraction methods: Laue method and Powder method; point defects in solids; concentration of Frenkel defects and Schottky defects.

2. QUANTUM PHYSICS: Failure of classical concepts; black body radiation; Planck's radiation law; wave packets; group velocity and phase velocity; Schrödinger wave equations: time dependent and time independent equations; significance of wave function; wave function for a particle in a box.

3. FREE ELECTRON THEORY: Elements of classical free electron theory and its limitations; Drude's theory of conduction; quantum theory of free electrons; Fermi level; Density of states (3D); average kinetic energy \( \frac{1}{3} kT \) of free electrons (3D); Fermi-Dirac distribution function; thermionic emission; Richardson's equation.

4. BAND THEORY and NANO TECHNOLOGY: Origin of energy bands; classification of solids into metals; semiconductors and insulators; Kronig Penney model (Qualitative); E-K diagrams; Brillouin zones; concept of effective mass and holes; hallow effect and its application, nanotechnology (basic concept only) and its application.

5. THERMAL PHYSICS: Gas law; iso-thermal and isentropic process; Rankin cycle; Carnet cycle; principal of equipartition of energy; specific heat of monoatomic gases; Maxwell’s velocity distribution; mean velocity; RMS velocity; most probable speed; Joule Thomson's expansion; liquification of He I and He II Stefan Boltzmann's law; Newton's law of cooling.

6. MAGNETIC PROPERTIES OF SOLIDS: Atomic magnetic moments; orbital diamagnetism; classical Langevin's theory of dia–magnetism and paramagnetism; ferro-magnetic domains; antiferromagnetism; ferrimagnetism (simple ideas).

7. SUPERCONDUCTIVITY: Introduction (experimental survey); Meissner effect; Type I and Type II superconductor; London equation.

**TEXT BOOK**

**REFERENCE BOOKS**
5. Ghatak and Loknathan, "Quantum Mechanics", McMillan

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LIST OF EXPERIMENTS
The experiments in 1st term will be based mainly upon optics, electrostatics, wave and oscillations which are the parts of the theory syllabus of 1st term.

1. To find the wavelength of sodium light by Newton’s rings experiment.
2. To find the wavelength of sodium light by Fresnel’s biprism experiment.
3. To find the wavelength of various colours of white light with the help of a plane transmission diffraction grating.
4. To find the refractive index and Cauchy’s constants of a prism by using spectrometer.
5. To find the wavelength of sodium light by Michelson interferometer.
6. To find the resolving power of a telescope.
7. To find the pitch of a screw using He-Ne laser.
8. To find the specific rotation of sugar solution by using a polarimeter.
9. To compare the capacitances of two capacitors by De’Sauty bridge and hence to find the dielectric constant of a medium.
10. To find the flashing and quenching potentials of Argon and also to find the capacitance of unknown capacitor.
11. To study the photoconducting cell and hence to verify the inverse square law.
12. To find the temperature co-efficient of resistance by using platinum resistance thermometer and Callender and Griffith bridge.
13. To find the frequency of A.C. mains by using sonometer.
14. To find the velocity of ultrasonic waves in non-conducting medium by piezo-electric method.

REFERENCE BOOKS
1. Worshnop, B.L. and Flint, H.T. “Advanced Practical Physics”, KPH
2. Gupta, S.L. & Kumar, V. “Practical Physics”, Pragati Prakashan

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LIST OF EXPERIMENTS
1. To find the low resistance by Carey – Foster’s bridge.
2. To find the resistance of a galvanometer by Thomson’s constant deflection method using a post office box.
3. To find the value of high resistances by Substitution method.
4. To find the value of high resistances by Leakage method.
5. To study the characteristics of a solar cell and to find the fill factor.
6. To find the value of e/m for electrons by Helical method.
7. To find the ionization potential of Argon/Mercury using a thyatron tube.
8. To study the variation of magnetic field with distance and to find the radius of coil by Stewart and Gee’s apparatus.
9. To study the characteristics of (Cu-Fe, Cu-Constantan) thermo couple.
10. To find the value of Planck’s constant by using a photo electric cell.
11. To find the value of co-efficient of self-inductance by using a Raleigh bridge.
12. To find the value of Hall co-efficient of semiconductor.
13. To study the V-I characteristics of a p-n diode.
14. To find the band gap of intrinsic semi-conductor using four probe method.
15. To calculate the hysteresis loss by tracing a B-H curve.

REFERENCE BOOKS
1. Worshnop, B.L. and Flint, H.T. “Advanced Practical Physics”, KPH
2. Gupta, S.L. and Kumar, V. “Practical Physics”, Pragati Prakashan.
B.Tech. Automobile Engineering (Regular)

ADDITIONAL/BRIDGE COURSES

OBJECTIVE
A student found deficient in any area of knowledge/skill needed for programmes of study e.g. Communication Skill, Mathematics, etc. may be required to do suitable additional course(s) on audit basis which will not be shown on his Grade Card. However if a bridge course(s) is (are) required for those students admitted to second year the same will be shown on the Grade Card as an audit course.

Note: These Courses are made for a specific purpose and are available only for the intended purpose.

### EN-291 ESSENTIALS OF COMMUNICATION

**OBJECTIVE**
The objective of bridge course is to bring some of the students who are not up to the mark and are not able to pursue the technical education like their counterpart parts. This course has been devised to bring the students to that level from where they can do justice to the technical education they are going to pursue.

1. Advertisements; notices; formal and integral invitations.
2. Report writing; or factual description based on verbal input provided.
3. Letter writing; business letter; enquires; registering complaints; asking and giving information; placing orders and sending replies; letter to editor.
4. Parts of speech: noun; pronoun; verb; adverb; adjective; proposition; conjunction; exclamatory and general English grammar.
5. Verb patterns and sentences structure and tense.
6. Foreign words; one word substitutions and word formation.
7. Group discussion and debate on various current affairs.

**TEXT BOOK**
Wren & Martin, “A High School Grammar & Composition”

**REFERENCE BOOKS**
2. Tikku M. C., “An Intermediate Grammar Book”

### MA-191 MATHEMATICS

**OBJECTIVE**
Mathematics is a very essential part of all engineering courses. The students entering in the first year who are some how weak in concepts of Mathematics need up gradation in their level of Mathematics. This course is designed keeping in view such students.

1. **BASIS OF CURVES**: Important equations for different types of curves in plane including Cartesian, Parametric forms; Concept of polar coordinates and important curves in polar coordinates.
2. **SEQUENCE AND SERIES**: Sequences, A.P, G.P., H.P; Special sequences \( \sum_{n=1}^{N} n, \sum_{n=1}^{N} n^2, \sum_{n=1}^{N} n^3 \);
Explanations of important functions.
3. **DIFFERENTIAL CALCULUS**: Definition of derivatives and concepts of partial derivatives, Differentiation of parametric curves up to second order; Successive differentiation including Leibnitz rule; analytical and geometrical significance of differentiation.
4. **INTEGRAL CALCULUS**: Formulae of indefinite integrals; Properties of definite integrals; Integration by parts and continued integration by parts.
5. **THREE DIMENSIONAL GEOMETRY**: Dimensional coordinates and important equation of planes and surfaces (including sphere, cone, cylinder and ellipsoid); cylindrical and spherical coordinates in three dimensions.
6. **VECTORS**: Representation of vectors in two and three dimensions; operations on vectors including dot and cross product of three vectors and four vectors.
7. **PROBABILITY THEORY**: Permutation; Combination; Binomial theorem.

**TEXT BOOK**
NCERT, “Mathematics for XI and XII”, NCERT, New Delhi

**REFERENCE BOOKS**

### MA-291 MATHEMATICS

**OBJECTIVE**
The students, who join the University after diploma course, are deficient in mathematics. This course is designed to upgrade and update their knowledge in mathematics so that they are at par with second year students.
1. **PARTIAL DIFFERENTIATION:** Functions of two or more variables; Partial derivatives; Total differential and differentiability; Derivatives of composite and implicit functions; Jacobians; Higher order partial derivatives; Homogeneous functions; Euler’s theorem.

2. **MULTIPLE INTEGRALS:** Double integrals; Change of order of integrations; Double integrals in polar co-ordinates; Applications of double integral to find area enclosed by plane curves and volume of solids of revolution; triple integrals; Volume of solids; Change of variables.

3. **SPECIAL INTEGRALS:** Differentiation under integral sign; Beta and gamma functions and relationship between them.

4. **LAPLACE TRANSFORMS:** Laplace transforms and its elementary properties; Inverse transforms; Convolution theorem.

5. **FOURIER SERIES AND FOURIER TRANSFORMS:** Euler’s formulae; Change of intervals; Fourier series of odd and even functions; Half range sine and cosines series; Fourier integrals; Fourier transforms; Elementary properties.

6. **DIFFERENTIAL EQUATIONS:** Formations of ordinary differential equations; Solutions of ordinary linear differential equations including solutions by Laplace transform.

7. **PARTIAL DIFFERENTIAL EQUATIONS:** Formations of partial differential equations; Solutions of linear and non-linear partial differential equations.

**TEXT BOOK**

**REFERENCE BOOKS**
PROFESSIONAL DEVELOPMENT COURSES

OBJECTIVE
To meet the corporate requirements, bridge the gap between technological skills and soft skills, by improving communication, behavioural, analytical skills, etc.

METHODOLOGY
To enable students become competent professionals and good citizens with moral and ethical values, a set of 14 courses of one credit each will be provided covering

(i) Value Added Courses,
(ii) Professional Development Courses, and
(iii) Co-curricular Activities.

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<th>PD-151</th>
<th>BASIC OF COMPUTER FUNDAMENTALS</th>
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OBJECTIVE
To understand fundamentals of computer applications, networking and building projects.

1. **MS-WORD:** Introduction to MS-Word: Menus, toolbars, ruler, scroll bars, creating, saving, importing, exporting and inserting files, formation, indents/out dents, lists, tabs, styles, working with frames, columns, pictures, chart/graphs, forms, tools, equations and macros.

2. **MS-EXCEL:** Worksheet overview: rows, columns, cell, menus, creating worksheets; opening and saving worksheet; formatting, printing, charts, window, establishing worksheet links, macros, database, tables, using files with other programs.

3. **MS-POWERPOINT:** Overview of MS-PowerPoint, creating slides and presentations, rehearsing presentation, insert, tools, format, slide-show, Window options.

4. **MS-PROJECT:** Starting a Project, Starting Microsoft Project 2000, planning a project, defining the project scope, outlining and task relationships, outlining the project, developing the schedule, changing task relationships and constraints, adding and assigning resources, developing the project calendar, assigning project resources, determining project costs, adjusting project resources and timelines, analyzing the project, using different views and reports, displaying project data, organizing project information, sorting and filtering project data, creating custom filters.

5. **NETWORKING:** Basics of networking, study of topology: LAN, WAN, MAN, Connecting devices: passive hub, repeater, active hub, bridges, two layer switches, routers, three layer switches, gateway, network attack and defense: most common attacks.

6. **TROUBLESHOOTING:** Ping command, TRACERT or TRACEROUT, IP configuration, NETSTAT, NET, recovery commands DISKPART etc., setting up local security policies, installation of servers.

7. **FUNDAMENTALS OF CYBER LAW:** Overview of computer and web technology, access control: operating system access controls, group and roles, access control lists, Unix operating system security, Windows NT, capabilities, added features in Windows 2000, granularity, sandboxing and proof-carrying code, hardware protection, other technical attacks.

REFERENCE BOOKS:
3. Sandler, “Teach Yourself MS Office”, BPB Publications
8. Ahmand Tabrez, “Cyber law , E-commerce & M-Commerce”

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<th>PD-191</th>
<th>CO-CURRICULAR ACTIVITIES</th>
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OBJECTIVE
To help the students in their all round growth and acquire attributes like team spirit, organizational ability, leadership qualities, etc.

OPERATION
The students are to take part in Co-curricular activities outside contact hours through clubs/ societies spread over all the three terms of the year. They are required to register for this course in each term and their performance will be evaluated in last term of the year.

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<th>PD-192</th>
<th>PERSONALITY SKILLS</th>
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OBJECTIVE
To equip the students with the understanding of human behavior, develop time management skills, and enhance personality.

1. **TRANSACTIONAL ANALYSIS:** Winners and losers; ego states; OK states; positive and negative strokes; life scripts; exercises.

2. **CREATIVE THINKING:** What is creativity; 6 thinking hats; mental blocks; exercises.
3. SELF DISCOVERY: Importance of knowing yourself; SWOT analysis; benefits; strengths and weaknesses; exercises.

4. DEVELOPING POSITIVE ATTITUDE: Meaning; changing attitudes; power of positive thinking; overcoming negative attitude; exercises.

5. TIME MANAGEMENT: Features, time management matrix; tips for time management; effective scheduling; time wasters; time savers; exercises and time bound tasks.

6. STRESS MANAGEMENT: What is stress; causes; positive and negative stress; effects; signs; tips to overcome stress; stress busters; exercises

7. DECISION MAKING: Definition; models and types; skills and techniques; courses of action; steps involved in decision making; individual decision making and group decision making; exercises

REFERENCE BOOKS
2. Harris, Thomas Anthony, "I'm OK, You're OK", Galahad Books, 2004
3. Dr. Alex, K., "Soft Skills", 2009, S. Chand, 2009

NOTE: One trainer per lecture and two trainers per practical session. Classroom with board/projector for PPT and video clips will be required.

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<tr>
<th>PD-251</th>
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OBJECTIVE
To empower the students with entrepreneurial skills, behaviour, grooming and effective interaction at the work place.

1. GOAL SETTING: Types of goals; setting smart goals; personal goal setting; business goal setting; goal setting techniques.

2. ENTREPRENEURIAL SKILLS: Meaning; entrepreneurial competencies; advantages; risks involved, avenues and opportunities; support from Govt.; basic and significant personality traits; venture project planning and entrepreneurship cycles; planning the project; entrepreneurship in daily life; case studies in entrepreneurship; exercises.

3. CORPORATE DRESSING: The corporate fit; corporate culture; dress codes; dressing for interviews; clothing do's and don'ts.

4. CORPORATE GROOMING: Making a good impression at work; grooming check list; accessoories, do's and don'ts for men and women; hygiene and skin care; hands and feet; make up and hair accessories.

5. ETIQUETTE & MANNERS: Social etiquette; dining etiquette; party and wedding etiquette; sensitivity towards diverse cultures; respecting religions and traditions.

6. BUSINESS ETIQUETTE: Dealing with people at work place (peers, subordinates and superiors); international business; etiquette at meetings and conferences.

7. COMMUNICATION MEDIA ETIQUETTE: Telephone etiquette; email etiquette; media etiquette.

REFERENCE BOOKS

NOTE: One trainer per lecture and two trainers per practical session. Classroom with board/projector for PPT and video clips will be required.

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<th>PD-193</th>
<th>ENTREPRENEURIAL &amp; PROFESSIONAL SKILLS</th>
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OBJECTIVE
MATLAB is a powerful language for technical computing. It is widely used in universities and colleges for courses in mathematics, science and especially in engineering. In industry the software is used in research, development and design. This course is intended for students who are using MATLAB for the first time and have little or no experience in computer programming.

1. BASIC STRUCTURE and FEATURES OF MATLAB: Command window; figure window; editor window and help window; arithmetic operations with scalars, order of precedence; using MATLAB as a calculator; display formats; elementary math built-in functions; scalar variables, assignment operator; predefined variables; useful commands for managing variables; applications in problem solving.

2. CREATING ARRAYS – one dimensional, two-dimensional; array addressing; built-in functions for handling arrays; mathematical operations with matrices; strings and strings as variables; generation of random numbers; examples of MATLAB applications.

3. SCRIPT FILES: Creating and saving a script file, current directory; output commands.

4. TWO – DIMENSIONAL PLOTS: Plot command; line specifiers plot of a given data; plot of a function; plotting multiple graphs in the same plot.

5. FUNCTIONS AND FUNCTION FILES: Creating a function file; input and output arguments; function body; comment lines; saving a function files; using a function file; programming in MATLAB.
B.Tech. Automobile Engineering (Regular)

TEXT BOOK

REFERENCE BOOK

<table>
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<th>PD-291</th>
<th>CO-CURRICULAR ACTIVITIES</th>
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Refer to PD-191 for details.

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<th>PD-292</th>
<th>EFFECTIVE COMMUNICATION</th>
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OBJECTIVE
To acquaint the students with the basics of effective spoken and written English and enhance their reading, listening, and communication skills.

1. COMMUNICATION: Importance; barriers and types of communication; methods to develop effective communication skills.
2. GRAMMAR: Parts of speech; subject/verb agreement; tenses; error correction; business idioms; Indianism in English; frequently mispronounced words; exercises.
3. SPOKEN ENGLISH: Vowel and consonant sounds; syllables and syllabic stress; conversational skills; extempore; JAM.
4. READING & LISTENING SKILLS: Reading with comprehension; story reading; passage reading; newspaper reading; listening and active listening; barriers to listening; effective listening and types of listening; exercises.
5. WRITING SKILLS: Importance of writing skills; how to develop writing skills; writing exercises i.e., essay writing, reviews, reports, etc.
6. NON VERBAL COMMUNICATION: History; kinesics; postures; gestures; functions; importance and challenges of non verbal communication.
7. BUSINESS COMMUNICATION: Business letters and messages; business reports; presentation skills; do’s & don’ts; personal journal.

REFERENCE BOOKS

NOTE: One trainer per lecture and two trainers per practical session. Classroom with board/projector for PPT and video clips will be required.

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<tr>
<th>PD-293</th>
<th>INTRA &amp; INTER-PERSONAL SKILLS</th>
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OBJECTIVE
To acquaint the students with the understanding of self development through good inter-personal skills for effective social communication in order to succeed in maintaining relationships in professional and social environments. This module will also help at learning group discussions and interview skills to enable employability and professional fit.

1. SELF AWARENESS: Development of our self image; social comparison; significant others; self esteem; self confidence.
2. ASSERTIVENESS & CONFIDENCE: Assertiveness; being confident; strategies to make assertive NO easier; dealing with emotions; difference between being aggressive and being assertive.
3. TEAM BUILDING & TEAM WORK: The team concept; elements of team work; stages of team formation; effective team; essential building blocks of effective teams; team player’s style; team tasks; exercises.
4. LEADERSHIP SKILLS: Leadership skills and styles; motivating people; understanding abilities; delegating tasks; managing people; overcoming hurdles; exercises.
5. INTERVIEW SKILLS: Why an interview; the first step to a successful interview; resumes that make an impact; the interview process; the interview preparation checklist; interviewing skills; putting your best foot forward; common interview mistakes; one on one HR interviews (two for each student).
6. GROUP DISCUSSION SKILLS: Meaning of a GD; types; role of a moderator; do’s and don’ts; mock GDs on general, knowledge based and abstract topics.
7. THE ART OF CONVERSATION: Skills to strike a conversation; sustaining conversation; communicating across cultures; conflict management.

REFERENCE BOOKS
Notes: One trainer per lecture and two trainers per practical session. Classroom with board/projector for PPT and video clips will be required.

**PD-351**

FINITE ELEMENT ANALYSIS LAB

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**OBJECTIVE**

At the end of the course, the students are expected to understand the basic concepts of Finite Element Analysis using ANSYS and its application in present industrial scenario.

1. Study of basic FEA parameters - modeling, material properties & meshing in ANSYS.
2. Study of basic FEA parameters - loading, solving problems & post processing in ANSYS.
3. To determine the effect of self-weight in a simple cantilever beam using FEA software.
4. To determine the effect of distributed load on an object & the use of element tables to extract the data through ANSYS.
5. To solve the simple buckling problems using Non-Linear method.
6. To solve the simple buckling problems using Eigen-value method.
7. Analysis of a pure conduction mixed convection/conduction/insulated boundary condition.
8.Transient heat conduction analysis using ANSYS.
9. Study the concept of contact point using an example in ANSYS.
10. Designing & Analysis using FEA parameters of a 2-D bridge in ANSYS.

**PD-391**

CO-CURRICULAR ACTIVITIES

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Refer to PD-191 for details.

**PD-392**

PROBLEM SOLVING SKILLS

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**OBJECTIVE**

To train and enhance the students' problem solving skills, reasoning ability, quantitative ability, and reading comprehension skills.

1. **LOGICAL REASONING**: Logical deductions (Syllogism & Venn Diagrams); logical connectives.
2. **ANALYTICAL REASONING**: Seating arrangements; combinations; selections; comparisons; blood relations; directions, etc.
3. **NON-VERBAL REASONING (ALPHA-NUMERIC & VISUAL PUZZLES)**: To solve problems on numbers, alphabet, symbols and visuals; problem types are series, analogies, odd man out, coding decoding, and symbols & notations.
4. **BUSINESS MATHS**: Number system; ratios; averages; time & work; time & distance; percentages; profit & loss; simple & compound interest.
5. **HIGHER MATHS**: Algebra; Mensuration.

6. **DATA INTERPRETATION & SUFFICIENCY**: Tables, Bar chart, line graph, pie charts; to enable student assess whether the given data is sufficient to solve a question; for both reasoning based and quant based problems.

7. **READING COMPREHENSION**: To enable a student comprehend short and long passages from the perspective of solving questions based on the passage.

**REFERENCE BOOKS**


**PD-393**

ADVANCED PROFESSIONAL DEVELOPMENT

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**OBJECTIVE**

To equip the students with the basics of law, accounting, corporate policies, and ethics; the general awareness useful in leading a well informed life.

1. **LAW FOR THE LAYMAN**: Indian Judiciary System; Intellectual Property Rights (IPR); labour laws; employee rights; human rights; criminal laws, civil rights.
2. **BASICS OF ACCOUNTING**: Credit-Debit transactions; balance sheet; ledgers; receipts & vouchers; P & L statement; exercises.
3. **MONEY MANAGEMENT**: Types of taxes; how to manage taxes; investment options; an overview of stocks & shares; savings options; understanding important terms (depreciation, VAT, education cess).
4. **CORPORATE RULES & POLICIES**: The need; advantages; illustrations of certain rules & policies followed by selected corporate; code of conduct.
5. **RIGHTS & DUTIES**: An overview of the Indian constitution; fundamental rights & duties; directive principles of state policy; societal values; ideologies of some famous personalities.
6. **TECHNOLOGY, POLITICS & RELIGIONS IN INDIA**: various religions and their teachings; political developments in India; history of science & technology.
7. **HUMAN VALUES**: Ethics at work place; human values; morals & ethics; professional ethics; case studies.

**REFERENCE BOOKS**


**NOTE:** One trainer per lecture and two trainers per practical session. Classroom with board/projector for PPT and video clips will be required.

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<th>PD-451</th>
<th>AUTOMOBILE INTEGRATED SYSTEM LAB</th>
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**OBJECTIVE**

At the end of the course, the students are expected to understand the concepts of eco friendly vehicles and application of electronic systems used in automobile.

1. Study of availability of non renewable energy sources in hybrid vehicle technology.
2. Study of electric vehicle.
3. Study of different types of batteries and BLDC motor used for electric vehicle.
4. Study of series power transmission technique used for hybrid electric vehicles.
5. Study of parallel and series /parallel power transmission technique used for hybrid electric vehicles.
6. Study of various techniques used in CAN bus system.
7. Study various protocol used in automobile.
8. Study various component of motronic system.
11. Modeling of Throttle by wire application using MATLAB/Simulink.

**TEXTBOOK**

Ronald Jurgen, “Automotive Electronics Handbook”; SAE publication

**REFERENCE BOOKS**

5. MATLAB/Simulink user manual.

<table>
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<th>PD-491</th>
<th>CO-CURRICULAR ACTIVITIES</th>
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Refer to PD-191 for details.
OPEN ELECTIVE COURSES

OBJECTIVE
The idea of open elective is to expand the application horizon of the knowledge acquired beyond the boundaries of one’s own discipline

METHODOLOGY
The student may enroll for one course from the list provided in the Scheme of Studies & Syllabus. The course shall strictly be from any other discipline. Selection of course from the same discipline of study is not allowed.

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<th>AE-411</th>
<th>TRANSPORT MANAGEMENT</th>
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OBJECTIVE
The course has been designed such that the student can own a fleet of buses; trucks etc and manage the same; He also gets familiar with provisions of motor vehicle act and vehicle insurance.

1. INTRODUCTION: Necessity for making acts and rules on motor vehicles; Procedure for enactment and implementation of these acts by central and state Govts; Formats of the acts; rules and titles; Definitions – articulated vehicle; axle weight; certificate of registration; driver; conductor; licence; contract carriage; stage carriage; dealer; educational institution bus; goods; goods carriage; gross vehicle weight; heavy goods vehicle; invalid carriage; learners licence; HMV; LMV; motor cabs etc.

2. DRIVING LICENCE: Necessity; age limit to obtain D.L learners D.L permanent D.L grant; restrictions; renewal; endorsement; disqualification; suspension; fees; documents; educational qualifications required for driving trucks; buses; oil tankers; missile carriers; driving on hills; Driving schools:requirements; Effectiveness of different DLs; Maintenance of state registers of D.L. conductors licence – necessity; grant; age limit; disqualifications; revocation; disqualification; uniforms.

3. VEHICLE REGISTRATION: Necessity; area of registration; time given for registration; format and documents to be attached and fees; period of registration; renewal; suspension; Temporary and permanent registration; vehicle fitness; refusal; NOC; registration for embassy vehicles; production of vehicle at the time of registration; Migration of vehicle from one state to other; Hire purchase; lease or hypothecation; transfer of registration on sale; removal of hypothecation clause; Transfer of ownership; Change of residence or place of business; death of owner; sale or purchase; Alteration in motor vehicle; age limit of vehicles; attachment of trailers; Maintenance of state registers of motor vehicles;

4. PERMITS: Necessity; route allotments; state Govts; powers; provisions for application of permits; Procedure of R;T;A to grant permits; limits of issuance of permits and rules; documents to be attached; preferences while issuing permits; Types of permits – Private service; all India goods carriage; temporary; national; composite etc; Renewal; duration; cancellation; suspension of permits and transfer of permits; Rules for replacement of vehicles; colour schemes; general conditions attached; Validation of permits for use in outside region; Issue of permits to state transport undertakings : restrictions

5. CONSTRUCTION; EQUIPMENT; MAINTENANCE AND TRAFFIC REGULATION:
General provisions; Central Govt; rules and provisions regarding construction; maintenance of vehicle; emissions and safety provisions; Control of traffic: limits of speed; weight; length and height; power to restrict and erect traffic signs; design of traffic signs and its colour scheme; Signals; driving test; Driving regulations; signaling devices; Definitions– Pass; ticket; removal of vehicle obstructing traffic; Safety measures for drivers and pillion riders; Precautions at unguarded railway crossings; Schemes for investigation of accidents and wayside amenities; Traffic navigation; global positioning system.

6. LOGISTICS: Definition of fleet; types of fleet-luxury cars; buses; trucks; cash vans; fire-fighting vehicles etc; Management; supervisory; training and staffing; Driver; conductor and Mechanics hiring; duties; Vehicle operations-productivity and control; Fleet maintenance programs; tyre maintenance; productivity and control; Budget activity; Fleet management and data processing; Procurement and disposal; labour relations; energy management; Loss prevention management; control and predicting costs; Fitness of vehicles; Stores; definition; management; storing methods; inventory control; Duties and responsibilities of store manager; purchase manager; Storing methods;Bin card; requisition card; Inventory control procedures; Vendor development; Stores-layout; spare parts flow chart; Store documentation; store organization.

7. MOTOR INSURANCE: Types; scope; limitations; liability of insurance Cos; insurance documents-claim form; estimate and bills; Necessity for insurance against third party risk; Requirements and limits of liability of insurance policies; Procedure to be followed for settlement of a claim after an accident; Surveyor and loss assessor; Surveyors report; Certificate of insurance transfer; Compensation to third party deaths; Motor accident claims tribunal (MACT); Transit insurance

TEXT BOOK
The Motor Vehicle Act, 1988; Govt. of India Publication.

REFERENCE BOOKS
B.Tech. Automobile Engineering (Regular)


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BA-271  HUMAN RESOURCE MANAGEMENT  L T P  Cr
5 0 0  3

OBJECTIVE
The course aims to provide the insights into effective management of human resources to enable the students to meet the HR challenges in the present scenario.

2. HUMAN RESOURCE PLANNING: Definition, objectives; process and importance job analysis; Description, specification and job evaluation.
3. DEVELOPING EFFECTIVE HUMAN RESOURCE: Recruitment; selection; placement and introduction process; human resource development: concept, employee training & development, career planning & development
4. PERFORMANCE MANAGEMENT: concept and process, performance appraisal, Potential appraisal Job Compensation: Wage & salary administration, incentive plans & fringe benefits; Promotions, demotions, transfers, separation, absenteeism and turnover; Quality of work life (QWL): Meaning, origin, development and various approaches and; to QWL, techniques for improving QWL; Quality circles: concept, structure, role of management QC in India
5. JOB SATISFACTION AND MORALE: Health, safety & employee welfare; counseling for effective; enforcing equal employment opportunity legislation; fair employment; fair practice laws,
6. HUMAN RESOURCE DEVELOPMENT: Human Resource: definition, objectives & approaches to human relations; Employee grievances and discipline; participation & empowerment; Introducing to collective bargaining; HR Audit.
7. HIGH PERFORMANCE WORK SYSTEM: Fundamental principles-Principle of shared info; principle of knowledge development; principle of performance reward linkage; principle of Egaliitarianism; Testing alignment of the HR system-HR deliverables

TEXT BOOK

REFERENCE BOOKS

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BA-272  ENTREPRENEURSHIP DEVELOPMENT  L T P  Cr
5 0 0  3

OBJECTIVE
To acquaint the students with the challenges of starting new ventures and enable them to investigate, understand and internalize the process of setting up a business.

1. CONCEPT OF ENTREPRENEURSHIP: meaning and characteristics of entrepreneurship, entrepreneurial culture, socio-economic origin of entrepreneurship, factors affecting entrepreneurship, conceptual model of entrepreneurship, traits of a good entrepreneur, entrepreneur, intra-preneur and manager
2. ENTREPRENEURIAL MOTIVATION: motivating, compelling and facilitating factors, entrepreneurial ambition, achievement motivation theory and kakinada experiment
3. ESTABLISHMENT OF ENTREPRENEURIAL SYSTEMS: search, processing and selection of idea, Input requirements
4. SMALL SCALE INDUSTRY: meaning, importance, characteristics, advantages and problems of SSIs. Steps for starting a small industry, guidelines for project report, registration as SSI.
5. ASSISTANCE TO SSI: need for incentives & subsidies, need for institutional support, role of government and other institutions.
6. FUNCTIONAL PLANS: Marketing plan- marketing research for the new venture, steps in preparing marketing plan, contingency planning; Organizational plan- Forms of ownership, designing organizational structure, job design, manpower planning; Financial plan- cash budget, working capital, proforma income statement, Proforma cash flow, proforma balance sheet, break even analysis.
7. SOURCES OF FINANCE: Debt or Equity financing. commercial banks, venture capital; financial institutions supporting entrepreneurs; legal issues- intellectual property rights, patents, trade marks, copy rights, trade secrets, licensing, franchising.

TEXT BOOK
Gupta C. B. and Srinivasan N. P., "Entrepreneurial Development", Sultan Chand & Sons

REFERENCE BOOKS

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CE-471  ADVANCED TRAFFIC ENGINEERING  L T P  Cr
5 0 0  3

OBJECTIVE
To introduce the students about various modern traffic engineering and management problems and their solutions.
1. INTRODUCTION AND TRAFFIC CHARACTERISTICS: Objectives and scope of traffic engg. Organisational set up of traffic engg department in India; Importance of traffic characteristics; Road user characteristics; Vehicular characteristics; Max dimensions and weights of vehicles allowed in India. Effects of traffic characteristics on various design elements of the road.

2. TRAFFIC SURVEYS: Methods of conducting the study and presentation of the data for traffic volume study; speed study and origin and destination study. Speed and delay study. Parking surveys; On street parking; off street parking. Accident surveys. Causes of road accidents and preventive measures; Use of photographic techniques in traffic surveys.


4. TRAFFIC CONTROL: Types of traffic control devices. Traffic signs; general principles of traffic signing; types of traffic signs. Road markings; types; general principles of pavement markings. Design of rotary. Grade separated intersections. Miscellaneous traffic control aids and street furniture.

5. Signal Design: Types of signals. Linked or co-ordinated signal systems. Design of signal timings by trial cycle method; approximate method; Webster's method and IRC method

6. Traffic Regulation And Management: Need and scope of traffic regulations. Regulation of speed; vehicles and drivers. General traffic regulations. Motor vehicle act. Scope of traffic management. Traffic management measures: restrictions on turning movements; one way streets; tidal flow operations; exclusive bus lanes; traffic restraint; road pricing.


TEXT BOOK
Khanna S. K. and Justo C. E. G., “Highway Engineering”, Nem Chand Bros., Roorkee

REFERENCE BOOKS

WEB REFERENCES
1. syllabus.icbose.com/jntu/19-TRANSPORTATION%20ENGINEERING.pdf2.
2. www.nitkkr.ac.in/WebCivil/Civil_syllabus.doc

CE-472 ELEMENTS OF TOWN PLANNING AND ARCHITECTURE L T P Cr

OBJECTIVE
To impart knowledge on various aspects of town planning and architecture, historical structures, planning development of habitats.

1. INTRODUCTION TO ARCHITECTURE: Origin & definition; factors influencing architecture – climate; topography; materials; socio - cultural conditions; economic and technological factors etc. components of architecture – functional; aesthetic and structural.

2. BASIC ELEMENTS OF ARCHITECTURE: Principles of architectural composition - concept of beauty; unity; balance; proportion scale; rhythm; harmony; contract; symmetry; character; integration etc. aesthetic responses to colour; texture; light & shade; formal and informal organizations of solids and void

3. INTRODUCTION OF TOWN PLANNING: General Planning concepts in town planning; ancient town planning Greak; Roman; Medieval & Renaissance towns; history of town planning in India; modern town planning – industrial revaluation and its impact ; garden city concept new town and satellite towns.

4. TOWN PLANNING LEGISLATIONS: Urbanisation trends in India ; classification of town; Evolution of planning legislation in India; organizations and administration of planning agencies at National state; regional level and metropolitan level ; building bye laws; provision of building regulation; function of local authorizes.

5. DEVELOPMENT PLANS: Need; objective; scope and content of master plan; regional plan; structural plan; zonal development plan etc; Planning of land uses – residential; industrial; commercial; principles of planning for traffic & transportation; utility and services ; zoning regulation; sub division regulation; FARs; dентitions etc.

6. ELEMENTS OF A TOWN / CITY PLAN: Planning attributes- physical infrastructure; social infrastructure; commerce; housing etc ; surveys for town planning ; importance of climate; topography; drainage; water supply in selection of site for development; planning standerdars – UDPFI guidelines.

7. COMPONENTS OF TOWN PLANNING: Housing; housing problems in India; National housing policy; housing agencies; housing finance institutions; Dhum housing; transportation planning process; national transportation policy; surveys of
transportation planning; urban conservation; National Building Code of India 1983 guidelines; norms for planting of shrubs, trees, etc.

**TEXT BOOK**

**REFERENCE BOOKS**

**REFERENCE WEB SITE**
1. www.jadavpur.edu/academics/.../Architecture/archsyl.htm
4. issuu.com/brentallpress/docs/adr3_vol3_1

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<th>CH-471</th>
<th>ADVANCED APPLIED CHEMISTRY</th>
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**OBJECTIVE**
To make students familiar with the concept of chemistry associated with dairy life, with the general method of analysis and other aspects related to engineering field.

1. **FUELS & Petrochemicals Technology:** Classification of fuels; coal biomass; biogas determination of calorific values using bomb calorimeter; biofuels and liquid fuels; general consideration of petrochemicals; an overview of petroleum refining; petroleum transpiration; an elementary ideas of petrochemicals; petroleum refining -catalytic cracking & naphtha reforming.

2. **Chemicals Toxicology:** Introduction; kind of toxic pollutants; toxic chemicals in air & soil; toxic elements in waste water; carcinogenesis, impact of toxic chemicals on enzymes; biochemical effects of As, Cd, Pb, Hg, CO, NO₂, O₃ CN-; Toxic metal pollutants; Toxic minerals and dust; Toxic organic compounds.

3. **Environmental Hazards & Pollution:** Cause; Effects; control & measures of water pollution; soil pollution; thermal pollution; Nuclear pollution; solid waste management; industrial waste & bio-medical waste management; cause; effects & control measures of urban & industrial waste.

4. **Industrial Waste Management:** Magnitude of industrial waste generation & their characteristics; effluent standards for disposal into water bodies; waste water characterization & process survey; advanced treatment &sludge handing; combined treatment of raw industrial waste with sewage; common effluent treatment for industrial estates; management of industrial waste from small scale industries.

5. **Selection procedure for physical; chemical & biochemical methods of industrial waste water treatment.

6. **Corrosion & Its Control:** Introduction; dry corrosion; wet corrosion; mechanism of wet corrosion galvanic corrosion; concentration; Cell; corrosion fitting corrosion; inergranular corrosion; waterline corrosion; stress corrosion; galvanic series; factors influencing corrosion; control methods.

7. **Polymer Technology:** Introduction of natural and synthetic polymers; classification of polymers on different basis; Natural rubber: Source; Formula; Elasticity of rubber; chemical relativity; properties; isomerism in rubber; vulcanized rubber and its uses.

8. **Advanced Analytical Methods:** Thermo analytical methods; Thermo gravimetric analysis (TGA); Differential thermal analysis (DTA); Differential scanning calorimetry (DSC); Instrumentation; Flame photometry; spectrophotometry; conductometry; conductometry chromatographic methods; Adsorption; liquid - liquid partition; ion-exchange; paper & thin-layer chromatography; gas chromatography; HPLC & Electrophorisis.

**TEXT BOOK**

**REFERENCE BOOKS**
1. Drago, “Physical Methods of Chemistry”.

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<tr>
<th>CS-303</th>
<th>COMPUTER GRAPHICS</th>
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**OBJECTIVE**
Students completing this course are expected to be able to:
- Write programs that utilize the OpenGL graphics environment.
- Use polygonal and other modeling methods to describe scenes.
- Understand and be able to apply geometric transformations.
- Create basic animations.
- Understand scan-line, ray-tracing, and radiosity rendering methods.

**PRE-REQUISITES**
Knowledge of computer programming, 2D and 3D geometry

1. **INTRODUCTION:** What is computer graphics, computer graphics applications, computer graphics hardware and software, two dimensional graphics primitives; points and lines, line drawing algorithms: DDA, Bresenham’s; circle drawing
algorithms: using polar coordinates, Bresenham’s circle drawing, mid point circle drawing algorithm; polygon filling algorithm, boundary filled algorithm, scan-line algorithm, flood fill algorithm.

2. TWO DIMENSIONAL VIEWING: The 2-D viewing pipeline, windows, viewports, window to view port mapping; clipping: point, clipping line (algorithms); 4 bit code algorithm, Sutherland-Cohen algorithm, parametric line clipping algorithm (Cyrus Beck).

3. POLYGON CLIPPING ALGORITHM: Sutherland-Hodgeman polygon clipping algorithm, homogeneous coordinates system, two dimensional transformations: transformations, translation, scaling, rotation, reflection, shearing, transformation, composite transformation.

4. THREE DIMENSIONAL GRAPHICS: Three dimensional graphics concept, matrix representation of 3-D transformations, composition of 3-D transformation; viewing in 3D: projections, types of projections; the mathematics of planner geometric projections; coordinate systems.

5. HIDDEN SURFACE REMOVAL: Introduction to hidden surface removal; the Z-buffer algorithm, scan-line algorithm, area sub-division algorithm.

6. REPRESENTING CURVES AND SURFACES: Parametric representation of curves: Bezier curves, B-Spline curves; parametric representation of surfaces; interpolation method.

7. ILLUMINATION, SHADING, IMAGE MANIPULATION: Illumination models, shading models for polygons, shadows, transparency; what is an image, filtering, image processing, geometric transformation of images.

TEXT BOOK

REFERENCE BOOKS

WEB REFERENCES

CS-402 ARTIFICIAL INTELLIGENCE L T P Cr 5 0 0 3

OBJECTIVE
To introduce about artificial intelligence approaches to problem solving, various issues involved and application areas

PRE-REQUISITES
Knowledge of neural networks, data structures

1. INTRODUCTION TO AI AND SEARCH TECHNIQUES: Foundation and history of AI; data, information and knowledge; AI problems and techniques – AI programming languages, problem space representation with examples; blind search strategies, breadth first search, depth first search, heuristic search techniques; hill climbing; best first search, A* algorithm AO* algorithm, Means-ends analysis.

2. KNOWLEDGE REPRESENTATION ISSUES: Predicate logic; logic programming; constraint propagation; representing knowledge using rules.

3. REASONING UNDER UNCERTAINTY: Reasoning under uncertainty, non monotonic reasoning; review of probability; Bayes' probabilistic inferences and Dempster Shafer theory; heuristic methods; symbolic reasoning under uncertainty; statistical reasoning, fuzzy reasoning.

4. PLANNING & GAME PLAYING: Minimax search procedure; goal stack planning; non linear planning, hierarchical planning, planning in situational calculus; representation for planning; partial order planning algorithm

5. LEARNING: Basic concepts; rote learning, learning by taking advice, learning by problem solving, learning from examples, discovery as learning, learning by analogy; explanation based learning; neural nets; genetic algorithms.

6. OTHER KNOWLEDGE STRUCTURES: semantic nets, partitioned nets, parallel implementation of semantic nets; frames, common sense reasoning and thematic role frames; architecture of knowledge based system; rule based systems; forward and backward chaining; frame based systems.

7. APPLICATIONS OF ARTIFICIAL INTELLIGENCE: Principles of natural language processing; rule based systems architecture; expert systems, knowledge acquisition concepts; AI application to robotics, and current trends in intelligent systems; parallel and distributed AI; psychological modeling, parallelism in reasoning systems, distributed reasoning systems and algorithms

TEXT BOOK

REFERENCE BOOKS
WEB REFERENCES

CS-422 CRYPTOGRAPHY AND DATA COMPRESSION L T P Cr
5 0 0 3

OBJECTIVE
The course will attempt to dispel some of the many myths that surround the idea of cryptography. Cryptography is (and will continue to be) an increasingly important area of IT and it is important that practitioners are aware of the realities of the subject. The course will provide a down-to-earth overview of cryptographic techniques applicable in an IT environment, and outline the constraints and limitations of realistic secure systems. A running theme is the tradeoff between usability and security of a system. Also covered are a number of compression techniques - data compression and data encryption are, in some respects, closely related. A working knowledge of C is assumed and essential.

PRE-REQUISITES
Knowledge of cryptography, analysis & design algorithms and mathematics

1. INTRODUCTION: Basics of cryptography; history; usefulness of compression techniques
2. COMPRESSION: Packing, Huffman coding, Run length encoding, Lempel-Ziv-Welch, PKZIP, Delta modulation, JPEG; latest compression techniques
3. ERROR DETECTION AND CORRECTION: Parity, 1, 2, n-dimensions, Hamming codes, p-out-of-q codes
4. CRYPTOGRAPHY: vocabulary; history; steganography - visual textual, cipher hiding, false errors; public key cryptography – authentication; signatures; deniability
5. MATHEMATICS: information; confusion; diffusion; modular arithmetic; inverses; Fermats little theorem; Chinese remainder theorem, factoring; prime numbers; discrete logarithms
6. ALGORITHMS: DES, AES (Rijndael), IDEA, One time pad, Secret sharing and splitting, RSA, Elliptic curves, Modes, Random numbers
7. ATTACKING SYSTEMS: Recognition, Destroying data, Cryptanalysis - Differential cryptanalysis - cracking DES

TEXT BOOK

REFERENCE BOOKS

WEB REFERENCES

EC-305 EMBEDDED SYSTEM DESIGN L T P Cr
5 0 0 3

OBJECTIVE
The course intends to cover the design issues involved in embedded systems and system-on-chip technologies. The course also deals with the applications and programming languages and processor architectures used for embedded systems. This course introduces the students to standard Embedded System Development tools and gives a hands-on experience in developing various embedded applications.

1. INTRODUCTION: Different types of microcontrollers: Embedded microcontrollers; External memory microcontrollers; Processor Architectures: Harvard vs. Princeton; CISC vs. RISC; microcontrollers memory types; Introduction to Real Time Operating System.
2. 8051 MICROCONTROLLER ARCHITECTURE: Architecture; memory considerations; Addressing modes; clocking; i/o pins; interrupts; timers; peripherals; serial communication; Instruction set; simple operations.
3. PIC MICROCONTROLLER ARCHITECTURE: Introduction to PIC microcontrollers; Architecture and pipelining; program memory considerations; Addressing modes; CPU registers; Instruction set; simple operations.
4. INTERRUPTS AND I/O PORTS: Interrupt logic; Timer2 scalar initialization; IntService Interrupt service routine; loop time subroutine; External interrupts and timers; synchronous serial port module; serial peripheral device; O/p port Expansion; I/p port expansion; UART.
5. SOFTWARE: Development tools/ environments; Assembly language programming style; Interpreters; High level languages; Intel hex format object files; Debugging.
6. PROGRAMMING WITH MICROCONTROLLERS: Arithmetic operations; Bit addressing; Loop control; Stack operation; Subroutines; interfacing of 8051 with LCD; LED; keyboard; motors; seven segment and other interfacing; PIC simple operations.
7. DESIGNING USING MICROCONTROLLERS: Music box; Mouse wheel turning; PWM motor control; aircraft demonstration; ultra sonic distance measuring; temperature sensor; pressure sensor; magnetic field sensor.

TEXT BOOK

REFERENCE BOOKS

OBJECTIVE
This subject covers the entire concept behind the cellular technology. It covers the different standards like GSM; CDMA and going through these topics will help the students to face telecom sector and software companies.

1. MOBILE RADIO SYSTEM: reference model; frequencies for radio transmission; signals; antennas; signal propagation; multiplexing; modulation
2. CHARACTERISTICS OF RADIO WAVES: Multipath characteristics of radio waves; signal fading; time dispersion; Doppler spread ; coherence time; LCR; fading statistics; diversity techniques
3. WIRELESS SYSTEMS: GSM; architecture; services; frame structure; signal processing Wireless data services :RAM ;CDPD; GPRS
4. WI-FI AND THE IEEE STANDARD 802.11: 802.11 architecture; MAC layer; PHY layer; Bluetooth and the IEEE standard 801.15
5. MOBILE NETWORK LAYER: MOBILE IP: Goals and requirements; IP packet delivery; agent discovery; registration; tunneling and encapsulation; optimization; reverse tunneling; IP-V6; Mobile ad-hoc networks
6. MOBILE TRANSPORT LAYER: Traditional TCP; classical TCP improvement; TCP over 2.5 G/3G wireless networks; performance enhancing proxies
7. CDMA IN MOBILE COMMUNICATION SYSTEMS: Introduction, spreading sequences, basic transmitter and receiver schemes in the CDMA system, RAKE receiver, joint detection of CDMA signals, basic properties of a CDMA mobile system

TEXT BOOK

REFERENCE BOOK

OBJECTIVE
The programmable logic controller represents a key factor in industrial automation. Its use permits flexible adaptation to varying processes as well as rapid fault finding and error elimination. Today, Industrial environment is steered with the latest technological advancements in computers and communication. Programmable Logic Controllers (PLC) based automation is its outcome. This subject is useful to understand the concept of automation used in industry.

1. INTRODUCTION: Programmable Logic Controller; advantages of PLCs Over Relay System; input output Section – Fixed input output, Modular input output, Discrete input output Modules, Analog input output Modules.
2. PROCESSOR UNIT: Processor; Memory types; Guarding against Electro Static Discharge; Peripherals; Memory Organization.
3. PROGRAMMING DEVICES: Programming Devices; Dedicated Desktop Programmes; Hard Held Programmes; Computer Programmes
4. LADDER DIAGRAM & PLC PROGRAMMING: Ladder Diagram Rules; Writing Diagram; Ladder Diagram; Basic Stop / START Circuit; Digital Logic gates; Sequenced Motor Starting; Relay Type Instruction; Programming a PLC; PLC Peripherals; Network Limitation; Program Scanning
5. Program Control Instructions: Master Control Relay Instructions; Latching Relay instruction; immediate input output instruction; Jump and Label Instruction.
6. PROGRAMMING TIMER & COUNTERS: Pneumatic Timers; Cascading Timers; Allen Bradley PLCs Counters; Combining Timer & Counters.
7. SCADA: Introduction; Concept of Automatic Scada; Architecture of Scada; Hierarchical of Supervisory Control & Data Acquisition System; Technology Available; Data Acquisition Unit; Remote Technical Unit.

TEXT BOOK

REFERENCE BOOKS
B.Tech. Automobile Engineering (Regular)

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<th>EE-431</th>
<th>INDUSTRIAL ELECTRONICS</th>
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**OBJECTIVE**
Students who enter the job market and become electronic engineers must be prepared to work on industrial electronics in many forms. The job responsibilities for these fields are rapidly changing because electronic devices and circuits have become thoroughly integrated into all aspects of modern industrial control systems during the past ten years. The role of an electronic engineer has changed to the point where he is expected to work on every aspect of industrial system from the simplest electrical components, such as fuses and motor, to the most complex, such as electronic boards, motor drives, and programmable controllers. This course provides sufficient depth to be a useful resource while working on job.

1. **INDUSTRIAL LOGIC CIRCUITS**: Relay logic; Types of relays; voltage ratings for coils and contacts; typical logic circuits; relay ladder & its application; solid state devices used for relay logic; solid state logic blocks; solid state relays.

2. **PROGRAMMABLE LOGIC CONTROLLERS (PLC)**: Programmable logic controller systems; PLC operation; input module circuitry; processor; processor operations; memory & its layout; program scanning; programming – assembly language; relay language or logic; programming basics; ladder diagram; timing function; sequence of operations; arithmetic functions; move function; conversion.

3. **TIMERS**: Functions, types – delay timers; interval times; repeat cycle timers; reset timers; timer classification – thermal timers; electromechanical timers; motor driven delay timers; block diagram of the basic elements of an electronic timer.

4. **ILLUMINATION**: Nature of light; basic laws of illumination; light sources and their characteristics; light production by excitation and ionization; incandescence; fluorescence; different types of lamps; their construction; operation and characteristic; application, latest light sources; design of illumination system.

5. **POWER SUPPLIES**: Performance parameters, of power supplies, comparison of rectifier circuit; filters, regulated power supplies; switching regulators; switch mode converter.

6. **POWER FACTOR CONTROL**: Static reactive power compensation; shunt reactive power compensator; application of static SCR controlled shunt compensators for load compensation; power Factor improvement and harmonic Control of Converter fed systems; methods employing natural and forced commutation schemes; implementation of forced commutation.

7. **MOTOR CONTROL**: Voltage control at constant frequency; PWM control; phase control of dc motor; PLC control of a DC motor.

**TEXT BOOK**

**REFERENCE BOOKS**

**LABORATORY**: Performance parameter of various power converters, sequence control of AC-DC power converter, Comparison of AC-DC converters with and without filters, Project on illumination, simulation of power converters using MATLAB, relay network programming, programming PLC.

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**OBJECTIVE**
Providing the knowledge to the students about various types of conventional and non-conventional electrical power plants and explain the concepts regarding their layout and their operations at different load conditions.

**PRE-REQUISTES**
Knowledge of electrical technology and circuits.

1. **INTRODUCTION**: Energy classification; sources; utilization; economics; power generation terminology; energy conversion matrix; and review of various principal fuels for energy conversion such as solar; biogas; wind ; tidal etc.

2. **SOLAR ENERGY**: Solar radiation and its measurement; solar energy collectors; storage and applications.

3. **WIND ENERGY**: Basic principles of wind energy conversion; site selection considerations; wind data and energy estimation; classification of WEC systems; Magnus effect; wind energy collectors; storage and applications of wind energy; safety systems.

4. **ENERGY FROM BIOMASS**: Introduction; biomass conversion technologies; biogas generation; classification of biogas plants; details of construction of some main digesters; methods for maintaining biogas production; problems related to bio-gas plants etc.

5. **ENERGY FROM THE OCEANS**: OTEC; open cycle; closed cycle OTEC systems; energy utilization; hybrid cycle etc. operation methods of utilization of tidal energy; prospects in India.

6. **PRODUCTION OF THERMAL ENERGY**: Introduction; conversion of mechanical energy; conversion of electrical energy; conversion of electromagnetic energy; conversion of chemical energy; conversion of nuclear energy etc. Study of typical energy converters such as high performance motors; special generators driven by biogas engines; wind turbines etc; mini-hydro generators; energy efficient motors; magneto hydro dynamics power generation; thermionic generation.

7. **ENVIRONMENTAL IMPACT OF POWER PLANT**: Introduction; particulate emissions; gaseous pollutants; thermal pollution; solid-waste pollution.
TEXT BOOK

REFERENCE BOOKS

OBJECTIVE
Providing a basic knowledge and understanding of the fundamental concepts of high voltage engineering, explaining various methods of HVDC power transmission, converter techniques and HVDC control and protection, and the method of measurement and testing of HVDC.

PRE-REQUISITES
Knowledge of electromagnetic field theory and power systems.

1. DC POWER TRANSMISSION TECHNOLOGY:
   Introduction; comparison of AC and DC transmission; application of DC transmission; description of DC transmission system; planning for HVDC transmission; modern trends in DC transmission.
2. THYRISTOR VALVE & ANALYSIS OF HVDC CONVERTERS:
   Introduction; thyristor device; thyristor valve; value tests; recent trends; pulse number; choice of converter configuration; simplified analysis of Graetz circuit; converter bridge characteristics; characteristics of twelve pulse converter; detailed analysis of converters.
3. CONVERTER AND HVDC SYSTEM CONTROL:
   General; principles of DC link control; converter control characteristics; system control hierarchy; firing angle control; current and extinction angle control; starting and stopping of dc link; power control; higher level controllers; telecommunication requirements.
4. CONVERTER FAULTS AND PROTECTION:
   Introduction; converter faults; protection against over currents; overvoltages in a converter station; surge arresters; protection against overvoltages; introduction of multiterminal DC systems; potential applications of MTDC systems; types of MTDC systems; control and protection of MTDC systems; study of MTDC systems
5. SMOOTHING REACTOR AND DC LINE:
   Introduction; smoothing reactors; DC line; transient over voltages in DC line; protection of DC line; DC breakers; monopolar operation; effects of proximity of AC and DC transmission lines.
6. REACTIVE POWER CONTROL, HARMONIC AND FILTERS:
   Introduction; reactive power requirement in steady state; sources of reactive power; static var systems; reactive power control during transients; introduction of harmonic and filters; generation of harmonics; design of AC filters; DC filters; carrier frequency and RI noise
7. MEASUREMENTS & TESTING OF HVDC:
   Measurement of high direct voltage; electrostatic voltmeters; generating voltmeter; sphere-gap; measurement of ripple voltages; types tests and routine tests of equipment; dielectric testing of HVDC equipments; power frequency voltage withstand tests; impulse voltage withstand test; measurement by sphere gaps; application of test voltage to the equipments under test.

TEXT BOOK
Arrillaga, J., “High voltage D.C.Transmission”, Peter Peregrinus Ltd, 1996

REFERENCE BOOKS

OBJECTIVE
Providing a basic knowledge and understanding of the fundamental concepts of high voltage engineering, explaining various basic laws governing the conduction and breakdown, voltage gradients on conductors, phenomenon of corona and lightning discharges and high voltage testing arrangements.

PRE-REQUISITES
Knowledge of Electromagnetic field theory and power systems.

1. INTRODUCTION:
   Recent trends in high voltage transmission.
2. CONDUCTION AND BREAKDOWN:
   Conduction and breakdown in gases; liquids and solid dielectrics; insulator breakdown; insulation characteristics of long air gaps.
3. VOLTAGE GRADIENTS ON CONDUCTORS:
   Electrostatic fields of sphere gaps; fields of line charges and their properties; charge-potential relations for multi-conductor lines; surface voltage gradients on conductors; distribution of voltage gradient on sub conductors of bundle.
4. CORONA:
   Corona and corona loss; corona loss formula; attenuation of traveling waves due to corona; audible noise-generation and characteristics; corona pulses--their generation and properties; properties of pulse; radio interference.
B.Tech. Automobile Engineering (Regular)

5. LIGHTENING: Lightening phenomenon; lightning stroke mechanism; principle of lightning protection; tower foot resistance; insulator flash over and withstand voltage; lightning arresters and their characteristics.

6. H. V. TESTING AND LAB EQUIPMENTS: Standard wave-shapes for testing; wave-shaping circuits: principles and theory; impulse generator; generation of ac high voltage for testing; generation of direct voltage: measurement of high voltage; general layout of H.V. laboratory.

7. MEASUREMENT OF HIGH ALTERNATING VOLTAGES: Peak voltage measurement with sphere-gaps; peak voltage measurement using measuring capacitors; peak voltage measurement with capacitor voltage divider; measurement of rms values by electrostatic voltmeters; capacitance voltage transformer; digital recording.

TEXT BOOK

REFERENCE BOOKS
1. Wadhwa C. L., "High Voltage Engineering", New Age international Ltd. 1995

EN-471 PROFESSIONAL COMMUNICATION L T P Cr
5 0 0 3

OBJECTIVE
The objective of devising this course is to prepare the students or this University to be ready to take up their professional job on the completion of this course. Professional Communication is essential for the pass outs of this University to help them prove their abilities in the interviews and to utilize their knowledge in active job.

1. PRACTICAL ENGLISH: Parts of speech; noun; pronouns; adjective; verb, adverb, propulsion, conjunctional interjection; conjunctional interjection; use of articles.
2. ADVANCED ENGLISH: Phrasal verbs; reported speech; conditional clauses; concord; correct the sentences; question tags; idioms.
3. VOCABULARY: Word formation; one word substitution; foreign words; words often confused; homophones; antonyms; synonyms.
4. BUSINESS ENGLISH: Importance: business phrases; emphatic expression; e-mail writing; resume writing; interview techniques; business letter; covering letter; application job; resignation letter, effective telephone handling.
5. PHONETICS: Basic concepts; vowels, consonants; phonemes; syllabus; articulation of speech; transcription of words; word stress; intonation.

6. BOOK REVIEW
7. MOVIE REVIEW

TEXT BOOK

The following four lessons are prescribe for textual study:
1. The Year 2050
2. Human Environment
3. The Discovery

REFERENCE BOOKS

EN-472 BUSINESS COMMUNICATION L T P Cr
5 0 0 3

OBJECTIVE
The course proposes to help students develop competence in business and technical communication. It focuses on writing skills and strategies for specific purposes. The inevitability of introducing this course to Engineering students is embodied in that it has comparatively a high concentration of certain complex writing techniques and procedures.

1 BUSINESS CORRESPONDENCE: Characteristics and formats of business letter; quotations, orders, tenders, sales letters, complaints, claim and adjustment letters; credit and collection letters; application; letters for vacant situations with emphasis on resumes and curriculum vitae; e-mail and netiquette format, style and tone
2 BUSINESS REPORTS AND PROPOSALS: Importance; function; pattern and formats of reports, typical business reports; report presentation, and formal reports: proposal formats, writing problem-solving proposals; executive summery proposals and project proposals
3 MEETINGS: Writing of memoranda; notes; agenda and minutes of the meeting
4 PUBLIC RELATIONS AND ADVERTISING

76
DOCUMENTS: Press releases; public service announcements, advertising strategy and its objectives; designing of classified and display advertising copies.

5 PHONETICS: Vowels; consonants; syllables; transcription; word stress & intonation.

6 ESSAY WRITING ON BUSINESS TOPICS-TRADITIONAL & CONTEMPORARY

7 BOOK REVIEW/MOVIE REVIEW

TEXT BOOK
Bansal R. K. and Harrison J. B., "Spoken English for India", Orient Longman

REFERENCE BOOKS
3 Ramesh M. S. and Pattanshetti C. C., “Effective Business English and Correspondence”, R. Chand & Co.
6 Sarah Freeman, “Written Communication in English”, Orient Longman.
7 Leo Jones and Riched Alexander, “International Business English”, Cambridge University Press

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<th>IT-423</th>
<th>INTRODUCTION TO E-COMMERCE &amp; ERP</th>
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OBJECTIVE
To provide knowledge about the protocols, methods, security issues in electronic commerce as well as about enterprise resource planning tools, models and techniques

PRE-REQUISITES
Knowledge of internet and web development, data mining, computer networks, software engineering

PART A
1. INTRODUCTION AND CONCEPTS: Networks and commercial transactions – Internet and other novelties, networks and electronic transactions today; model for commercial transactions; Internet environment – internet advantage; world wide web and other internet sales venues; online commerce solutions.

2. ELECTRONIC PAYMENT METHODS: Updating traditional transactions, secure online transaction models; online commercial environments; digital currencies and payment systems; offline secure processing; private data networks; security protocols; electronic payment systems: digital payment systems

3. DIGITAL CURRENCIES: Operational process of Digicash; Ecash Trail; Using Ecash; Smart cards; Electronic Data Interchange: basics, EDI versus Internet and EDI over Internet; Strategies, Techniques and Tools; Shopping techniques and online selling techniques.

PART B

5. ERP – RESOURCE MANAGEMENT PERSPECTIVE: Functional and Process of Resource; Management; Introduction to basic modules of ERP System: HRD, Personnel management, training and development; skill inventory, material planning and control, inventory; forecasting; manufacturing; production planning; production scheduling; production control; sales and distribution; finance; resource management in global scenario.

6. ERP - INFORMATION SYSTEM PERSPECTIVE: Introduction to OLAP (Online Analysis and Processing), TP, OAS, KBS, MRP, BPR, SCM, REP, CRM, Information Communication Technology.

7. ERP-KEY MANAGERIAL ISSUES: Concept Selling; IT infrastructure; implication of ERP systems on business organization; critical success factors in ERP System; ERP Culture implementation issues; resistance to change; ERP selection issues; return on investment; pre and post implementation issues.

TEXT BOOK
Kalakota Ravi and Whinston Andrew, "Frontiers of Electronic Commerce", Addison Wesley, 1996

REFERENCE BOOKS
B.Tech. Automobile Engineering (Regular)


WEB REFERENCES
2. www.bizautomation.com
3. itmanagement.earthweb.com/erp
4. www.e2-llc.com/e2_ecommerce_erp.aspx
5. e-comm.webopedia.com/TERM/e/ERP.html

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OBJECTIVE
Using a "building block" approach, the ISM curriculum provides a core understanding of storage technologies and progresses into system architectures, introduction to networked storage, and introduction to information availability. The course provides a comprehensive introduction to data storage technology fundamentals. Students will gain knowledge of the core logical and physical components that make up a storage systems infrastructure.

PRE-REQUISITES
Knowledge of Computer Networks at B Tech level

1. INTRODUCTION: Meeting today's data storage needs - data creation; data creation: individuals, business; categories of data; data storage models; common data storage media and solutions - tape storage systems, optical data storage, disk based storage
2. DATA CENTER INFRASTRUCTURE: Example; key requirements of storage systems management activities
3. STORAGE SYSTEMS ARCHITECTURE: Storage system environment; components of a host; connectivity; physical disks; RAID array; disk storage systems; data flow exercise
4. NETWORKED STORAGE: Direct Attached Storage (DAS), Network Attached Storage (NAS), Fiber Channel Storage Area Network (FC SAN), IP Storage Area Network (IP SAN), Content Addressed Storage (CAS)
5. BUSINESS CONTINUITY: Introduction, overview, backup and recovery, local replication, remote replication.
6. MONITORING AND MANAGING THE DATA CENTER: Areas of the data center to monitor; considerations for monitoring the data center; techniques for managing the data center.
7. SECURING STORAGE AND STORAGE VIRTUALIZATION: Securing the storage infrastructure; virtualization technologies.

TEXT BOOK
Osborne Marc Farley, "Building Storage Networks", Tata McGraw Hill

REFERENCE BOOKS


WEB REFERENCES

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OBJECTIVE
To acquaint the students with the various concepts and tools of applied mathematics which will be very basic and the very soul and guide of computer field.

1. SET THEORY: Different types of sets; Set operations; Classes of sets; Relation; Types of relation; Functions; Types of functions and composition of functions and relation; Cardinality and inverse relations; Fuzzy sets; Basic operations of fuzzy sets.
2. BOOLEAN ALGEBRA & LATTICES: Definition of Boolean algebra; Basic operations of Boolean algebra; Partially ordered sets; Lattices; Sub Lattices; Different types of Lattices; Operations on Lattices.
3. NUMBER THEORY: Basic properties; Divisibility theory; Congruences; Chinese remainder theorem; Fermat's little theorem; \( \tau \) & \( \mu \) functions.
4. COMBINATORICS: Fundamental principal of counting; Pigeonhole principal; Multinomial coefficients; Recurrence relation; Generating functions.
5. ALGEBRAIC STRUCTURES: Binary operations; Group; Subgroup; Normal subgroup and their elementary properties; Order of element and group; Lagrange's theorem; Rings; Sub ring; Ideal; Integral domain; Field only definition and examples.
6. GRAPH THEORY: Introduction to graphs; Type of graphs; Sub graphs and isomorphic graphs; Representation of graphs; Properties of graphs; Euler's formula for planar graph; Eulerian and Hamiltonian graph; Ore's theorem.
7. TREES: Trees and their properties; Spanning trees; Kruskal's algorithm; Prim's algorithm; Binary tree.

TEXT BOOK

REFERENCE BOOK
3. Deo, "Graph Theory", Prentice Hall of India.
MA-472 | ADVANCED HIGHER ENGINEERING MATHEMATICS | L T P Cr
| | | 5 0 0 | 3 |

OBJECTIVE
To acquaint the students with the various concepts and tools of applied mathematics which will be very basic and the very soul and guide of various engineering subjects.

1. SERIES SOLUTION OF DIFFERENTIAL EQUATION: Series solution and its validity; General method; Forms of series solution.
2 & 3. CALCULUS OF VARIATIONS: Introduction; Functionals; Euler's equation; solutions of Euler's equation; Geodesies; Isoperimetric problems; Several dependent variables; Functionals involving higher order derivative; Approximate solution of boundary value problems- Rayleigh-Ritz methods; Hamilton's principle; Lagrange's equations.
4 & 5. TENSOR ANALYSIS: Introduction; Summation convention; Transformation of coordinates; Tensor of order zero; Kronecker Delta; Contravariant and Co-variant tensors; Quotient law; Riemannian space; Conjugate tensor; Christoffel symbols; Transformation of Christoffel symbol; Covariant differentiation of a covariant tensor; Covariant differentiation of a contravariant tensor.
6 & 7. INTEGRAL EQUATIONS: Definition and classification of integral equations; Conversion of a linear differential equation to an integral equation and vice versa; Volterra Integral equations, solution of integral equation by resolvent Kernel, Method of successive approximation, Euler integrals, Volterra Integral equation of the first kind, Fredholm equation of second kind.

TEXT BOOK

REFERENCE BOOKS

MA-473 | ADVANCED NUMERICAL TECHNIQUES | L T P Cr
| | | 5 0 0 | 3 |

OBJECTIVE
To acquaint the students with the various concepts and tools of applied mathematics which will be very basic and the very soul and guide of various engineering subjects.

1. EIGEN VALUE PROBLEMS: Eigen values and eigen vectors; Power methods: Jacobi's methods; Given's methods; Householder's methods.
2 & 3. DIFFERENCE EQUATIONS: Introduction; formation of difference equations; complementary function; particular integral; difference equations reducible to linear form; simultaneous difference equations and its applications.
4. PARABOLIC PARTIAL DIFFERENTIAL EQUATION: Transient heat flow equation; the explicit method; Crank-Nicolson method; parabolic equation in two or three dimension; finite elements for heat flow.
5. HYPERBOLIC PARTIAL DIFFERENTIAL EQUATION: The wave equation; solving the wave equation by finite differences; comparison to the d'Alembert solution; method of characteristics; the wave equation in 2-D; finite elements and the wave equation.
6. APPROXIMATION OF FUNCTION: Chebyshev polynomials; economized power series; approximation with rational functions; Fourier series; getting Fourier co efficient numerically and fast Fourier transform.
7. APPLICATION IN ENGINEERING FIELD: Application of Gaussian quadrature in evaluating stiffness and stress matrices for 2D and 3D elements.

TEXT BOOK

REFERENCE BOOKS
2. Sastry S. S., "Introductory Methods of Numerical Analysis", Prentice Hall of India

MA-474 | OPERATION RESEARCH | L T P Cr
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OBJECTIVE
The aim of the topic is to provide a common platform for the Engineers, Scientists along with people from management, industry & defence sector. This topic also provides how to get optimal solution in above said branch.

1. LINEAR PROGRAMMING: Linear programming modeling and examples; resolution of degeneracy; duality theory; dual-simplex and primal-dual algorithms; transportation; assignment problems; sensitivity analysis; industrial applications of linear programming like product mix problems; blending problems; optimal allocation of resources, etc.
2. INTEGER PROGRAMMING, GOEL PROGRAMMING & MULTICRITERIA DECISION MAKING: Formulation of various industrial problems
as integer and mixed integer programming problems; branch and bound algorithm; cutting plane methods for pure and mixed integer programming problems; Knap-sack; travelling salesman and shortest route problems. Multicriteria decision; multicriteria decision making models; determination of set of feasible alternatives; solution techniques; goal programming approach; goal programming models; ranking and weighting of multiple goals; simplex method in goal programming.

3. **NON-LINEAR PROGRAMMING**: Constraint qualification and Kuhn-Tucker necessary conditions; sufficiency of Kuhn-Tucker necessary conditions and convex programs: Linear Complementarity Problem (LCP); Quadratic programming and use of LCP for solving quadratic programming problems.

4. **SEQUENCING MODEL**: Two machine and n jobs (no passing) problem and three machine and n jobs (no passing) problems; different routing; 2 jobs and m machines; n jobs and m machines; branch and bound algorithms.

5. **QUEING THEORY & INVENTORY CONTROL**: Introduction to waiting line models; steady state behavior of M/M/1 and M/M/C queues-the problem of machine interference and use of finite queuing tables- introduction to M/G/1, and G/M/1 inventory control problem; Concept of inventory and various costs; EQQ formula newspaper boy problems.

6. **PERT/CPM**: Introduction to network analysis; Definition of a project; job and events; drawing of arrow diagrams; determination of critical paths and calculation of floats; resource allocation and least cost planning; use of network flows for least cost planning; uncertain duration and PERT.

7. **STOCHASTIC PROGRAMMING**: Stochastic programming with one objective function; stochastic linear programming; two stage programming technique; chance constrained programming technique.

**TEXT BOOK**

**REFERENCE BOOKS**

**OBJECTIVE**
The course provides knowledge of ergonomics principles so that the students are able to visualize factors which affect the efficiency of human beings. After the study of the subject, the students will be able to select a proper design of display controls, equipment, work plan and environment.

1. **INTRODUCTION**: Definition of ergonomics and ergonomist; social and economic values of ergonomics; general and individual ergonomics.
2. **POSTURE AND MOVEMENT**: Biomechanical; physiological and anthropometric background; postures; sitting and standing; Movement – lifting; carrying; pulling and pushing; Workplace design and assessment.
3. **INFORMATION AND OPERATION**: User; information – visual; hearing and other senses; Control for operation – fixed and others diaries user friendliness; different forms and help; Website design; mobile interaction; virtual reality.
4. **ENVIRONMENTAL FACTORS**: Noise reduction; hearing conservation; Vibration prevention; illumination – light intensity; brightness differences; colour of light; Climate – heat and cold; Chemical substances – measures; ventilation.
5. **WORK ORGANISATION JOBS & TASKS**: Tasks; jobs; work organization – flexible; autonomous groups; coaching measurement styles.
6. **ERGONOMIC APPROACH**: Project management – initiative phase; problem identification phase; selection of solution phase; implementation phase; evaluation phase.
7. **CASE STUDIES**: A set of case studies will be used to demonstrate how ergonomics had lead to changes in work activity; safety and product design; Case studies will include advanced computer application; work place assessment; accidents; analysis and industrial inspection.

**TEXT BOOK**
Jan Dul and Bernard Weerdancester, "Ergonomics for Beginners", CRC Press/Taylor and Francis Group

**REFERENCE BOOKS**
3. Verma A. P., "Industrial Engineering", S. K. Kataria and Sons

**ME-443 FINITE ELEMENT ANALYSIS**

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**OBJECTIVE**
The objective of the course is to teach the fundamentals of finite element method of solids; structures and fluids with emphasis on the underlying theory, assumptions, and modeling issues as well as providing hands on experience using finite element software to model, analyze and design systems of relevance to mechanical engineering. This includes the theoretical foundations and appropriate use of finite element methods.
solution; The relevance and place of finite element method; Historical comments; Basic concept of FEM; Boundary and initial value problems; Gradient and divergence theorems; Functional; Variational calculus; Variational formulation of VBPS; The method of weighted residuals; The Ritz method.

2. **FINITE ELEMENT ANALYSIS OF ONE DIMENSIONAL PROBLEMS:** 1D second order equations; discretisation of domain into elements; Generalised coordinates approach; derivation of elements equations; assembly of element equations; imposition of boundary conditions; solution of equations; Cholesky method; Post processing.

3. **EXTENSION OF THE METHOD TO FOURTH ORDER EQUATIONS AND THEIR SOLUTIONS:** time dependant problems and their solutions; example from heat transfer; fluid flow and solid mechanics.

4. **FINITE ELEMENT ANALYSIS OF TWO DIMENSIONAL PROBLEMS:** Second order equations involving a scalar; valued function; model equation; Variational formulation – Finite element formulation through generalised coordinates approach; Triangular elements and quadrilateral elements; convergence criteria for chosen models; Interpolation functions; Elements matrices and vectors; Assembly of element matrices; boundary conditions; solution techniques.

5. **ISOPARAMETRIC ELEMENTS AND FORMULATION:** Natural coordinates in 1, 2 and 3 dimensions; use of area coordinates for triangular elements in; 2 dimensional problems; Isoparametric elements in 1, 2 and 3 dimensions; Largrangean and serendipity elements; Formulation of element equations in one and two dimensions; Numerical integration.

6. **APPLICATIONS TO FIELD PROBLEMS IN TWO DIMENSIONS:** Equations of elasticity; plane elasticity problems; axisymmetric problems in elasticity; Bending of elastic plates; Time dependent problems in elasticity; Heat transfer in two dimensions; Incompressible fluid flow and related problems.

7. **INTRODUCTION TO ADVANCED TOPICS (NOT FOR EXAMINATION PURPOSES):** Three dimensional problems; Mixed formulation; use of software packages.

**TEXT BOOK**

**REFERENCE BOOKS**

**OBJECTIVE**
This gives the knowledge of estimation; conversion and utilization of non conventional sources of energy. With the depletion of fossil fuel sources, the importance of non-conventional renewable sources of energy has gained tremendous importance. This course introduces the students to these sources and how these can be utilized for power production.

1. **INTRODUCTION**: Trends of energy consumption; sources of energy; conventional and Renewable; fossil fuel; availability and limitations; need to develop new energy sources.
2. **SOLAR ENERGY**: Solar radiation characteristics and estimation; Solar Collectors; Flat Plate and concentrating types; Their comparative study; design and material selection; Efficiency; Selective paints and surfaces; Heating of air and water for building and other Uses; Thermal storages; Solar Ponds; Solar pumps; Solar Power; Solar Cookers etc; Direct Conversion of Solar energy to electricity and its various uses; materials; limitations and Costs.
3. **BIO-CONVERSION**: Generation of bio-gas; digesters and their design; selection of material; feed to digester; paralytic gasification; production of hydrogen; Algae production and their uses.
4. **WIND ENERGY**: Types of rotors; horizontal axis and vertical axis systems; system design and site selection.
5. **GEO-THERMAL ENERGY**: Sites; potentiality and limitation; study of different conversion systems.
6. **TIDAL ENERGY**: Sites; potentiality and possibility of harnessing from site; limitations; Ocean Thermal Energy; Principle of utilization and its limitations; description of various systems.
7. **OTHER NON-CONVENTIONAL ENERGY SOURCES**: Fluidized bed combustions; heat from waste and other sources.

**TEXT BOOK**

**REFERENCE BOOKS**
4. Sharma P. C., “Power Plant Engineering”, S. K. Kataria and Sons

**PH-471**: **NON DESTRUCTIVE TESTING TECHNIQUES**

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**OBJECTIVE**
To give a general overview of novel non destructive testing methods, the principles behind them, their uses, the advantages and limitations, both in application and defect detection capability.
1. NON-DESTRUCTIVE TESTING: Non-destructive testing (NDT); role, components and advantages; common NDT techniques.
2. ULTRASONIC TESTING: Ultrasonic flaw detection; principle, working and applications, advantages and limitations.
3. RADIOGRAPHY: X-ray radiography, Gamma ray radiography and Neutron radiography; principle, working and applications, advantages and limitations.
4. EDDY CURRENT TESTING: Principle, working and applications of eddy current testing; probes and sensors; testing procedures, applications, advantages and limitations.
5. MAGNETIC TESTING: Magnetic testing; particle, flux leakage testing; magnetization methods; detectables, applications, advantages and limitations.
6. DYE PENETRANT TESTING: Principle, working and applications of dye penetrant testing, advantages and limitations.
7. VISUAL AND OPTICAL TESTING: Principle, working and applications of holographic interferometry, optical interface techniques, advantages and limitations.

**TEXT BOOK**

**REFERENCE BOOKS**

**PH-472** | **NANO TECHNOLOGY** | **L T P Cr** | **5 0 0 3**
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**OBJECTIVE**
The goal is to teach students some basic nanoscience/hanotechnology. Students are expected to learn both some basic science and technology. Students from all branches are expected to assist each other in teaming and discussing the content and die context, and to maintain respect for the scientific approach.

1. **NANOMATERIALS**: Introduction to nanomaterials; nano-scale in one dimension: thin films, layers and surfaces, nanoscale in two dimensions: carbon nano-tubes; inorganic nano-tubes, nano-wires, biopolymers; nano-scale in three dimensions: nano-particles, fullerenes (Carbon 60), dendrimers, quantum dots
2. **NANOMETROLOGY**: Introduction to nanometrology; length measurement; force measurement; measurement of single molecules; applications of metrology.
3. **ELECTRONICS, OPTOELECTRONICS AND INFORMATION AND COMMUNICATION TECHNOLOGY**: Introduction to electronics; optoelectronics and information and communication technology; nanoscience in electronics, opto-electronics and information and communication technology; current applications: computer chips, information storage, opto-electronics; applications anticipated in the future: sensors.
4. **NANO-BIOTECHNOLOGY AND NANOMEDICINE**: Introduction to nano-biotechnology and nano-medicine, nano-science in nano-biotechnology and nano-medicine, current and future applications: array technologies, drug delivery, drug discovery, medical imaging, nanotechnologies and cancer treatment, implants and Prosthetics.
5. **NANOFABRICATION**: Lithographic techniques for nano-printing; nano-manipulation techniques, self assembly.
6. **SYNTHESIS AND CHARACTERIZATION**: Metallic, semiconducting, magnetic and carbon based nano structures, nanocomposites and biological nanomaterials.
7. **APPLICATIONS OF NANOMATERIALS**: Nanoscreens and cosmetics, composites, clays, coatings and surfaces, tougher and harder cutting tools, paints; remediation, fuel cells; displays, batteries, fuel additives, catalysts; carbon nanotube composites; lubricants, magnetic materials; medical implants; machinable ceramics, water purification, military battle suits.

**TEXT BOOK**
Poole Charles P. and Owens Frank J., “Introduction to Nanotechnology”, Wiley InterScience, 2003

**REFERENCE BOOKS**

**PH-473** | **LASER TECHNOLOGY** | **L T P Cr** | **5 0 0 3**
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**OBJECTIVE**
To give a general overview of fundamentals of Laser, Laser production techniques and applications.

1. **CONDITIONS**: Conditions for producing laser, concept of coherence - spatial and temporal, population inversions
2. **GROWTH FACTOR:** Einstein coefficients, gain and gain saturation, saturation intensity, development and growth of a laser beam, exponential growth factor, threshold requirement for a laser.

3. **NORMAL INVERSION:** Inversions and two level systems, steady state inversions,

4. **POPULATION INVERSION:** Three and four level systems, transient population inversions, factors effecting population inversion, laser Amplifiers.

5. **EXCITATION AND PUMPING:** Excitation or pumping threshold requirements, pumping pathway and specific excitation parameters associated with optical and particle pumping.


7. **LASER SPECTROSCOPY:** Introduction and applications

**TEXT BOOK**

**REFERENCE BOOKS**

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Lingaya's Group of Institutions:

- Lingaya's University (Faridabad)
- Lingaya's Institute of Health Sciences
- Lingaya's Public School
- Lingaya's Lalita Devi Institute of Management & Sciences, New Delhi (I.P. University)
- Sri Viveka Institute of Technology, Vijayawada