R G M COLLEGE OF ENGINEERING & TECHNOLOGY
(AUTONOMOUS)
NANDYAL-518501, KURNOOL DIST., A.P., INDIA

DEPARTMENT OF
MECHANICAL ENGINEERING (MECH)

(ESTD-1995)

B.TECH SYLLABUS 2019

Applicable for students admitted into
B.Tech (Regular) from 2019-20
B.Tech (Lateral Entry Scheme) from 2020-21
REGULATIONS, Course Structure & Detailed Syllabus

R G M COLLEGE OF ENGINEERING AND TECHNOLOGY
AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING
(Affiliated to J.N.T.U.A, Anantapuramu)

ACADEMIC REGULATIONS, COURSE STRUCTURE AND DETAILED SYLLABI
B.Tech. (Regular) from 2019-20 and B.Tech. (Lateral Entry Scheme) from 2020-21

For pursuing four year Bachelor Degree Program (under graduate) of study in Engineering (B.Tech.), Two year Master (post graduate) Degree of study in Engineering (M.Tech.), Two year Master (post graduate) degree of study in Business Administration (MBA), Three-year Master (post graduate) Degree of study in Computer Applications (MCA) offered by Rajeev Gandhi Memorial College of Engineering and Technology, Nandyal -518501 under Autonomous status and herein referred to as RGMCET (Autonomous).

All the rules specified herein approved by the Academic Council will be in force and applicable to students admitted from the Academic Year 2019-20 onwards. Any reference to "Institute" or "College" in these rules and regulations shall stand for Rajeev Gandhi Memorial College of Engineering and Technology (Autonomous).

All the rules and regulations, specified hereafter shall be read as a whole for the purpose of interpretation. As and when a doubt arises, the interpretation of the Chairman, Academic Council is final. As per the requirements of statutory bodies, the Principal, Rajeev Gandhi Memorial College of Engineering and Technology shall be the Chairman, Academic Council.

The candidate seeking admission into the first year of study of four year B.Tech degree Program should have:

i) Passed either Intermediate Public Examination (IPE) conducted by the Board of Intermediate Education, Andhra Pradesh with Mathematics, Physics and Chemistry as optional subjects (or any equivalent examination certified by Board of Intermediate Education) or a Diploma in Engineering in the relevant branch conducted by the Board of Technical Education, Andhra Pradesh (or any equivalent examination certified by State Board of Technical Education) for admission.

ii) Secured a rank in the EAMCET examination conducted by AP State Council for Higher Education (APSCHE) for allotment of a seat by the Convener, EAMCET, for admission.

Admission Procedure:

As per the norms of A.P. State Council of Higher Education (APSCHE), Government of Andhra Pradesh, admissions are made to the first year of Four year B.Tech. Degree program as follows:-

a) As per the norms of Government of Andhra Pradesh, A-Category (based on the rank obtained in EAMCET) seats will be filled by the Convener, EAMCET.

b) As per the norms of Government of Andhra Pradesh, B-Category seats will be filled by the management.

Admission to the Second year of Four year B.Tech. Degree Program in Engineering:

i) Candidates qualified in ECET and admitted by the Convener, ECET, in such cases for admission, when needed permission from the statutory bodies is to be obtained.

ii) 10% of the sanctioned strength in each program of study (of RGMCET) shall be filled by the Convener, ECET as lateral entry.

List of Programs offered

1. B.Tech – Regular & Lateral Entry
2. M.Tech – Regular
3. MBA – Regular
4. MCA – Regular

Academic Regulations for 2019 B. Tech. (Regular)

(Effective for the students admitted into the I year from the Academic Year 2019-2020)

The B.Tech. Degree be conferred by the Jawaharlal Nehru Technological University Anantapur, Anantapuramu, students who are admitted to the program and fulfill all the requirements for the award of the Degree as specified below:

1.0 Award of B.Tech. Degree

1.1 The student will be declared eligible for the award of the B. Tech. degree if he fulfils the following academic regulations:

1.2 Pursued a course of study for not less than prescribed course work duration and not more than double the prescribed course work duration.

1.3 Registered for 160 credits and secured 160 credits with compulsory subjects as listed in Table-1.

Table 1: Compulsory Subjects

S.No	SUBJECT PARTICULARS
1	All the subjects offered in B.Tech course / MOOCs
2	Mandatory Learning Courses [Environmental Science, Induction Program, Indian Constitution, Essence of Indian Traditional Knowledge]
3	All practical subjects
4	All Skill Development Courses/ value added courses
5	Mini projects
6	Comprehensive Viva-Voce
7	Seminar
8	Internship
9	Extra Academic Activities-EAA
10	Life Science
11	Project work Phase-I
12	Project Work Phase-II

2.0 Forfeit of seat

Students, who fail to fulfill all the academic requirements for the award of the degree within **eight academic years** from the year of their admission, shall forfeit their seat in B.Tech, course.

3.0 Courses of study

The following courses of study are offered at present as specializations for the B.Tech. Course: and any other course as approved by the authorities of the University from time to time.

1. **Civil Engineering**
2. **Computer Science and Engineering**
3. **Electrical and Electronics Engineering**
4. **Electronics and Communication Engineering**
5. **Mechanical Engineering**

Table 2: Credits

Subject	Semester			
	Periods/ Week	Credits	Internal Marks (IM)	External Marks (EM)
Theory	2+1*	03	30	70
English Theory	2+1*	02	30	70
Life Science	02	02	30	70
Mandatory Learning Courses	03	00	00	00
Mini project/ Practical	03	1.5	25	50
Drawing	03	03	30	70
Skill Development Courses/Value Added Course	1+2*	0.5**	30	70
Comprehensive Viva (CV)	--	0.5	00	50
Extra Academic Activities	02	00	00	00
Seminar		0.5	50	00
Internship		1.0	00	Certificate from Internship Agency
Project Phase-I		1.0	25	00
Project Phase-II	--	08	25	100

* Tutorial

** [Skill Development / value Added Courses credits will not be considered for the award of division.

However, all these courses have to be cleared through internal evaluation by scoring minimum of 40% marks. The credits obtained in Skill development courses will be taken in to account for the award of degree.]

Note:- Mandatory Learning Courses /EAA will not carry any credits but attendance requirements of 75% should be fulfilled otherwise they have to reregister to fulfill academic requirements.

4.0 Distribution and Weightage of Marks

4.1 The performance of the student in each semester shall be evaluated subject –wise with a maximum of 100 marks for theory and 75 marks for practical subject. In addition, mini-project, Comprehensive Viva-Voce (CV) shall be evaluated for 50 marks each and the project work shall be evaluated for 150 marks.

4.2 For theory subjects, the distribution shall be 30 marks for Internal Evaluation (20 marks for internal test and 10 marks for assignment or field work/group task/Online test) and 70 marks for the End-Examination.

4.3 During the semester there shall be 2 tests for theory subjects. In each Internal test there shall be one compulsory (short answers) question and 3 descriptive questions are to be answered. The duration of internal test will be for 2hours. First test to be conducted in 3 units and second test to be conducted in the remaining 3 units of each subject. For awarding of 20 Internal marks the performance of the student in two

Internal examinations conducted one in the middle of the semester and the other towards the end of the semester giving a weight age of 0.75 for the better score and 0.25 for the other score will be considered. There shall be two assignments in each subject (problem based/ field work/group task/Online test) for award of 10 marks so that internal component (marks) will be 30 marks (20 marks for internal test+10 marks for assignments / field work/group task).

Table 3: Units for Internal Tests

Semester	
3 Units	First Internal test
3 Units	Second Internal test

4.4 In the case of Skill Development Courses, two Internal examinations shall be conducted one in the middle of the semester and the other at the end of the semester for 30 marks and the marks scored by the student in these exams with a weight age of 0.75 for better score and 0.25 for the other score will be awarded as Internal marks for 30. For the remaining 70 marks an end examination will be conducted along with other theory examinations. However skill development courses/Value added courses, end examination will be evaluated internally.

4.5 No makeup test for internal examination or assignments/group tasks will be conducted in any subject or practical. The student, who is absent for any test shall be deemed to have scored zero marks in that subject.

4.6 Open and Professional Electives will commence from 3rd year Second semester onwards. The open elective offered in 3-2 semester will be based on self-study/MOOCs. All the students have to opt for the MOOCs (Self Study) and should acquire the required credits. If the student fails to opt for MOOCs, (Under unavoidable circumstances) he/she has to write two internal tests besides the end examination conducted by the institute (Elective offered in place of MOOCs by the Dept.) like other subjects. However, he/she has to obtain the certificate from the organization in which he has registered. Any MOOCs course selected by the student should be of more than 45 hours duration /12 weeks course with minimum of 3 credits and also from the reputed organization. Attendance of the student who has opted for MOOCs will be taken from the remaining subjects and labs only in that semester while finalizing the attendance for fulfilling the minimum requirements of attendance for promotion to the next semester. Attendance will not be recorded for MOOCs.

{Massive open online Courses (MOOCs') B.Tech students can avail the facility of earning up to a maximum of 5% credits of their degree requirements through MOOCs. MOOC courses eligible for this purpose are the courses offered by NPTEL/ SWAYAM/EDX/Course by any other reputed organisation approved by the department only. The student shall obtain prior approval of the Head of the Department before registering for MOOC's. MOOC courses can be taken in lieu of Elective courses such as Open Electives & Professional Electives (pertaining to their branch only) and Employability Enhancement Courses. No Core, Lab or Project Course can be dropped in lieu of MOOC. The student shall submit course Title, institute which offered MOOC, Examination system and Credits of the Course, duration of course - After deciding on the MOOC and a course which is approved as its equivalent in the curriculum a student can enrol for it and clear it any time as per his/her convenience and obtain the assessment certificate.

If the assessment certificate is submitted

(i) Before the commencement of the semester in which the equivalent course is offered, the student will be exempted from attending the regular class work and internal assessment exams of the equivalent subject.

(ii) During the semester the student is permitted to withdraw from the remaining part of the course work and internal assessment tests.

(iii) After the semester is over but before the results of that semester are declared the student can request for considering his performance in the MOOC in lieu of its equivalent.

The student shall submit to the HOD the original certificate issued by MOOC authorities along with a photocopy of the same. The original will be returned after verification and verification shall be certified by the Head of the Department on the photocopy which shall be kept in records. An equivalent Grade corresponding to grade/marks awarded by MOOC agency shall be determined by a committee consisting of Principal, Controller of Examinations, Dean Student affairs and HoD concerned. This equivalent Grade shall be shown in the grade sheet and accounted in the SGPA and CGPA calculations.

4.7 Gap Year – Concept of student Entrepreneur in Residence shall be introduced and the outstanding students who wish to pursue entrepreneurship are allowed to take a break of one year at any time after I/II/III year to pursue full time entrepreneurship. This period may be extended for another one year (two years in total) and this period would not be counted for the maximum duration for completion of graduation. An evaluation committee shall be constituted to evaluate the proposal submitted by the student and committee shall decide on permitting the student for having the Gap Year. The committee consists of Principal as Chairman and all HODs as members.

4.8 In the open electives offered from III year II Sem onwards Student has to select the subjects among the list of open elective subjects by the other departments (inter - department). Student has to clear the subject as per norms to get the required credits. At least minimum of 40 students should register for any open elective; otherwise that open elective will not be offered.

4.9 Out of the professional electives offered from III Year II Semester onwards again one Professional elective in IV Year I Sem will be a MOOCs (Self Study) and the student has to acquire the required credits to clear the subject as specified in 4.6.

4.10 The institute would like to offer **Honours** and **Minor** as optional feature of the B. Tech program aimed at providing additional learning opportunities for academically motivated and bright students. In order to earn Honours or Minor, student has to earn a minimum of 20 extra credits. For this in addition to the regular subjects, a student has to pursue (Self-study/MOOCs) five additional subjects from 3-1 semester onwards and acquire the required credits. The Minor is indicated by separate CGPA and is reflected in the degree certificate as for example, B.Tech in ECE with Minor in Artificial Intelligence. Each department shall offer at least one Minor and also Honours. The student has to select the subjects which are not studied in their regular course and student should have cleared all the subjects up to and including 2-1 semester with above 8.5 CGPA (for SC/ST students 8.0 CGPA) to become eligible for registration for Honours/Minor. GPA and CGPA of 8.0 has to be maintained in the subsequent semesters without any backlog subjects in order to keep the Minor/Honours discipline registration active else Minor/Honours registration will be cancelled. The breakup of the credits are 5 subjects which carry 15 credits @3 credits per subject and project work carries 5 credits. The evaluation pattern of subjects and project work will be similar to methods followed in regular course evaluation. No

attendance minimum will be considered for Honours/Minor. Not more than two subjects are allowed for registration in any semester for Honours/ Minor. The student is eligible to receive B.Tech with Honours if he acquires the required additional credits in the same discipline in which he is pursuing his B.Tech degree. If the students acquire the additional credits from other disciplines then he is eligible to receive B.Tech along with Minor degree in the specified area. Minimum strength for offering Minor/Honours in a discipline is considered as One-Fifth (20% of the class) of the class size and Maximum size would size would be Four-Fifth of Class size (i.e 80% of the class).

4.11 Extra - Academic Activity (EAA)

Each of the following activities carries 0 credits and every student is required to register for **two** activities during second year of study (one in each semester) which is mandatory.

a) ***NSS/NCC***
b) ***Games and Sports***
c) ***Yoga/Meditation***
d) ***Extension Activities***
e) ***Literary/ Cultural Activities***

Any other which may be offered in future.

The activities shall be carried out in the allotted hours. The activities will be monitored by the respective faculty in charge, senior faculty member of the department and the Department HOD. Grades will be awarded on the basis of participation, attendance, performance and behavior. Grades shall be entered in the marks statement as GOOD, SATISFACTORY and UNSATISFACTORY and shall not be counted towards CGPA calculation. If any student gets an Unsatisfactory Grade, he/she has to repeat the activity in the immediate subsequent year.

4.12 The student has an option of going for internship in IV year, II Sem in a reputed organization (The finalization of the internship organization will be as per college guidelines (HOD, two Senior faculty members of the department and same will be recommended to the Principal for approval). In case any student opted for internship he need not attend the classes however he has to write internal and external examination of subjects when ever conducted in that semester and acquire the required credits. The project work in the final semester may be carried out during the internship and same may be submitted for evaluation. Student has to acquire 01 credit by going for internship (minimum of Two weeks) / carrying out internal project work/ study project report on any industry/ attending workshop in reputed institutions for two weeks. Certificate from the organization has to be submitted to this effect attested by Head of the Department and internship incharge to the academic section before the commencement of 3-2 semester. Student is expected to carry out the activities mentioned here during the summer break before the commencement of 3-1 semester.

4.13 The medium of instruction for all Course work, Examination, Seminar Presentations, Project Reports and all academic activities shall be English.

5.0 Question Paper Pattern

5.1 Each Internal Test question paper shall contain 5 questions, of which the First question is compulsory and three questions are to be answered from the remaining four. Compulsory question carries 5 marks (It contains 5 questions of one marks - no choice in first question). The remaining 3 questions carry 5 marks each. Each question shall have a,b,c.... parts.

5.2 The End Examination question paper will have 7 questions and students have to answer5 questions. However, the first question is compulsory and it consists of 7 short answer questions, each carrying 2 marks. The next 4 questions are to be answered from the remaining 6 questions and each carries 14 marks. Each 14 marks question shall have a, b, c .. parts. Evaluation of answer scripts shall be done by either Internal or External examiners appointed by the Principal. A minimum of 50% of subjects will be evaluated by external examiners.

5.3 For practical subjects, there shall be a continuous evaluation during the semester for 25 internal marks and End Examination carries 50 marks. Of the 25 marks for Internal, 15 marks shall be awarded for day-to-day work, 5 marks to be awarded by conducting an internal laboratory test and 05 marks will be allotted for any creativity/ innovation/ additional learning in lab beyond prescribed set of experiments etc. The End Examination shall be conducted by the teacher concerned and an external Examiner from other institutions.

5.4 For the subject having design and/or drawing, (such as Engineering Graphics, Machine Drawing etc.) and estimation, the distribution shall be 30 marks for Internal evaluation (15marks for day-to-day work and 5 marks for Internal tests and 10 marks for assignments) and 70 marks for End Examination. There shall be two internal tests in a Semester and the better of the two shall be considered for the award of marks for internal tests.

5.5 The Engineering drawing, wherever offered is to be treated as a theory subject. Evaluation method adopted for theory subjects shall be followed here as well.

5.6 There shall be two Mini-Projects, in collaboration with an industry/EPICS (Engineering Projects In Community Services) (wherever is possible) of their specialization, to be taken up during the vacation (data collection, components etc.) after II year II Semester and III Year II Semester examination and implementation/ simulation shall be carried out in III year I Semester and IV Year I Semester during lab classes. Implementation or fabrication/simulation of mini projects will be treated as laboratory. However, the mini project and its report shall be evaluated in III year I Semester and IV Year I Semester. The mini project shall be submitted in the report form and should be presented before the committee, which shall be evaluated for 50 marks. The committee consists of an external Examiner, Head of the Department and the supervisor of mini project. There shall be 25 internal marks for mini project which will be awarded based on the performance and involvement of the student during mini project period.

5.7 There shall be comprehensive Viva-Voce examination at the end of each semester. CV Examination shall be conducted by the committee consisting of Senior faculty (based on the recommendation of HOD), an external Examiner from other institutions and HOD and evaluated for 50 marks.

5.8 The project topic should be approved by Internal Department Committee (IDC). Out of total 150 marks for the project work, 50 marks shall be for Internal Evaluation (25 marks for Phase-I and 25 marks for Phase-II) and 100 marks for the End Semester Examination. The evaluation of project work phase-I shall be conducted at the end of the IV year I semester and Phase-II shall be conducted at the end of the IV year II semester. The project viva voce examination will be conducted by the committee consisting of an external Examiner from other institute, Head of the Department and the supervisor of the project. The Internal evaluation for 50 marks shall be on the basis of two seminars (25 marks for Phase-I and 25 marks for Phase-II) given by each student on the topic of the project. The Internal evaluation of the project work for 50

marks shall be conducted by the committee consisting of head of the Department or his nominee, senior faculty member and the supervisor of project.

5.9 For all practical/mini project/main project/CV etc. the HOD of the concerned dept. shall submit a panel of 4 external examiners from different institutes and one will be selected by the Chief Superintendent of the Examination for conducting of end examination.

5.10 **Revaluation of End Examination Scripts**: Revaluation of End Examination scripts is allowed for theory subjects only by paying requisite fee. Procedure for Revaluation: The script will be revaluated by an examiner appointed by the Principal. The maximum of revaluation and regular end examination grade will be awarded for that subject. Student can apply for revaluation in a subject only once.

Table4: Distribution of weightages for examination and evaluation

Sl. No.	Nature of subject	Marks	Type of examination and mode of assessment		Scheme of Examination
1	Theory	70	End Examination. Both internal and external Evaluation (at least a minimum of 50% subjects will be sent for external evaluation)		End Examination in theory subjects will be for 70 marks.
		30	20	Internal Examinations (Internal evaluation)	These 20 marks are awarded to the students based on the performance in two (per semester) Internal examinations with a weightage of 0.75 for better score and 0.25 for the other score.
			10	Assignments/Field work/Group task/Online Test (Objective Type) (Internal evaluation)	Average of two assignments /Field work/group task in a semester each evaluated for 10 marks.
2	Practical	50	End lab examination (External evaluation)		This End Examination in practical subjects will be for a maximum of 50 marks.
		25	15	Internal evaluation	Day-to-day performance in lab experiments and record.
			05	Internal evaluation	Internal lab examination at the end of year/semester
			05	Internal	05 marks will be allotted for

				evaluation	any creativity/ innovation/ additional learning in lab beyond prescribed set of experiments etc.
3	Mini Project	50	End Examination (External evaluation)		This End Examination in mini project will be for a maximum of 50 marks.
		25	Internal evaluation		Day-to-day performance in executing mini project.
4	Comprehensive Viva-Voce(CV)	50	External evaluation		This end viva voce examinations in all the subjects for 50 marks.
5	Project work	100	External evaluation		This end viva voce in project work for 100 marks
		50	Internal evaluation 25 marks for Phase-I 25 Marks for Phase-II		These 50 marks will be based on the performance of the student in the project reviews apart from attendance and regularity(25 marks for Phase-I and 25 marks for Phase-II)
6	Skill Development Courses/ Value Added Course/ Mock interviews and Group Discussion	30	Internal evaluation		These 30 marks are awarded to the students based on the performance of two Internal examinations with a weight age of 0.75 for better score and 0.25 for the other score.
		70	Internal Evaluation		Based on the performance in the end examination.
7	Internship/Internal Project/Study Report/Work shop	00	-		Certificate form Internship Agency
8	Life Science	70	External Evaluation		End Examination in theory subjects will be for 70 marks.
		30	20	Internal Examinations (Internal evaluation)	These 20 marks are awarded to the students based on the performance in two (per semester) Internal examinations with a weightage of 0.75 for better score and 0.25 for the other score.
			10	Assignments/Field	Average of two assignments

				work/Group task/Online Test (Objective Type) (Internal evaluation)	/Field work/group task in a semester each evaluated for 10 marks.
9	EAA	00	Internal evaluation		Based on performance and committee report.
10	Mandatory Learning Courses	00	Internal evaluation		No examinations. Attendance minimum is required

6.0 Attendance Requirements:

6.1 The student shall be eligible to appear for End examinations of the semester if he acquires a minimum of 75% of attendance in aggregate of all the subjects of that semester.

6.2 Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in a semester may be granted by the College Academic Committee.

6.3 The student will not be promoted to the next semester unless he satisfies the attendance requirement of the present semester. They may seek re-admission for that semester when offered next.

6.4 **Shortage of Attendance below 65% in aggregate shall in NO case be condoned.**

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

6.6 The stipulated fee shall be payable towards condonation of shortage of attendance.

7.0 Minimum Academic Requirements:

The following academic requirements have to be satisfied in addition to the attendance requirements mentioned in item No.6.0.

7.1 The student shall be deemed to have satisfied the minimum academic requirements and earned the credits allotted to each theory or practical or design or CV or drawing subject or Skill Development Coursesor project if he secures not less than 35% of marks in the End Examination and he has to score minimum of 40% marks from internal and external exam marks put together to clear the subject.

7.2 The student shall be promoted from II to III year only if he fulfils the academic requirement of securing a minimum of 40.5 credits out of 81 credits from all the exams conducted up to and including II year II semester regular examinations irrespective of whether the candidate takes the examination or not.

7.3 The student shall be promoted from third year to fourth year only if he fulfils the academic requirements of securing minimum of 61.5 credits out of 123 credits from all the exams conducted up to and including III year II semester regular examinations, whether the candidate takes the examinations or not.

Table 5: Promotion rules

Promotion from	Total credits to register	Minimum credits to obtain for promotion
II yr to III yr	81	40.5
III yr to IV yr	123	61.5

7.4 The student shall register and put up minimum attendance in all 160 credits and earn 160 credits. Grades obtained in 157 credits (excluding the credits obtained in Skill

Development Courses/Value added courses) shall be considered for the calculation of CGPA.

7.5 Students who fail to earn 160 credits as indicated in the course structure in Table-1 within eight academic years from the year of their admission shall forfeit their seat in B.Tech. Course and their admission shall stand cancelled.

8.0 Course pattern:

8.1 The entire course of study is of four academic years. Each academic year consists of two semesters

8.2 The student is eligible to appear for the End Examination in a subject, but absent at it or has failed in the End Examination may appear for that subject at the supplementary examination.

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Table: 6: Course pattern

Year	Semester	No. of Subjects		No. of Skill Development Courses	Number of Labs		Total credits	
First Year	First	CE/ME/CSE 05 {CE-I-HSMC LAC-BSC MEC/AC-BSC PEE/EM/BEM-ESC PPS-I-ESC	ECE/EEE 05 {CE-I-HSMC LAC-BSC AP-BSC ED-ESC PPS-I-ESC}	00	CE/ME/CSE EC lab-BSC PPS-I Lab-ESC DEL Lab-HSMC CV-I	ECE/ EEE EP Lab-BSC PPS-I Lab-ESC EW&ITW-LC CV-I	4X3=12 1x2=02 3X1.5=4.5 1x0.5=0.5	19
	Second	05 {CE-II-HSMC OPDEVC-BSC AP/EP-BSC ED-ESC PPS-II-ESC}	05 {CE-II-HSMC OPDEVC-BSC MEC-BSC NA/BEE-ESC PPS-II-ESC}	00	EP lab-BSC PPS-II Lab-ESC EW&ITW-LC CV-II	EC lab-BSC PPS-II Lab-ESC DEL Lab-HSMC CV-II	4X3=12 1x2=02 3X1.5=4.5 1x0.5=0.5	19
Second Year	First	BSC Life Science Four Subjects	BSC Life Science Four Subjects	01	Subjects Life Science Labs CV (Comprehensive Viva)-III SDC/VAC EAA		5X3=15 1x2=2.0 3x1.5=4.5 1X0.5=0.5 1x0.5=0.5 No Credits	22.5
	Second	MC-I/MC-2/MC-3 Five Subjects SDC/VAC	MC-I/MC-2/MC-3 Five Subjects SDC/VAC	01	Subjects Labs CV (Comprehensive Viva)-IV SDC/VAC Mandatory Course-1/2/3 (ECE/CSE&EEE/CE&ME) (Indian Heritage, Culture Tradition) Mandatory Course-3 (Constitution of India) EAA		5X3=15 3X1.5=4.5 1X0.5=0.5 1x0.5=0.5 No Credits No Credits	20.5
Third Year	First	Five Subjects SDC/VAC MC-I/MC-2/MC-3	Five Subjects SDC/VAC MC-I/MC-2/MC-3	01	Subjects(05S) Labs SDC/VAC CV (Comprehensive Viva)-V Mandatory Course-1/2/3 (ECE/CSE&EEE/CE&ME) (Indian Heritage, Culture Tradition)		5X3=15 3X1.5=4.5 1x0.5=0.5 1X0.5=0.5 No Credits	20.5
	Second	03S + OEC1(MOOCs) + PEC1 MC-I/MC-2/MC-3	03S + OEC1(MOOCs) + PEC1 MC-I/MC-2/MC-3	01	Subjects(03S, OEC1, PEC1) Labs Mini Project-1(EPICS) SDC/VAC CV (Comprehensive Viva)-VI Internship Mandatory Course-1/2/3 (ECE/CSE&EEE/CE&ME) (Indian Heritage, Culture Tradition) Mandatory Course-3 (Constitution of India)		5X3=15 2x1.5=3.0 1x1.5=1.5 1X.5=0.5 1X0.5=0.5 1x1.0=1.0 No Credits	21.5
Fourth Year	First	1S+PEC2+PEC3/(MOOCs)+PEC4+OEC2		01	Subjects (01S, PEC2, PEC3, PEC4, OEC2) Labs SDC/VAC CV (Comprehensive Viva)-VII Project Phase 1 Mini project-2 (EPICS)		5X3=15 2X1.5=03 1X0.5=0.5 1X0.5=0.5 1x1.0=1.0 1X1.5=1.5	21.5
	Second	PEC5 + OEC3		01	Subjects (PEC5, OEC3) SDC/VAC CV (Comprehensive Viva)-VIII Seminar Project Phase-2/Internship		2X3=06 1X0.5=0.5 1X0.5=0.5 1x.5=0.5 1X8=08	15.5
							GRAND TOTAL	**160**
MC-1 (Environmental Studies), MC-2 (Indian Heritage, Culture Tradition), MC-3 (Constitution of India)								

9.0 Transitory Regulations:

Candidates who have been detained for want of attendance or not fulfilled academic requirements or who have failed after having undergone this course in earlier regulations or have discontinued and wish to continue the course are eligible for admission into the unfinished semester from the date of commencement of class work with the same or equivalent subjects as and when subjects are offered subject to section 2.0 and they continue to be in the academic regulations in which they were readmitted.

10.0 With-holding of results:

If the candidate has any dues not paid to the Institute or if any case of indiscipline of malpractice is pending against him, the result of the candidate shall be withheld and he will not be allowed / promoted into the next higher semester. The issue of degree is liable to be withheld in such cases.

11.0 Award of Class:

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

Table 7: Award of Division

Class Awarded	% of marks to be secured	Division/ Class	CGPA	CGPA secured from 157 Credits (Excluding the credits obtained in Skill Development Courses)
First Class with Distinction	70% and above	First class With Distinction	≥ 7.5	
First Class	Below 70% but not less than 60%	First Class	≥ 6.5 and < 7.5	
Second Class	Below 60% but not less than 50%	Second Class	≥ 5.5 and < 6.5	
Pass Class	Below 50% but not less than 40%	Pass	≥ 4 and < 5.5	

12.0 Grading:

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

Table 8: Conversion into Grades and Grade points assigned

Range in which the % of marks in the subject fall	Grade	Grade point Assigned	Performance
90 to 100	O	10	Out standing
80 to 89.9	A^+	09	Excellent
70 to 79.9	A	08	Very Good
60 to 69.9	B^+	07	Good
50 to 59.9	B	06	Above Average
45 to 49.9	C	05	Average
40 to 44.9	P	04	Pass
<40	F	00	Fail
Ab	AB	00	Fail

12.1 Requirement for clearing any subject: The students have to obtain a minimum of 35% in End Examination and they have to score minimum of 40% marks from

Internal and external exam marks put together to clear the subject. Otherwise they will be awarded fail grade.

12.2 F is considered as a fail grade indicating that the student has to reappear for the end supplementary examination in that subject and obtain a non-fail grade for clearing that subject.

12.3 In case of skill development/ value added course / soft skill subjects, as there is no end exam, all 100 marks are for internal assessment only. Student has to score 40% in these courses to complete the subject which will be evaluated internally. Marks obtained in these courses shall not be considered for award of Division.

12.4 To become eligible for the award of degree the student must obtain a minimum CGPA of 4.0

13.0 Supplementary Examinations:

Apart from the regular End Examinations, the institute may also schedule and conduct supplementary examinations for all subjects for the benefit of students with backlogs. Such students writing supplementary examinations as supplementary candidates may have to write more than one examination per day. For eighth semester, special (Advance) supplementary examinations will be conducted in second week following the results publication date of regular examination of eighth semester only.

14.0 Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA)

The Grade Point Average (GPA) for each semester and Cumulative Grade Point Average (CGPA) up to any semester is calculated as follows:

i) Semester Grade Point Average will be computed as follows:

$$GPA = \frac{\sum_1^n C_j \times GP_j}{\sum_1^n C_j}$$

Where, n is the number of subjects in that semester. C_j is Credits for the subjects. GP_j is the grade point obtained for the subject and the summation is over all the subjects in that semester.

ii) A Cumulative Grade Point Average (CGPA) will be computed for every student at the end of each semester. The CGPA would give the cumulative performance of the student from the first semester up to the end of the semester to which it refers to and is calculated as follows:

$$CGPA = \frac{\sum_1^m GPA_j \times TC_j}{\sum_1^m TC_j}$$

Where 'm' is the number of semester under consideration. TC_j the total number of credits for a j^{th} semester and GPA_j is the Grade Point Average of the j^{th} semester. Both GPA and CGPA will be rounded off to the second digit after decimal and recorded as such.

While computing the GPA / CGPA, the subjects in which the student is awarded zero grade points will also be included.

For any academic/employment purpose the following formulae shall be used for conversion of CGPA to % of marks. % of marks = (CGPA –0.5) x 10.

15.0 Grade Sheet:

A grade sheet (Memorandum) will be issued to each student indicating his performance in all subjects of that semester in the form of grades and also indicating the GPA and CGPA.

16.0 Award of Degree

After having admitted into the program, B.Tech degree shall be conferred on a student who has satisfied the following conditions.

(i) The student joining with Intermediate qualification must have, after admission into the Regular B.Tech programme of the college, pursued a regular course of study for not less than four academic years and not more than eight academic years.
(ii) The student joining under lateral entry scheme with diploma qualification must have, after admission into III Semester B.Tech, pursued a regular course of study for not less than three academic years and not more than six academic years.
(iii) The student must have satisfied the minimum academic requirements in appropriate branch of engineering in each semester of the program, herein after prescribed.
(iv) Students must register for all the courses and earn the credits specified
(v) Students who fail to fulfil all the academic requirements for the award of degree within the specified period from the year of their admission shall forfeit their seat in B.Tech course and their admission stands cancelled.
(vi) The student shall successfully complete non-credit courses like EAA/MC/Internship.
(vii) The student has no dues to the institution, library, hostels etc.
(viii) The student has no disciplinary action pending against him/her.

The Degree will be conferred and awarded by Jawaharlal Nehru Technological University Anantapur, Ananthapuramu on recommendations by the Academic council of RGMCET (Autonomous) basing on the eligibility as in clause 6.0 and 7.0.

17.0 Transcripts:

After successful completion of prerequisite credits for the award of degree, a Transcript containing performance of all academic years will be issued as a final record. Duplicate transcripts will also be issued if required after the payment of requisite fee and also as per norms in vogue.

18.0 Rules of Discipline:

18.1 Any attempt by any student to influence the teachers, Examiners, faculty and staff of Examination section for undue favours in the exams, and bribing them either for marks or attendance will be treated as malpractice cases and the student can be debarred from the college.
18.2 When the student absents himself, he is treated as to have appeared and obtained zero marks in that subject(s) and grading is done accordingly.
18.3 When the performance of the student in any subject(s) is cancelled as a punishment for indiscipline, he is awarded zero marks in that subject(s).
18.4 When the student's answer book is confiscated for any kind of attempted or suspected malpractice, the decision of the Chief Superintendent is final.

19.0 Minimum Instruction Days:

The minimum instruction days for each semester shall be 95 clear instruction days excluding the days allotted for tests/examinations and preparation holidays declared if any.

20.0 Amendment of Regulations:

The college may, from time to time, revise, amend or change the regulations, scheme of examinations and syllabi. However the academic regulations of any student will be same throughout the course of study in which the student has been admitted. However students will continue to be in the academic regulations in which they were readmitted.

21.0 Transfers

There shall be no branch transfers after the completion of admission process.

22.0 General:

22.1 The Academic Regulations should be read as a whole for the purpose of any interpretation.

22.2 In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Academic Council is final.

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

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

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

(Effective for the students getting admitted into II year from the Academic Year 2020-2021 onwards)

1.0 The Students have to acquire a minimum of 122 credits out of 122 from II to IV year of B.Tech. Program (Regular) for the award of the degree.

2.0 Students, who fail to fulfil the requirement for the award of the degree in 6 consecutive academic years from the year of admission, shall forfeit their seat.

3.0 The same attendance regulations are to be adopted as that of B. Tech. (Regular).

4.0 Promotion Rule:

The student shall be promoted from third year to fourth year only if he fulfils the academic requirements of securing minimum of 42.5 credits out of 85 credits from all the exams conducted up to and including III year II semester regular examinations, whether the candidate takes the examinations or not.

5.0 Award of Class:

After the student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of B. Tech. Degree he shall be placed in one of the following four classes: The marks obtained in the best 119 credits will be considered for the calculation of percentage and award of class.

Table 1: Award of Division

Class Awarded	% of marks to be secured	Division/ Class	CGPA	
First Class with Distinction	70% and above	First class With Distinction	≥ 7.5	CGPA secured from 119 Credits (Excluding the credits obtained in Skill Development Courses)
First Class	Below 70% but not less than 60%	First Class	$6.5 and < 7.5$	
Second Class	Below 60% but not less than 50%	Second Class	$\geq 5.5 \; and \; < 6.5$	
Pass Class	Below 50% but not less than 40%	Pass	$\geq 4 \; and \; < 5.5$	

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

R G M COLLEGE OF ENGINEERING AND TECHNOLOGY
AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

I B.TECH, I-SEMESTER COURSE STRUCTURE

Subject Code	Name of the Subject	Hours/Week			Credits	Marks		
		Lecture/ Theory	Tutorial	Laboratory /Practical		Internal	External	Total
THEORY								
A0001191	Communicative English - I	1	1	-	2	30	70	100
A0002191	Linear Algebra and Calculus	2	1	-	3	30	70	100
A0003191	Applied Chemistry	2	1	-	3	30	70	100
A0302191	Basic Engineering Mechanics	2	1	-	3	30	70	100
A0501191	Programming for Problem Solving - I	2	1	-	3	30	70	100
PRACTICALS								
A0091191	Engineering Chemistry Lab	-	-	3	1.5	25	50	75
A0591191	Programming for Problem Solving – I Lab	-	-	3	1.5	25	50	75
A0092191	Digital English Language Lab	-	-	3	1.5	25	50	75
A0093191	Comprehensive Viva - I	-	-	-	0.5	-	50	50
	Contact Periods / Week	9	5	9	19	225	550	775

I B.TECH, II-SEMESTER COURSE STRUCTURE

Subject Code	Name of the Subject	Hours/Week			Credits	Marks		
		Lecture/ Theory	Tutorial	Laboratory/ Practical		Internal	External	Total
THEORY								
A0006192	Communicative English - II	1	1	-	2	30	70	100
A0007192	Ordinary, Partial Differential Equations and Vector Calculus	2	1	-	3	30	70	100
A0008192	Engineering Physics	2	1	-	3	30	70	100
A0301191	Engineering Drawing	2	1	-	3	30	70	100
A0502192	Programming for Problem Solving - II	2	1	-	3	30	70	100
PRACTICALS								
A0094191	Engineering Physics Lab	-	-	3	1.5	25	50	75
A0593192	Programming for Problem Solving – II Lab	-	-	3	1.5	25	50	75
A0592191	Engineering Workshop and IT Workshop	-	-	3	1.5	25	50	75
A0095192	Comprehensive Viva - II	-	-	-	0.5	-	50	50
	Contact Periods / Week	9	5	9	19	225	550	775

R G M COLLEGE OF ENGINEERING AND TECHNOLOGY
AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

II B.TECH, I-SEMESTER COURSE STRUCTURE

Subject Code	Name of the Subject	Hours/Week			Credits	Marks		
		Theory	Tutorial	Lab		Internal	External	Total
THEORY								
A0009193	Numerical Methods and Probability Theory	2	1	0	3	30	70	100
A0503193	Python Programming	2	1	0	3	30	70	100
A0303193	Mechanics of Solids	2	1	0	3	30	70	100
A0304193	Material Science and Metallurgy	2	1	0	3	30	70	100
A0305193	Thermodynamics	2	1	0	3	30	70	100
LIFE SCIENCES								
A0010193	Biology for Engineers	2	0	0	2	30	70	100
SKILL DEVELOPMENT COURSE								
A0011193	Aptitude, Arithmetic, Reasoning and Comprehension	1	2	0	0.5	30	70	100
PRACTICALS								
A0594193	Python Programming Lab	0	0	3	1.5	25	50	75
A0392193	Engineering Mechanics and Mechanics of Solids Lab	0	0	3	1.5	25	50	75
A0393193	Material Science Lab	0	0	3	1.5	25	50	75
A0096193	Comprehensive Viva - III	0	0	-	0.5	0	50	50
		13	**7**	**9**	**22.5**	**285**	**690**	**975**

II B.TECH, II-SEMESTER COURSE STRUCTURE

Subject Code	Name of the Subject	Hours/Week			Credits	Marks		
		Theory	Tutorial	Lab		Internal	External	Total
THEORY								
A0204193	Basic Electrical and Electronics Engineering	2	1	0	3	30	70	100
A0306194	Manufacturing Technology	2	1	0	3	30	70	100
A0307194	Theory of Machines	2	1	0	3	30	70	100
A0302193	Fluid Mechanics and Hydraulic Machinery	2	1	0	3	30	70	100
A0308194	Applied Thermodynamics	2	1	0	3	30	70	100
SKILL DEVELOPMENT COURSE								
A0016194	Design Thinking for Innovations	1	2	0	0.5	30	70	100
MANDATORY LEARNING COURSE								
A0015194	Environmental Science	2	0	0	0	0	0	0
PRACTICALS								
A0394194	Manufacturing Technology Lab	0	0	3	1.5	25	50	75
A0391193	Fluid Mechanics and Hydraulic Machinery Lab	0	0	3	1.5	25	50	75
A0395194	Thermal Engineering Lab	0	0	3	1.5	25	50	75
A0097194	Comprehensive Viva - IV	0	0	0	0.5	0	50	50
	Contact Periods / Week	**13**	**7**	**9**	**20.5**	**255**	**620**	**875**

R G M COLLEGE OF ENGINEERING AND TECHNOLOGY

AUTONOMOUS

DEPARTMENT OF MECHANICAL ENGINEERING

III B.TECH, I-SEMESTER COURSE STRUCTURE

Subject Code	Name of the Subject	Hours/Week			Credits	Marks		
		Theory	Tutorial	Lab		Internal	External	Total
THEORY								
A0309195	Industrial Management and Accountancy	2	1	0	3	30	70	100
A0310195	Design of Machine Elements - I	2	1	0	3	30	70	100
A0311195	Metal Cutting and Machine Tools	2	1	0	3	30	70	100
A0312195	Engineering Metrology and Mechanical Measurements	2	1	0	3	30	70	100
A0313195	Heat Transfer	2	1	0	3	30	70	100
SKILL DEVELOPMENT COURSE								
A0314195	Computer Aided Machine Drawing	1	2	0	0.5	30	70	100
MANDATORY LEARNING COURSE								
A0017194	Indian Heritage and Culture	2	0	0	0	0	0	0
PRACTICALS								
A0396195	Dynamics and Instrumentation Lab	0	0	3	1.5	25	50	75
A0397195	Metrology and Machine Tools Lab	0	0	3	1.5	25	50	75
A0398195	Heat Transfer Lab	0	0	3	1.5	25	50	75
A0098195	Comprehensive Viva-V	0	0	0	0.5	00	50	50
	Contact Periods / Week	**13**	**7**	**9**	**20.5**	**255**	**620**	**875**

III B.TECH, II-SEMESTER COURSE STRUCTURE

Subject Code	Name of the Subject	**Hours/Week**			Credits	**Marks**		
		Theory	Tutorial	Lab		Internal	External	Total
THEORY								
A0315196	Industrial Safety Engineering	2	1	0	3	30	70	100
A0316196	Design of Machine Elements - II	2	1	0	3	30	70	100
A0512195	Core JAVA Programming	2	1	0	3	30	70	100
OPEN ELECTIVE-I/MOOCs								
A0317196	Power Plant Engineering	2	1	0	3	30	70	100
A0318196	Non-Destructive Testing and Evaluation							
A0319196	Tool Design							
PR0FESSIONAL ELECTIVE-I								
A0320196	Autotronics	2	1	0	3	30	70	100
A0321196	Mechanical Vibrations							
A0322196	Cryogenic Engineering							
SKILL DEVELOPMENT COURSE								
A0323196	Parametric Modelling -I	1	2	0	0.5	30	70	100
MANDATORY LEARNING COURSE								
A0018194	Constitution of India	2	0	0	0	0	0	0
PRACTICALS								
A0581195	Core JAVA Programming Lab	0	0	3	1.5	25	50	75
A0383196	Numerical Simulation Lab	0	0	3	1.5	25	50	75
A0082196	Mini Project –I (EPICS)	0	0	3	1.5	25	50	75
A0099196	Internship	0	0	0	1	0	0	0
A0081196	Comprehensive Viva-VI	0	0	0	0.5	0	50	50
	Contact Periods / Week	**13**	**7**	**9**	**21.5**	**255**	**620**	**875**

R G M COLLEGE OF ENGINEERING AND TECHNOLOGY
AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

IV B.TECH, I-SEMESTER COURSE STRUCTURE

Subject Code	Name of the Subject	Hours/Week			Credits	Marks		
		Theory	Tutorial	Lab		Internal	External	Total
THEORY								
A0324197	CAD / CAM	2	1	0	3	30	70	100
PROFESSIONAL ELECTIVE-II		2	1	0	3	30	70	100
A0331197	Finite Element Methods							
A0332197	Micro and Nano Manufacturing							
A0333197	Rapid Prototyping							
PROFESSIONAL ELECTIVE-III		2	1	0	3	30	70	100
A0328197	Refrigeration and Air Conditioning							
A0342198	Computational Fluid Dynamics							
A0343198	Advanced Welding Technology							
PROFESSIONAL ELECTIVE -IV/ MOOCs		2	1	0	3	30	70	100
A0334197	Production and Operations Management							
A0335197	Modern Manufacturing Methods							
A0336197	Internal Combustion Engines							
OPEN ELECTIVE-II		2	1	0	3	30	70	100
A0325197	Operations Research							
A0330197	Industrial Waste Management							
A0327197	Entrepreneurship							
SKILL DEVELOPMENT COURSE								
A0337197	Parametric Modeling-III [Solid Edge]	1	2	0	0.5	30	70	100
PRACTICALS								
A0384197	Computer Aided Machining Lab	0	0	3	1.5	25	50	75
A0385197	Parametric Modelling-II Lab [CATIA]	0	0	3	1.5	25	50	75
A0084197	Mini Project-II [EPICS]	0	0	3	1.5	25	50	75
A0085197	Comprehensive Viva-VII	0	0	0	0.5	0	50	50
A0083197	Project Phase-1	0	0	0	1	25	0	25
	Contact Periods / Week	**11**	**7**	**9**	**21.5**	**280**	**620**	**900**

R G M COLLEGE OF ENGINEERING AND TECHNOLOGY
AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

IV B.TECH, II-SEMESTER COURSE STRUCTURE

Subject Code	Name of the Subject	Hours/Week			Credits	Marks		
		Theory	Tutorial	Lab		Internal	External	Total
PROFESSIONAL ELECTIVE-V		2	1	-	3	30	70	100
A0338198	Industrial Automation and Robotics							
A0329197	Automobile Engineering							
A0340198	Mechanics of Composite Materials							
OPEN ELECTIVE-III		2	1	-	3	30	70	100
A0341198	Non-Conventional Energy Resources							
A0339198	Mechatronics							
A0345198	Industrial IoT							
SKILL DEVELOPMENT COURSE								
A0344198	Modelling and Analysis	1	2	-	0.5	30	70	100
A0088198	Comprehensive Viva-VIII	0	0	0	0.5	0	50	50
A0086198	Seminar	0	0	0	0.5	50	0	50
A0087198	Project Phase-II /Internship	0	0	0	8	25	100	125
Contact Periods / Week		**5**	**4**	**0**	**15.5**	**165**	**360**	**525**

R G M COLLEGE OF ENGINEERING AND TECHNOLOGY
AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

I B.Tech, I-Sem (ME) L T C
1 1 2

(A0001191) COMMUNICATIVE ENGLISH- I

(For Branches: CE, EEE, Mech, ECE & CSE)

COURSE OBJECTIVES:

- Communicative English-I is prescribed to make students communicate their thoughts, opinions and ideas freely and in real life situations. It has been framed with basics of English usage covering LSRW (Listening, Reading, Speaking and Writing Skills) with suitable practice versions. Further, this course is designed to update the learner in relevant English skills to face campus recruitments and other competitive exams.

COURSE OUTCOMES:

- Develop speaking, reading skills by prescribed lesson. Understand basic grammar principles.
- Write effective letters for job application and complaints, Enhance reading comprehension.
- Comprehend English speech sound system, stress and Intonation, Understand the usage of Vocabulary.
- Enhance reading comprehension, Vocabulary, Speaking, Grammar.
- Acquire knowledge in writing skills, learn Grammar usage and interpret the poem.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	2	3	-	-	-	-	1
CO2	-	-	-	-	-	2	3	-	-	-	-	1
CO3	-	-	-	-	-	3	2	-	-	-	-	1
CO4	-	-	-	-	-	3	2	-	-	-	-	1
CO5	-	-	-	-	-	2	3	-	-	-	-	1

UNIT-1

Speaking - Describing Home Towns - Hobbies - Reading - Essay - My Vision for India by APJ. Abdul Kalam, (http://www.studypage.in) Essay Writing Practice - Remedial Grammar - Practice - Standard Abbreviations & Acronyms

UNIT-2

Writing - Principles of Punctuation - Prewriting Techniques - Letter formats - Formal letter - Writing - Practice - Techniques of Spelling - Reading Comprehension Skills - Practice

UNIT-3

Listening & Speaking - Introduction to English Pronunciation - Minimal Pairs Practice - Words with complex pronunciation - Movie Analysis - Discussion - Grammar & Vocabulary - Concord - Idioms & Phrases - Practice

UNIT-4

Reading - Skimming and Scanning - What is a Drone: Main Features & Applications of Today's Drones by Jack Brown - Vocabulary - Computer Terminology - Phrasal Verbs - Speaking - Current Affairs - Discussions - Grammar & Usage - Articles & Prepositions - Practice.

UNIT-5

Writing: Structure of Paragraph Writing - Cause and Effect - Compare and Contrast -Practice - Techniques - Report writing - Official Reports - Business Reports - Practice -Grammar & Usage - Conditional sentences - IF Poem by Rudyard Kipling.

UNIT-6

Listening & Speaking - Indian English Variants - Difference between British and American English - Listening comprehensions - Test - Remedial Grammar - Correction of Sentences - Sentence Completions - Movie Analysis - Debate

REFERENCE TEXT BOOKS:

1) English Language & Communication Skills for Engineers (AICTE Syllabus**)** by Sanjay Kumar & Pushpa Latha, Oxford University Press, 2018
2) Practical English Usage by Michael Swan, Oxford University Press.
3) The Definitive Guide to IELTS Academic Writing, Oxford University Press, 2019.

R G M COLLEGE OF ENGINEERING AND TECHNOLOGY
AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

I B.Tech, I-Sem (ME)

L	T	C
2	1	3

(A0002191) LINEAR ALGEBRA & CALCULUS

(For Branches: CE, EEE, Mech, ECE & CSE)

COURSE OBJECTIVES:

- The essential tool of matrices and linear algebra in a comprehensive manner.
- The fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
- To deal with functions of several variables that are essential in most branches of engineering.
- Apart from some other applications they will have a basic understanding of Beta and Gamma functions.
- The mathematical tools needed in evaluating multiple integrals and their usage

COURSE OUTCOMES:

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

- Understand the use of matrices and linear system of equations in solving problems such as Network analysis, encoding and decoding in Cryptography and Quantum mechanics problems.
- Apply the concept of Gamma and Beta functions linear digital signal processing, discrete Fourier transform, digital filters and Oscillatory theory in engineering.
- Analyze differential and integral calculus to solve improper integrals and its applications in many engineering disciplines.
- Determine the process to evaluate double and triple integrals and understand its usage to find surface area and volumes of various bodies in engineering.
- Identify the applications of advanced calculus & Linear algebra in electro-magnetic theory and in telecommunication engineering.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	1	-	2	-	-	-	-	-	-	-	-
CO3	1	2	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	3	-	-	-	-	-	-	-	-
CO5	1	3	-	-	-	-	-	-	-	-	-	-

UNIT-1

Matrices: Elementary row transformations – Rank – Echelon form, Normal form – Solutions of Linear System of Homogenous and Non Homogeneous equations.

UNIT-2

Eigen Values, Eigen vectors – Properties; Cayley – Hamilton Theorem (without proof) – Inverse and Power of a matrix by Cayley – Hamilton theorem.

UNIT-3

Quadratic forms: Linear Transformation – Reduction of quadratic form to canonical form and their nature.

UNIT-4

Mean value theorems: Rolle's Theorem – Lagrange's Mean Value Theorem – (excluding proof). Taylor's and Maclaurin's Series for e^x, $\sin x$, $\cos x$ and $\log(1+x)$.

Functions of several variables – Jacobian – Maxima and Minima of functions of two variables - Lagrange's method of Multipliers with three variables only.

UNIT-5

Special functions: Gamma function – Properties – Beta function – properties – Relation between Gamma and Beta functions – Evaluation of Integrals using Gamma & Beta functions.

UNIT-6

Multiple integrals: – Evaluation of Double integrals (Cartesian and Polar) – Change of Variables – Change of order of Integration – Evaluation of triple integrals.

TEXT BOOKS/REFERENCES:

1) G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2) Erwin kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2011.
3) Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4) Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
5) T.K.V. Iyengar, B. Krishna Gandhi and Others, Mathematical Methods, S. Chand & Company.
6) T.K.V. Iyengar, B. Krishna Gandhi and Others, A Text Book of Engineering Mathematics, Vol – 1, S. Chand & Company.
7) S.R.K. Iyengar and R.K. Jain, Advanced Engineering Mathematics, Narosa publishing.

R G M COLLEGE OF ENGINEERING AND TECHNOLOGY
AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

I B.Tech, I-Sem (ME) L T C
2 1 3

(A0003191) APPLIED CHEMISTRY

(For branches CE & Mech)

COURSE OBJECTIVES:

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

COURSE OUTCOMES:

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

- Demonstrate the corrosion prevention methods and factors affecting corrosion (L2)
- Explain the preparation, properties, and applications of thermoplastics &thermo settings& elastomers (L2)
- Explain calorific values, octane and cetane number (L2)
- Explain the setting and hardening of cement (L2)
- Summarize the application of adsorption and nanomaterials (L2)

MAPPING WITH COs & POs:

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

UNIT-1

Water Technology: (12 hrs)

Introduction – Types of water, Soft and hard water, hardness of water, Estimation of hardness of water by EDTA Method and Numerical problems on hardness, Water Softening methods - zeolite and ion-exchange processes - desalination of brackish water - reverse osmosis (RO) - Boiler troubles **-** scale and sludge, Boiler Corrosion, Caustic Embrittlement, Priming and foaming – Analysis of water – Alkalinity, Dissolved oxygen by Winkler's method - specifications for drinking water, Bureau of Indian Standards(BIS) and World health organization(WHO) standards

Learning outcomes: The student will be able to

- List the differences between hardness and hard water (L1)
- List the differences between temporary and permanent hardness of water (L1)
- Explain the principles of reverse osmosis.(L1)
- Comparing the quality of drinking water with BIS and WHO standards. (L2)
- Illustrate the problems associated with hard water for production of steam(L2)
- Explain the working principles of different softening methods (L2)
- Understanding the problems due to presence of alkalinity and dissolved oxygen (L3)

UNIT-2

Electrochemistry and Applications: (10 hrs)

Types of Conductance – Conductance, Specific conductance, Equivalent Conductance and molar conductance. Determination of equivalent conductance by Wheatstone bridge method, concept of conductivity, conductivity cell, conductometric titrations (acid-base titrations), Numerical Problems on conductance. Nernst equation, cell potential calculations, Electrodes – concepts, reference electrodes (Standard hydrogen electrode and Calomel electrode) photovoltaic cell – working and applications.

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

- Apply Nernst equation for calculating electrode and cell potentials (L3)

- Applications of Conductometric titrations (L2)
- Solve problems based on conductance and cell potential (L3)
- Learning about the concept of electrodes (L2)

UNIT-3

Corrosion: (12 hrs)

Definition - Severity of the Problem

Types of Corrosion: Direct chemical attack type of corrosion, electrochemical type of corrosion and their mechanism, other types of corrosion: Galvanic, pitting, concentration cell type corrosion and water line corrosion. Factors affecting the rate of the corrosion, Proper design and material selection, Cathodic protection against corrosion, Use of inhibitors, Metallic Coatings, Hot dipping method (Galvanization, Tinning).

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

- Apply pilling Bed-worth rule for corrosion and corrosion prevention (L3)
- Understanding and analysing the severity problem of corrosion(L3)
- Demonstrates the corrosion prevention methods and factors affecting the corrosion(L2)
- Learning the principles of protection against corrosion methodologies (L2)

UNIT-4

Advanced Engineering Materials: (8 hrs)

Refractories- Classification, Properties and its Applications, Reasons for failure of the refractory materials.

Lubricants- Classification, Functions of lubricants, Mechanism of lubrication (fluid-film lubrication), Properties of lubricating oils (viscosity, viscosity index, saponification number, oiliness, flash and fire points, emulsification, carbon residue, mechanical stability and aniline point).

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

- Identify the factors affecting the refractory material(L3)
- Illustrate the functions and properties of lubricants (L2)
- Identifying the constituents of Portland cement (L3)
- Enumerate the reactions at setting and hardening of cement.

UNIT-5

Surface Chemistry and Applications: (9 hrs)

Introduction to surface chemistry, Adsorption- Types of adsorption, Adsorption of gases on solids and its applications, Adsorption isotherm-Langmuir adsorption isotherm theory and postulates, Nanomaterials: Introduction and applications of nanomaterials in catalysis, medicine, sensors.

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

- Outline the preparation of nanomaterials and metal oxides (L2)
- Understanding and analyzing the concept of adsorption(L1)
- Identify the application of nanomaterials in medicine, sensors and catalysis (L2)

UNIT-6

Polymers and Fuel Chemistry: (12 hrs)

Polymers: Classification of polymers, functionality, chain growth and step growth polymerization, Copolymerization with specific examples and mechanisms of additional polymerization.

*Plastics***:** Thermoplastics: Preparation, properties and applications of PVC and Teflon.

Thermosets: Bakelite and Urea-formaldehyde.

Fuels –Types of fuels, calorific value, numerical problems based on calorific value; Analysis of coal-Proximate and Ultimate analysis.

Liquid Fuels: Extraction of petroleum, knocking, Octane and Cetane number.

Flue gas: Analysis by Orsat's apparatus.

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

- Explain different types of polymers and their applications (L2)
- Solve the numerical problems based on Calorific value(L3)
- Significance of flue gas analysis
- Explain calorific value and its significance(L2)
- Octane and cetane ratings of fules

TEXT BOOKS:

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

REFERENCE BOOKS:

1) K N Jayaveera, G V Subba Reddy and C Rama Chandraiah, Engineering Chemistry 1/e Mc Graw Hill Education (India) Pvt Ltd, New Delhi 2016
2) H.F.W. Taylor, Cement Chemistry, 2/e, Thomas Telford Publications, 1997.
3) D.J. Shaw, Introduction to Colloids and Surface Chemistry, Butterworth-Heineman,1992.
4) K SeshaMaheswaramma and MridulaChugh, Engineering Chemistry Pearson India Education Services Pvt. Ltd
5) Skoog and West, Principles of Instrumental Analysis, 6/e, Thomson, 2007.

R G M COLLEGE OF ENGINEERING AND TECHNOLOGY
AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

I B.Tech, I-Sem (ME) L T C
2 1 3

(A0302191) BASIC ENGINEERING MECHANICS

COURSE OBJECTIVES:

- This course will serve as a basic course by introducing the concepts of basic mechanics which will help as a foundation to various courses.
- To impart knowledge about the basic laws of statics and their applications in problem solving.
- Model the problem using good free body diagrams and accurate equilibrium equations.
- Identify and model various types of loading and support conditions that act on structural systems.
- To give on exposure on inertial properties of surfaces and solids.
- To provide an understanding on the concept of friction.

COURSE OUTCOMES:

After completion of the course the student will be able to

- Use a standard process for analyzing static objects.
- Construct free body diagrams of an object or a system of connected bodies.
- Describe conditions of equilibrium and their associated component equations.
- Use conditions of equilibrium and known forces and moments to solve for unknown external and internal forces and moments present in an object of system of connected objects.
- Calculate the center of gravity, center of mass, centroid, moment of inertia and mass moment of inertia for simple and composite volumes.
- Analyze and evaluate the frictional forces between the bodies.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	1	-	1	1	-	1	-	-	-	-	-
CO2	1	-	-	2	-	-	1	**1**	-	-	-	-
CO3	1	1	-	-	1	-	-	-	-	-	-	-
CO4	1	-	-	-	-	1	-	1	-	1	-	-
CO5	1	-	1	-	1	-	-	1	-	-	-	1
CO6	1	1	-	**1**	-	**1**	**1**	-	-	-	**1**	-

UNIT-1

Introduction to Engineering mechanics- classification of engineering mechanics – basic terminologies in mechanics - units and dimensions – laws of mechanics – parallelogram and triangular law of forces – Lame's theorem- principle of transmissibility – single equivalent force – simple problems

UNIT-2

Equilibrium of rigid body- composition system of forces – resolution of forces – general method of composition of forces – equilibrium of bodies – equilibrium of connected bodies – simple examples - Moment of a force – Varignon's theorem – couple – resultant of non-concurrent force system- x and y intercept of resultant- simple problems

UNIT-3

Support Reactions- introduction – types of supports – types of loading – analytical method for finding out the reactions of a beam – simple problems on simply supported beams, overhanging beams and roller and hinged supports beams

UNIT-4

Center of gravity and centroid – Determination of areas – First moment of area and the centroid of sections – Rectangle, circle, triangle from integration – T-section, I-section, angle section, hollow sections by using standard formula

UNIT-5

Area moment of inertia and mass moment of inertia – Introduction – radius of gyration – theorem of perpendicular axis – theorem of parallel axis – second moment of area – rectangle, circle, triangle from integration – T-section, I-section, angle section, hollow section by using standard formula – polar moment of inertia – mass moment of inertia

UNIT-6

Friction- Introduction - Types of friction - laws of Coulomb friction – Frictional force – Angle of repose –Equilibrium of a body lying on rough inclined plane – Analysis of ladder friction – Analysis of wedge friction

TEXT BOOKS

1. Engineering Mechanics by Shames &Rao – Pearson Education.
2. Engineering Mechanics by Dr.R.K.Bansal, Lakshmi Publications.
3. Engineering Mechanics – B. Bhattacharyya, Oxford University Publications.
4. Engineering mechanics by S SBhavikatti, New age International Publications.

REFERENCE BOOKS:

1. Engineering Mechanics by FedrinandL. Singer – Harper Collings Publishers.
2. Engineering Mechanics by SeshigiriRao, Universities Press, Hyderabad.
3. Engineering Mechanics by Rajsekharan, Vikas Publications.
4. Engineering Mechanics (Statics and Dynamics) by Hibller and Gupta; Pearson Education.
5. Engineering Mechanics by S.Timoshenko, D.H.Young and J.V.Rao, Tata McGraw-Hill Company.
6. Engineering Mechanics by Chandramouli, PHI publications.
7. Engineering Mechanics –Arthur P. Boresi and Richard J. Schmidt. – Brooks/Cole – CengageI

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DEPARTMENT OF MECHANICAL ENGINEERING

I B.Tech, I-Sem (ME)

L	T	C
2	1	3

(A0501191) PROGRAMMING FOR PROBLEM SOLVING-I

(For Branches: CE, EEE, Mech, ECE & CSE)

COURSE OBJECTIVES:

- To make students aware about fundamentals of computer programming.
- To provide exposure on C programming language
- To provide exposure on various C programming concepts like arrays, functions, pointers, Structures etc.
- To develop solutions for various problems by using C programming language.

COURSE OUTCOMES:

At the end of this course, the student would be able to

- Design algorithms and flowcharts for real world applications
- Know the usage of various operators in Program development
- Design programs involving decision and iteration structures.
- Apply the concepts code reusability using Functions
- Analyse the concepts of Arrays and Strings for real world problems.
- Able to apply the pointers in programs

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	3	-	2	-	-	-	2	1	-	-
CO2	2	-	-	-	2	-	-	-	-	-	-	-
CO3	3	2	3	2	-	2	-	-	2	-	-	-
CO4	3	-	2	-	-	-	-	-	3	-	-	-
CO5	-	3	3	-	-	2	-	-	-	-	2	-
CO6	-	-	3	-	-	-	2	-	-	-	-	-

UNIT-1

Problem Solving Using Computers: Introduction, Algorithms, Flowcharts and pseudo code.

Overview of C Language: Introduction, Salient Features of C Language, Structure of a "C" Program.

C Language Preliminaries: Keywords and Identifiers, Constants, Variables, Data Types, and Input Output Statements with suitable illustrative "C" Programs.

UNIT-2

Operators: Assignment Operators, Relational and Logical Operators, Increment and Decrement Operators, Bitwise Operators, Ternary Operator, Type Conversion, Precedence and Associativity with suitable illustrative C Programs.

UNIT-3

Statements in C: Conditional/Decision Statements: if, if-else, Nested if-else, else-if ladder, Switch-Statement and goto statement with suitable illustrative C Programs.

Loop Control Statements: while, do-while and for with suitable illustrative "C" Programs, break, continue statements.

UNIT-4

Arrays: Definition, Importance of an array in C language, One-Dimensional Arrays, Two-Dimensional Arrays, Example programs on the topics mentioned above.

Strings: Introduction to Strings, String I/O, String Operations with and without built-in functions

(strlen( ), strcmp( ), strcat( ),strcpy( ), and strrev( )) Example Programs on the topics mentioned above

UNIT-5

Functions: Introduction to Functions, benefits of functions, types of functions, Function calls, return vs. exit( ), Parameter Passing mechanisms, Call-by-Value, Recursion, Storage Classes, preprocessor directives

UNIT-6

Pointers: Pointer variable and its importance, Pointer variable declaration, initialization of pointer variables, how to access a value from a memory location through it‘s pointer variable. Arithmetic operations on pointer variables, Scale factor length. Pointers and functions - pointers as function arguments (i.e., call-by-reference), Pointers and Arrays, Pointers and Strings, Generic Pointers.

TEXT BOOKS:

1) B.A.Forouzon and R.F. Gilberg, “COMPUTER SCIENCE: A Structured Programming Approach Using C”, Third edition, CENGAGE Learning, 2016
2) Pradip Dey and ManasGhosh, Programming in C, Oxford University Press, 2nd Edition 2011.

REFERENCE BOOKS:

1) Byron Gottfried, “Programming with C “, Schaum’s Outlines, 2nd Edition, TATA McGraw-Hill.
2) M.T.Somashekara, “Problem Solving Using C”, PHI, 2nd Edition 2009.
3) A.K.Sharma, Computer Fundamentals and Programming in C, 2nd Edition, University Press
4) Rajaraman V., "The Fundamentals of Computers", 4th Edition,Prentice Hall of India, 2006.
5) R S Bichker, "Programming in C", University Press, 2012.

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I B.Tech, I-Sem (ME) P C
3 1.5

(A0091191) ENGINEERING CHEMISTRY LAB

(For Branches: CE, EEE, Mech, ECE & CSE)

COURSE OBJECTIVE:

- Verify the fundamental concepts with experiments

COURSE OUTCOMES:

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

- Learning the analytical skills while doing the experiments (L3)
- Learning the quality of water and its significance (L2)
- Importance of the Conductometric titrations while determine the strength of weak acids an coloured solutions (L3)
- Analyse the IR and UV-Visible Spectra of some organic compounds (L3)

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	1	1	-	1	-	-	-	-	1	-	-	1
2	-	2	1	-	2	1	1	1	-	-	1	-
3	-	1	-	-	1	-	1	-	1	-	-	1
4	1	3	2	1	2	-	1	-	-	-	1	1
Course	1	2	1	-	2	1	-	-	1	1		1

LIST OF EXPERIMENTS:

1) Preparation of standard $K_2Cr_2O_7$ solution
2) Estimation of Hardness of Water by using Standard EDTA solution
3) Estimation of Copper by using Standard EDTA solution
4) Estimation of Magnesium by using Standard EDTA solution
5) Estimation of dissolved oxygen by Winkler's method
6) Determination of Strength of given Hydrochloric Acid against standard sodium hydroxide solution by Conductometric titrations
7) Determination of Strength of given Acetic Acid against standard sodium hydroxide solution by Conductometric titrations
8) Determination of strength of mixture of acids against standard sodium hydroxide solution by conductometric method.
9) Verification of Beer-Lambert's law
10) Determine the strength of Cu(II) ion by colorimeter
11) Determination of total alkalinity of water
12) Preparation of a simple polymer
13) Thin layer chromatography
14) Identification of simple organic compounds by IR and UV-Visible Spectroscopy
15) HPLC method in separation of liquid mixtures

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DEPARTMENT OF MECHANICAL ENGINEERING

I B.Tech, I-Sem (ME) P C
3 1.5

(A0591191) PROGRAMMING FOR PROBLEM SOLVING LAB - I

(For Branches: CE, EEE, Mech, ECE & CSE)

COURSE OUTCOMES:

- To learn about different types of operators
- To learn how decision making is done during programming
- To learn about various simple constructs used for programming
- To learn to define functions and call them with appropriate parameters
- To understand the usage of string libraries to do common string operations
- To understand pointer referencing and pointer dereferencing

COURSE OUTCOMES:

At the end of this course, the student would be able to

- Apply the specification of syntax rules for numerical constants and variables, data types
- Know the Usage of various operators and other C constructs
- Design programs on decision and control constructs
- Develop programs on code reusability using functions
- Implement various concepts of arrays and strings

MAPPING WITH Cos & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	2	-	-	-	-	-	-	-
CO2	2	-	-	-	3	-	-	-	-	-	-	-
CO3	-	3	3	-	-	-	-	-	-	-	-	-
CO4	3	-	2	-	-	-	-	-	-	1	2	-
CO5	-	2	-	-	2	-	2	-	-	-	-	1

RECOMMENDED SYSTEMS /SOFTWARE REQUREMENTS:

- Intel based desktop PC with ANSI C Compiler and Supporting Editors

Write a C program to demonstrate the various operators used in C language.

Exercise-1

a) Write a C program to find the roots of a quadratic equation.
b) Write a C program to find both the largest and smallest number in a list of integers.

Exercise-2

a) Write a C program, which takes two integer operands and one operator from the user, performs the specified operation and then prints the result. (Consider the operators +,-,*, /, % and use Switch Statement)
b) Write a C Program to find the reverse of a given number.

Exercise-3

a) Write a C program to find the sum of individual digits of a positive integer.
b) Write a C program to generate the first ‘n‘ terms of the Fibonacci sequence.
[**Note:** A Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence.]
c) Write a C program to generate all the prime numbers between 1 and n, where ‘n‘ value is given by the user.
[**Note:** Develop each of the above programs by using different loop constructs supported by C language. (i.e., while, do while and for Loops)]

Exercise-4

a) Write a C Program to mask the most significant digit of the given number.
b) Write a program which Prints the following pattern

```
0
111
22222
3333333
444444444
```

Exercise-5

a) Write a C program to find all the even numbers in the given one dimensional array.
b) Write a C program to print the elements of an array in reverse order.
c) Write a C program to construct a pyramid of numbers.

Exercise-6

Write a C program to perform the following operations:

a) Addition of Two Matrices
b) Multiplication of Two Matrices
   [Note: Use functions to implement the above specified operations]

Exercise-7

Write C programs that use both recursive and non-recursive functions

a) To find the factorial of a given integer.
b) To find the GCD (greatest common divisor) of two given integers.

Exercise-8

a) Write a C Program to solve the Towers of Hanoi problem by using recursive function.
b) Write a C Program to demonstrate the various storage classes, which are supported by the C language. [i.e., automatic, external, static and register]

Exercise-9

a) Write a C Program to demonstrate that, how to pass an entire array as an argument to a function with a suitable example.
b) Write a C Program to perform various operations on given two strings using string handling functions.

Exercise-10

a) Write a C Program to perform various arithmetic operations on pointer variables.
b) Write a C Program to demonstrate the following parameter passing mechanisms:
   i) Call-by-value
   ii) Call-by-reference

Exercise-11

a) Write a C program that uses functions to perform the following operations:
   i). To insert a sub-string in to a given main string from the specified position.
   ii). To delete '**n**' Characters from a given position in a given string.
b) Write a C program to determine if the given string is a palindrome or not.

Exercise-12

a) Write a C program that displays the position or index in the string 'S' where the string 'T' begins, or – 1 if 'S' doesn't contain 'T'.
b) Write a C program to count the lines, words and characters in a given text.

REFERENCE BOOKS

1) Programming in C, Pradeep Dey, Manas Ghosh, Oxford Heigher Education
2) The Spirit of C, an introduction to modern programming, M.Cooper, Jaico Publishing House.
3) Mastering C, K.R. Venugopal and S.R. Prasad, TMH Publications.
4) Computer Basics and C Programming, V. Raja Raman, PHI Publications.

I B.Tech, I-Sem (ME) P C
3 1.5

(A0092191) DIGITAL ENGLISH LANGUAGE LAB

(For Branches: CE, EEE, Mech, ECE & CSE)

The Digital English Language Lab focuses on the production and practice of sounds of language and equips students with the use of English and vocabulary in everyday situations and contexts.

COURSE OBJECTIVES:

- To facilitate the students to use language effectively in everyday social conversations
- To expose the students to the blend of self-instructional and modes of language learning teacher assisted through digital lab
- To improve the fluency and intelligibility of student in spoken English and neutralize their mother tongue influences
- To help the students to participate in-group discussions, to face interviews and shape the individual language learning.

COURSE OUTCOMES:

- Social interactions, greetings, self-introductions and group talk
- Improving standard pronunciation patterns and neutralize the mother tongue impact
- Developing communication through listening, reading, speaking and writing activities
- Enhancing vocabulary and grammar to develop professional language
- Improving life skills through GD and role plays practices

MAPPING WITH COs & POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	-	1	1	2	2	3	-	2
CO2	1	-	-	-	-	2	1	2	2	3	-	2
CO3	1	-	-	-	-	2	1	2	2	3	-	2
CO4	1	-	-	-	-	2	1	2	2	3	-	2
CO5	1	-	-	-	-	2	1	2	2	3	-	2

Digital English Language Lab consists of two parts:

1) CALL (Lab): Computer Assisted Language Learning
2) ICS (Lab): Interactivity Communication Skills

Exercise-1

Introduction to Phonetics - Speech Sounds - Vowels - Phonetic Transcription - CALL Lab - Ice Breaking Activity - Self Introductions (SWOT) - Social Interactions - Pair work - ICS Lab

Exercise-2

Diphthongs - Consonants - Phonetic Transcription - CALL Lab - Just A Minute (JAM) - ICS Lab

Exercise-3

Listening Comprehension (audio) - IELTS Testing Exercises - CALL Lab - Speaking Activity - Group talk - ICS Lab

Exercise-4

Vocabulary Building - Synonyms & Antonyms - Analogy - Testing Exercises - CALL Lab - Narration of a Story/Event/ Describing an Object - ICS Lab

Exercise-5

Situational Dialogues - CALL Lab - Role Play - ICS Lab

Exercise-6

Pronunciation Evaluation Testing Exercises through EPD - CALL Lab - Group Discussion - ICS Lab - Any student based activities

Course Outcomes:

Student will able to learn:

- ❖ Will understand the spoken skills from CALL and ICS
- ❖ Will know the variations in accent of native and non-native speakers of English and achieve accent neutralization
- ❖ Will develop the reading & listening comprehension skills

PRESCRIBED SOFTWARE:

- K-VAN Solutions (licensed software)
  - ➢ Advance Communication Skills Lab
  - ➢ English Language Communication Skills Lab
- Cambridge Advanced Learners' English Dictionary with CD
- IELTS Academic Preparation and Practice with CD

BOOKS SUGGESTED FOR DELL: (CENTRAL LIBRARY)

1) Skill Pro – A Course in Communication Skills and Soft Skills by Prof. K. Sumakiran et.al, EMESCO.
2) Skill Pro-I Foundation Course - 4 - by Dr. G. Gulam Tariq et.al, Maruthi Publications.
3) Strengthen Your Steps – A Multimodal Course in Communication skills by Dr. M. Hari Prasad et.al
4) English Pronouncing Dictionary Daniel Jones Current Edition with CD
5) English Dictionary for Advanced Learners, (with CD) International edn. Macmillan 2009.

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DEPARTMENT OF MECHANICAL ENGINEERING

I B.Tech, II-Sem (ME)

L	T	C
1	1	2

(A0006192) COMMUNICATIVE ENGLISH- II

(For Branches: CE, EEE, Mech, ECE & CSE)

COURSE OBJECTIVES:

- The course Communicative English - II is an extension of Communicative English - I. This will provide inputs in business vocabulary to introduce Communicative style in writing and speaking to expose students to professional scenario. This will led students to write letters in professional contexts. Communicative English -II enhances the students' communication skills in terms of LSRW Skills.

COURSE OUTCOMES:

- Develop communicative competence by enunciating words and learn Language games.
- Build the habit of reading skills and enhance styles of writing.
- Interpret different accents and modulations through active listening and improvisation of writing skills.
- Write clear and coherent passages.
- Improve the ability to speak effectively in English in real life situations and understanding of Team Dynamics.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	2	3	-	-	-	1	2
CO2	-	-	-	-	-	3	2	-	2	-	3	1
CO3	-	-	-	-	-	2	3	-	2	-	1	1
CO4	-	-	-	-	-	2	3	-	2	-	1	1
CO5	-	-	-	-	-	2	3	-	2	-	2	1

UNIT-1

a) Speaking - News Paper Reading - Narrating a Story/ Event
b) Vocabulary Development: Root words-Homonyms-Homophones-Wordlists - Quizzes - Language Games – Puzzles

UNIT-2

a) Reading Comprehension-Life is a Pizza by Richard Templar from Rules of Life - Vocabulary on Eateries, Food & Travel
b) Business Writing - Memorandums - Letters - Style & Formats - E-mail Writing - Practice

UNIT-3

a) Listening & Speaking - TED Talks - Listening Comprehension- Practice - Tests
b) Writing - Proposals - Technical Paper Writing- Practice – Movie Analysis

UNIT-4

a) Writing - Gadget Reviews - Technical Jargon - Resume Writing - Practice
b) Précis Writing - Techniques of Writing the Précis- Sample Analysis-Practice.

UNIT-5

a) Speaking - Seeking Information - Preferences - Likes & Dislikes - Cross - Cultural Communication
b) Satya Nadella: When empathy is good for business https://www.morningfuture.com - Team Dynamics Activity

UNIT-6

a) Listening & Writing - Movie/Short Film/Documentary Analysis
b) Info Graphics- Techniques - Practice from IELTS Videos

REFERENCE TEXT BOOKS:

1) Word Power Made Easy by Norman Lewis, Goyal Publications
2) Group Dynamics for Teams 3rd Ed. By Levi, Daniel. Sage Publications India Pvt.Ltd. New Delhi, 2011.
3) Business English Essentials by Henderson, Greta Lafollette & Price R Voiles 7th Edition. Glencoe/McGraw Hill.
4) On Writing Well by William Zinsser, Harper Perennial Press, 2016

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AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

I B.Tech, II-Sem (ME)

L	T	C
2	1	3

(A0007192) ORDINARY, PARTIAL DIFFERENTIAL EQUATIONS & VECTOR CALCULUS

(For Branches: CE, EEE, Mech, ECE & CSE)

COURSE OBJECTIVES:

- The effective mathematical tools for the solutions of differential equations that model physical processes.
- To enlighten the learners in the concept of differential equations and multivariable calculus.
- To introduce the solution methodologies for second order Partial Differential Equations with applications in engineering
- To familiarize the concepts in vector calculus like gradient, divergent and curl, as well as, divergent theorems.

COURSE OUTCOMES:

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

- Obtain the knowledge of first and higher order differential equations and its use in solving Circuit analysis, heat transfer problems in engineering.
- Analyze solving higher order linear differential equations with variable coefficients and its applications.
- Understand about formation and solution of partial differential equations and importance in thermodynamics, continuum mechanics and fluid mechanics.
- Understand about vector differentiation and its applications in Electromagnetic theory.
- Apply the concept of vector integration to solve many problems in field theory, Electromagnetic theory and transmission lines.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	-	-	-	-	-	-	-
CO2	3	1	-	-	-	-	-	-	-	-	-	-
CO3	1	2	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	3	-	-	-	-	-	-	-	-
CO5	1	3	2	-	-	-	-	-	-	-	-	-

UNIT-1

Differential equations of first order and first degree - Formation of ODEs - Solution of ODEs - Exact, Non - Exact, Linear and Bernoulli's equations - Applications of ODEs to L - R & C - R circuits.

UNIT-2

Non-homogeneous linear differential equations of second and higher order with constant coefficients with RHS term of the type, e^{ax}, Sin ax, Cos ax, Polynomials in x, e^{ax} V(x), xV(x), Method of Variation of parameters.

UNIT-3

Higher Order linear Differential Equations with variable coefficients: Cauchy's and Legendre's linear Differential equations, simultaneous linear differential equations with constant coefficients.

UNIT-4

Partial Differential Equations of First order: First order partial differential equations, Formation of partial differential equations, solutions of first order linear and non – linear Partial differential equations, Method of separation of variables.

UNIT-5

Vector Differentiation: Introduction of Vector differentiation– Scalar and vector point functions – Gradient of scalar function– Directional derivatives – Divergence of a vector function – Curl of a vector function.

UNIT-6

Vector integration: Line integral - Potential function – Area, Surface and volume integrals. Vector integral theorems: Green's theorem (without proof) – Stoke's theorem (without proof) and Gauss Divergence Theorem (without proof); Verification of Green's, Stoke's and Gauss Theorems.

TEXT BOOKS/REFERENCES:

1) G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2) Erwin kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2011.
3) Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
4) T.K.V. Iyengar, B. Krishna Gandhi and Others, Mathematical Methods, S. Chand & Company.
5) T.K.V. Iyengar, B. Krishna Gandhi and Others, A Text Book of Engineering Mathematics, Vol – 1, S. Chand & Company.
6) S.R.K. Iyengar and R.K. Jain, Advanced Engineering Mathematics, Narosa publishing.
7) Ian Sneddon, Elements of Partial Differential equations, McGraw Hill.

R G M COLLEGE OF ENGINEERING AND TECHNOLOGY
AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

I B.Tech, II-Sem (ME)

L	T	C
2	1	3

(A0008192) ENGINEERING PHYSICS

(For branches CE & Mech)

COURSE OBJECTIVES:

- To provide basic concepts of interaction of light with matter, nanomaterials, ultrasonics and quantum physics to the engineering students.

COURSE OUTCOMES:

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

- Apply the concept of light to test the material properties
- Construct a quantum mechanical model to explain the behavior of a system at the microscopic level.
- Apply the knowledge of nanomaterials in the development of nanotechnology.
- Detect the flaws present in the materials using ultrasonics
- Apply the functional materials for the benefit of mankind.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	2	1	1	-	-	-	-	-	-	1
CO2	3	-	1	1	2	-	-	-	-	-	-	-
CO3	3	-	2	2	2	-	1	-	-	-	-	1
CO4	1	3	2	1	1	-	-	-	-	-	-	-
CO5	1	3	2	-	2	-	-	-	-	-	-	1

UNIT-1 WAVE OPTICS (9 h)

Interference: Introduction – Division of amplitude – Newton's rings and its applications. **Diffraction:** Introduction – Fraunhofer diffraction at single slit – Diffraction Grating – Grating spectra – Determination of wavelength of light.

UNIT-2 QUANTUM MECHANICS (9 h)

Introduction to quantum physics – Wave-Particle duality – de Broglie hypothesis – Verification of wave character of Matter waves (Davison–Germer experiment) – Uncertainty principle – Thought experiment (Electron diffraction) – Wave function (ψ) – Schrodinger's one-dimensional time-independent wave equation – Particle in 1D-potential box.

UNIT-3 THE CRYSTAL STRUCTURE OF SOLIDS (9 h)

Introduction – Space lattice – Basis – Unit cell (primitive and Non-primitive) – Crystal systems – Bravais lattices – Atomic radius, Nearest neighbouring distance, Coordination number and packing factor for SC, BCC, FCC lattices – Diamond structure – Crystal planes and directions – Miller Indices – calculation of interplanar distance.

UNIT-4 ULTRASONICS (9 h)

Introduction – Production of ultrasonics by magnetostriction and piezoelectric method – Detection methods – Properties – Cavitation – Pulse-echo & Transmission mode of non-destructive testing (NDT) methods – General applications of ultrasonics.

UNIT-5 NANOMATERIALS (9 h)

Introduction – Properties of nanomaterials: Surface area to volume ratio and Quantum confinement – Synthesis of nanomaterials – Ball milling – Sol-gel – chemical vapour deposition (CVD) techniques – Carbon nanotubes (CNTs) – Applications.

UNIT-6 FUNCTIONAL MATERIALS (9h)

Introduction – Fiber reinforced plastics (FRPs) – Piezoelectrics – Piezoresistors – Metallic glasses – Shape memory alloys (SMAs) – Properties and Applications.

TEXT BOOKS

1) M. N. Avadhanulu, P.G. Kshirsagar & TVS Arun Murthy" AText book of Engineering Physics"- S. Chand Publications, 11thEdition 2019.

2) R. K. Gaur and S.C. Gupta, "Engineering Physics", Dhanpat Rai Publications, New Delhi.

REFERENCES

1) "Concepts of Modern Physics", Arthus Beiser, Tata Mc Graw Hill Publications, New Delhi.
2) "Physics Volume – II", Resnick, Halliday and Krane, Wiley, New Delhi.
3) "Elements of Solid State Physics", J.P. Srivastava, PHI Learning, 4th eds. New Delhi.
4) "Introduction to Nanotechnology", Charles P. Poole and Frank J. Ownen, Wiley.
5) "Applied Physics", S.P.Basavaraju, Subhas Stores, Bangalore.
6) "Nanotechnology", M. Ratner & D. Ratner, Pearson Ed, New Delhi.

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AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

I B.Tech, II-Sem (ME)

L	T	C
2	1	3

(A0301191) ENGINEERING DRAWING

(For Branches: CE, EEE, Mech, ECE & CSE)

COURSE OBJECTIVES:

- Increase ability to communicate with people
- Learn to take data and transform it into graphic drawings.
- Learn basic engineering drawing formats
- Prepare the student for future Engineering positions

COURSE OUTCOMES:

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

- Understand the theory of orthographic projection.
- Understand the conventions and the methods adopted in engineering drawing.
- Know the importance of sectioning and Developments of solids in actual applications.
- Improve their visualization skills so that they can apply these skills in developing new products.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	3	-	-	-	-	-	2	-
CO2	3	2	3	2	3	-	-	-	-	-	-	-
CO3	3	2	2	1	3	-	-	-	-	-	-	1
CO4	3	2	2	2	3	-	-	-	-	-	1	-

UNIT-1

Polygons-Construction of Regular Polygons using given length of a side; Conic sections- Ellipse-Arcs of Circles and Oblong Methods, Construction of Parabola and Hyperbola by eccentricity method only.

UNIT-2

Introduction to Orthographic Projections- Projections of Points-Projections of Straight Lines parallel to both planes; Projections of Straight Lines-Parallel to one and inclined to other plane, inclined to both planes, determination of true lengths, angle of inclinations.

UNIT-3

Projections of Planes- Regular Planes Perpendicular / Parallel to one Reference, Plane and inclined to other Reference Plane.

UNIT-4

Projections of Solids-Prisms, pyramids, cones and Cylinders with the axis inclined to one Plane.

UNIT-5

Section of solids: Sectioning of prism, pyramid, cone and cylinder– sectional view – true shape. Solids in simple position and cutting plane inclined to one reference plane only.

Development of surface of solids: Development of truncated prism, pyramid, cone and cylinder – frustum of cone and pyramid

UNIT-6

Conversion of Isometric Views to Orthographic Views/Projections-Conversion of Orthographic Views to Isometric Projection/ Views.

TEXT BOOK:

1) Engineering Drawing by N.D. Bhatt, Chariot Publications.
2) Engineering Drawing and Graphics, Venugopal/New age publications.

REFERENCE BOOKS:

1) Engineering Drawing. K.L Narayana, P. Kannaiah, Scitech Publications.
2) Engineering Drawing, B.V.R Gupta, J.K. Publishers.
3) Engineering Drawing by M.B. Shah and B.C. Rana, Pearson Publishers.
4) Engineering Drawing, Johle, Tata Mc Graw - Hill.
5) K.V. Natarajan, 'A text book of Engineering Graphics', Dhanalakshmi publishers, Chennai (2006).

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I B.Tech, II-Sem (ME) L T C
2 1 3

(A0502192) PROGRAMMING FOR PROBLEM SOLVING - II

(For Branches: CE, EEE, Mech, ECE & CSE)

COURSE OBJECTIVES:

- To make students aware about structures and unions in C language.
- To provide exposure on various searching and sorting techniques.
- To provide exposure on various data structures like stacks, queues, circular queues and linked lists etc.,
- To develop solutions for various problems by using C Programming Language by students.

COURSE OUTCOMES:

At the end of this course, the student would be able to

- Develop programs with user defined data types.
- Apply various file handling techniques for better data management
- Apply stacks in various applications
- Apply queues in various applications and distinguish between stacks and queues.
- Analyze various dynamic data structures.
- Implement various searching and sorting techniques

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	3	-	2	-	-	-	2	-	-	2
CO2	3	-	3	-	-	2	-	-	-	-	2	-
CO3	3	2	-	-	-	-	3	-	-	-	-	-
CO4	-	3	-	-	-	-	2	-	-	-	-	-
CO5	3	3	2	-	-	2	3	-	-	-	-	-
CO6	3	-	-	2	3	3	-	-	-	-	-	-

UNIT-1

STRUCTURE AND UNIONS IN C LANGUAGE: Structures – Introduction, Features of Structures. Declaration and Initialization of Structures, Accessing structure members, structure initialization. Nested Structures, Array of Structures, Arrays within structures and Pointers to Structures, Structures and Functions, Unions, typedef. Example Programs on the topics mentioned above.

UNIT-2

Files : Input and Output – Concept of a file, streams, text files and binary files, Differences between text and binary files, State of a file, Opening and Closing files, file input / output functions(standard library input / output functions for files), file status functions (error handling),Positioning functions, command –line arguments, C program examples.

UNIT-3

INTRODUCTION TO DATA STRUCTURES: Classification of data structures, dynamic memory allocation functions in C language. **Stacks:** Definition, Various representation methods, operations on stacks and their implementation in C language, applications of stacks.

UNIT-4

QUEUES: Definition, Various representation methods, operations on queues and their implementation in C language, applications of queues. Circular queues- operations on circular queues and their implementation in C language.

UNIT-5

LINKED LISTS: Definition, Various representation methods, operations on linked lists and their implementation in C language.

UNIT-6

SEARCHING AND SORTING TECHNIQUES: Searching Techniques - Linear search and Binary Search Techniques. Sorting techniques - Bubble Sort, Selection Sort, Insertion

Sort. Implementation of all the above mentioned techniques in C language and trace them by giving different test data.

TEXT BOOKS:

1) B.A.Forouzon and R.F. Gilberg, "COMPUTER SCIENCE: A Structured Programming Approach Using C", Third edition, CENGAGE Learning, 2016
2) PradipDey and ManasGhosh, Programming in C, Oxford University Press, 2nd Edition 2011.

REFERENCE BOOKS:

1) Byron Gottfried, "Programming with C", Schaum's Outlines, 2nd Edition, TATA McGraw-Hill.
2) M.T.Somashekara, "Problem Solving Using C", PHI, 2nd Edition 2009.
3) A.K.Sharma, Computer Fundamentals and Programming in C, 2nd Edition, University Press
4) Rajaraman V., "The Fundamentals of Computers", 4th Edition, Prentice Hall of India, 2006.
5) R S Bichker, "Programming in C", University Press, 2012.

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AUTONOMOUS
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I B.Tech, II-Sem (ME) P C
3 1.5

(A0094191) ENGINEERING PHYSICS LAB

(For Branches: CE, EEE, Mech, ECE & CSE)

COURSE OBJECTIVES:

- The laboratory should help the student to develop a broad array of basic skills and tools of experimental physics and data analysis.
- The laboratory should help students to understand the role of direct observation in physics and to distinguish inferences based on theory and the outcomes of experiments.
- To learn about the optical experiments in establishing the fundamentals in Interference and Diffraction phenomena which will be visualized with the light and laser experiments mentioned in the syllabus.
- To learn about the basic electronic experiments such as energy band gap determination, Hall Effect to know the type of extrinsic semiconductors, Stewart-Gee's experiment in field intensity determination and Solar I-V characteristics.

COURSE OUTCOMES:

After completion of the course the students will be able to

- Operate optical instruments like microscope and spectrometer.
- Determine thickness of a hair/paper with the concept of interference.
- Estimate the wavelength of different colors using diffraction grating.
- Measure the resolving power of the given optical device.
- Study the variation of intensity of the magnetic field due to circular coil carrying current with distance.
- Evaluate the acceptance angle of an optical fibre and numerical aperture.
- Calculate the band gap of the given semiconductor using four probe method.
- Identify the type of semiconductor (i.e., n-type or p-type) using Hall Effect.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	-	1	-	-	-	-	-	-	1
CO2	2	-	2	1	-	-	-	-	-	-	-	-
CO3	3	2	-	1	1	-	-	-	-	-	-	1
CO4	3	2	-	1	1	-	-	-	-	-	-	1

LIST OF EXPERIMENTS (ANY10 EXPERIMENTS)

1) Determination of wavelength of light – Newton's rings
2) Determination of thickness of a thin film
3) Spectrometer – Transmission grating
4) Determination of wavelength of a Sodium light – Normal Incidence
5) Dispersive power of a prism - spectrometer
6) Laser experiment: wavelength determination using grating
7) Laser experiment: particle size determination
8) Determination of numerical aperture of an optical fiber
9) Field along the axis of coil carrying current – Stewart Gee's method
10) Determination of rigidity modulus – Torsional Pendulum
11) Determination of Band gap of Si or Ge – Four probe method
12) Study of B – H Curve.
13) Determination of Charge density and Hall coefficient or magnetic flux density – Hall effect.
14) Study of I-V characteristics of Solar Cell.
15) Measurement of Dielectric constant

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DEPARTMENT OF MECHANICAL ENGINEERING

I B.Tech, II-Sem (ME) P C
3 1.5

(A0593192) PROGRAMMING FOR PROBLEM SOLVING LAB - II

(For Branches: CE, EEE, Mech, ECE & CSE)

COURSE OBJECTIVES:

- To understand how to use structures and unions as a compound data types
- To understand various basic file operations
- To understand various stack and queue operations
- To understand various linked list operations
- To understand basic searching and sorting techniques

COURSE OUTCOMES:

At the end of this course, the student would be able to

- Develop applications on user defined data types
- Apply dynamic memory allocation through pointers
- Use different data structures for create/update basic data files
- Implement linear data structures through stacks and queues
- Implement various searching and sorting techniques, Linked lists.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	3	2	-	3	-	-	2	-	-	-
CO2	-	-	-	-	3	-	2	-	-	-	1	-
CO3	-	2	-	-	3	2	-	-	-	-	-	2
CO4	3	-	3	-	-	-	-	-	-	-	-	-
CO5	3	-	-	2	-	3	-	-	-	2	-	-

RECOMMENDED SYSTEMS /SOFTWARE REQUREMENTS:

- Intel based desktop PC with ANSI C Compiler and Supporting Editors

Exercise-1

a) Write a C Program to copy the contents of one structure variable to another structure variable.
b) Write a C program to implement nested structure to store and display the student information. The structure student contains the field‘s S.no, name, and date. Date is the nested structure and it contains the fields day, month and year.

Exercise-2

a) Write a C program to add two distances which is in feet and inches
b) Write a C program to illustrate passing the whole structure as argument to a function.

Exercise-3

Write a C program that uses functions to perform the following operations:

a) Reading a complex number
b) Writing a complex number
c) Addition of two complex numbers
d) Multiplication of two complex numbers (Note: represent complex number using a structure.)

Exercise-4

a) Write a C program to implement Union Concept.
b) Write a C program which copies last ‘n‘ characters from one file to another.

Exercise-5

a) Write a C program to reverse the first ‘n‘ characters in a file.
b) Write a C program to merge two files into a third file.

Exercise-6

Write a C program to implement the following operations on Stack using array representation

a) Push

b) Pop
c) Display

Exercise-7

Write a C program to implement the following operations on Queue using array representation

a) Insert
b) Delete
c) Display

Exercise-8

Write a C program to implement the following operations on Singly Linked list using linked representation

a) Insert
b) Delete
c) Display
d) Search

Exercise-9

Write a C program that implements the following sorting methods to sort a given list of integers in ascending order.

a) Bubble sort
b) Selection sort
c) Insertion sort

Exercise-10

Write C program to implement the following searching methods to search an element in a given list of integers

a) Linear Search
b) Binary Search

REFERENCE BOOKS:

1) Programming in C, Pradeep Dey, Manas Ghosh, Oxford Heigher Education
2) Computer programming and Data Structures, E.Balaguruswamy, Tata Mc Graw Hill. 2009 revised edition.
3) Mastering C, K.R. Venugopal and S.R. Prasad, TMH Publications.

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I B.Tech, II-Sem (ME) P C
3 1.5

(A0592191) ENGINEERING WORKSHOP AND IT WORKSHOP

(For Branches: CE, EEE, Mech, ECE & CSE)

ENGINEERING WORKSHOP

COURSE OBJECTIVES:

- To familiarize with the basic manufacturing processes and to study the various tools and equipment used, hands-on training is given in different sections. Essentially student should know the labour involved, machinery or equipment necessary, time required to fabricate and also should be able to estimate the cost of the product or job work.

COURSE OUTCOMES:

At the end of the Engineering Work Shop:

- A student should know the basic knowledge of various tools and their use in different sections of manufacturing such as fitting, carpentry, tin smithy, welding etc. and basic engineering practices such as plumbing, electrical wiring, electronic circuits, machine shop practice.
- Ability to design and model various basic prototypes in the trade of fitting such as Straight fit, V- fit.
- Ability to make various basic prototypes in the trade of Tin smithy such as rectangular tray, and open Cylinder.
- Ability to perform various basic House Wiring techniques such as connecting one lamp with one switch, connecting two lamps with one switch, connecting a fluorescent tube, Series wiring, Go down wiring.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	-	1	2	2	1	-	-	-	2	-	2	1	1	-	-	1
CO2	-	-	-	-	2	1	-	-	2	2	2	-	2	-	-	1
CO3	-	-	-	-	2	1	-	-	2	2	2	-	2	-	-	1
CO4	-	-	-	-	2	1	-	-	2	2	2	-	2	-	-	1

Note: At least two exercises to be done from each trade.

1) TRADES FOR EXERCISES:

A] Carpentry

1) T-Lap Joint
2) Cross Lap Joint
3) Dovetail Joint
4) Mortise and Tennon Joint

B] Fitting

1) Vee Fit
2) Square Fit
3) Half Round Fit
4) Dovetail Fit

C] House Wiring

1) Parallel/Series Connection of two/three bulbs
2) Stair Case wiring
3) Tube Light Wiring
4) Measurement of Earth Resistance/Go down Wiring

D] Tin Smithy

1) Rectangular Tray
2) Square Box without lid

3) Open Scoop
4) Funnel

E] Welding

1) Single V butt joint
2) Lap joint
3) Double V butt joint
4) T fillet joint.

F] Soldering

1) Soldering & Disordering Practice
2) Series Circuit
3) Parallel Circuit

2) TRADES FOR DEMONSTRATION:

a) Plumbing
b) Machine Shop
c) Bosch Power Tools

REFERENCE BOOKS:

1) Engineering Work shop practice for JNTU, V. Ramesh Babu, VRB Publishers Pvt. Ltd., 2009.
2) Work shop Manual / P.Kannaiah/ K.L.Narayana/ SciTech Publishers.
3) Engineering Practices Lab Manual, Jeyapoovan, Saravana Pandian, 4/e Vikas.
4) Dictionary of Mechanical Engineering, GHF Nayler, Jaico Publishing House

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AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

IT WORKSHOP

COURSE OBJECTIVES:

- The modules include training on PC Hardware, and Productivity tools including text processor, spread sheet, presentation tools. It enables the students to understand and fix the common hardware, software issues & makes the students to install either Windows or UNIX based Operating system in the machines.
- Enable students to understand how computers work, different types of computers, functions of applications, input and data storage devices, different operating systems,
- It makes the students to understand and use the common office suite tools like word, excel etc. effectively in their daily usage.

COURSE OUTCOMES:

By the end of module students will be expected to demonstrate

- PC Hardware- introduces the students to a personal computer and its basic peripherals, the process of assembling a personal computer. The students should work on working PC to disassemble and assemble to working condition.
- To do installation of system software like MS Widows and Linux and the required device drivers.
- Productivity tools- module would enable the students in crafting professional word documents; excel spread sheets and power point presentations using the Microsoft suite of office tools.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	-	2	-	-	-	-	-	-	-	-
CO2	2	2	-	2	-	-	-	-	-	-	-	-
CO3	2	2	-	-	-	-	-	-	-	3	-	-
CO4	2	2	-	2	3	-	-	-	-	-	-	-

PC HARDWARE

Exercise 1 - Identify the peripherals of a computer, components in a CPU and its functions.

Exercise 2 - Every student should disassemble and assemble the PC back to working condition.

Exercise 3 - Every student should individually install MS windows on the personal computer and also install Linux as dual boot with both Windows and

OFFICE TOOLS

Exercise 4 - Word Orientation: The mentor needs to give an overview of LaTeX and Microsoft (MS) office equivalent tool word: Importance of LaTeX and MS office tool Word as word Processors, Details of the four tasks and features that would be covered in each. Accessing, overview of toolbars, saving files, Using help and resources, rulers, format painter in word.

Task 1-Task III: Using Word Processor to create project certificate. Features to be covered: Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing, Borders and Colors, Inserting Header and Footer, Using Date and Time option in Word.

SPREAD SHEET

Exercise 5 – Spread Sheet Orientation: The mentor needs to tell the importance of MS office 2007, 2010/ equivalent tool Excel as a Spreadsheet tool, give the details of the four tasks and features that would be covered in each. Using Excel – Accessing, overview of toolbars, saving excel files, Using help and resources.

Task 1-Task III: Features to be covered: - Gridlines, Format Cells, Summation, auto fill, Formatting Text, Formulas, Functions

PRESENTATION

Exercise 6 - Students will be working on basic presentation utilities and tools which help them create basic power point presentation. Topic covered during this Exercise includes :- PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows in PowerPoint. Students will be given model power point presentation which needs to be replicated (exactly how it's asked).

REFERENCES:

1) Introduction to Information Technology, ITL Education Solutions limited, Pearson Education.
2) LaTeX Companion – Leslie Lamport, PHI/Pearson.
3) Introduction to Computers, Peter Norton, 6/e Mc Graw Hill
4) Upgrading and Repairing, PC's 18th e, Scott Muller QUE, Pearson Education
5) Comdex Information Technology course tool kit, Vikas Gupta, WILEY Dreamtech
6) IT Essentials PC Hardware and Software Companion Guide, Third Edition by David Anfinson and Ken Quamme. – CISCO Press, Pearson Education.

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AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

II B.Tech, I-Sem (ME) L T C
2 1 3

(A0009193) NUMERICAL METHODS AND PROBABILITY THEORY

(For branches CE & Mech)

COURSE OBJECTIVES:

- To familiarize the students with the foundations of probability and Numerical methods.
- To impart probability concepts and Numerical methods in various applications in Engineering.

COURSE OUTCOMES:

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

- Understand various Numerical methods to solve transcendental equations and rate of convergence. Analyze the concept of Interpolation its applications in digital image processing, computer graphics and in many engineering disciplines.
- Understand the concept of Numerical differentiation and integration and its importance in mechanics.
- Identify various numerical methods to solve linear and non-linear ordinary differential equations and its applications in non-linear analysis.
- To know the importance of probability, random variables and distributions in solving various mechanical and civil engineering problems.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	2	-	-	-	-	-	-	-
CO2	3	3	2	2	3	-	-	-	-	-	-	-
CO3	2	3	2	3	2	-	-	-	-	-	-	-
CO4	3	2	3	2	3	-	-	-	-	-	-	-
CO5	2	3	2	3	3	-	-	-	-	-	-	-

UNIT-1

Solution of Algebraic and Transcendental Equations: Introduction – The Bisection Method – The Method of False Position – The Iteration Method – Newton-Raphson Method.

UNIT-2

Interpolation: Introduction – Finite differences – Forward Differences – backward Differences –Newton's forward and backward difference formulae for interpolation – Gauss forward and backward difference formulae for interpolation - Lagrange's Interpolation formula.

UNIT-3

Numerical Differentiation – Numerical Integration – Newton-cote's integration formula – Trapezoidal rule – Simpson's 1/3 Rule – Simpson's 3/8 Rule.

Numerical solution of Ordinary Differential equations: Solution by Taylor's series-Picard's Method of successive Approximations – Euler's Method – Runge – Kutta Method.

UNIT-4

Curve fitting: Fitting a straight line – Second degree curve – Exponential curve-Power curve by method of least squares.

UNIT-5

Basic concept of probability – Random variables – Expectation – Discrete and continuous distributions.

UNIT-6

Distribution functions: Binomial Distribution – Poison Distribution and Normal Distribution – Related properties.

TEXTBOOKS:

1) Iyengar T.K.V., Krishna Gandhi B., Rangantham S., and Prasad M.V.S.S.N., (2006), "Mathematical Methods", S. Chand & Company, India.
2) Iyengar T.K.V., Krishna Gandhi B., Rangantham S., and Prasad M.V.S.S.N., (2015), "Probability and Statistics", S. Chand & Company, India.

REFERENCES:

1) Erwin kreyszig., (2011), "Advanced Engineering Mathematics", 10th Edition, John Wiley & Sons, United States
2) Ramana B.V., (2010), "Higher Engineering Mathematics", Tata McGraw Hill New Delhi, 11th Reprint, India
3) Kandasamy P., Thilagavathy K., and Gunavathi K., (2012), 2nd Edition, Numerical Methods, S. Chand & Company, Reprint India
4) Sastry S.S., (2005), 4th Edition, "Introductory methods of numerical analysis". PHI.
5) Grewal B.S., (2010), 35th Edition, "Higher Engineering Mathematics"., Khanna Publishers, India

R G M COLLEGE OF ENGINEERING AND TECHNOLOGY
AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

II B.Tech, I-Sem (ME) L T C
2 1 3

(A0503193) PYTHON PROGRAMMING

(For branches CE, EEE, Mech, ECE & CSE)

COURSE OBJECTIVES:

This course will enable students to

- Learn Syntax and Semantics of various Operators used in Python.
- Understand about Various Input, Output and Control flow statements of Python.
- Handle Strings and Files in Python.
- Understand Lists, Tuples in Python.
- Understand Sets, Dictionaries in Python.
- Understand Functions, Modules and Regular Expressions in Python.

COURSE OUTCOMES:

The students should be able to

- Examine Python syntax and semantics and be fluent in the use of various Operators of Python.
- Make use of flow control statements and Input / Output functions of Python.
- Demonstrate proficiency in handling Strings and File Systems.
- Create, run and manipulate Python Programs using core data structures like Lists and Tuples.
- Apply the core data structures like Sets and Dictionaries in Python Programming.
- Demonstrate the use of functions, modules and Regular Expressions in Python.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	1	-	-	-	1	1	1
CO2	2	3	-	-	-	-	-	-	1	-	-	-	1	1	1
CO3	1	-	2	-	-	-	-	-	1	-	-	-	1	1	1
CO4	2	-	2	-	-	-	-	-	1	-	-	-	1	1	1
CO5	2	-	2	-	-	-	-	-	1	-	-	-	1	1	1
CO6	2	-	2	-	-	-	-	-	1	-	-	-	1	1	1

UNIT-1

Introduction: History of Python, Need of Python Programming, Applications Basics of Python Programming Using the REPL(Shell), Running Python Scripts, Variables, Assignment, Keywords, Input-Output, Indentation. Overview on data types: Numbers, Strings, Lists, Set, Tuple and Dictionaries.

Operators in Python: Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Shift Operators, Ternary operator, Membership Operators, Identity Operators, Expressions and order of evaluations. Illustrative examples on all the above operators.

UNIT-2

Input and Output statements: input() function, reading multiple values from the keyboard in a single line, print() function, 'sep' and 'end' attributes, Printing formatted string, replacement operator ({}). Illustrative examples on all the above topics.

Control flow statements: Conditional statements – if, if-else and if-elif-else statements. Iterative statements – for, while. Transfer statements – break, continue and pass. Illustrative examples on all the above topics.

UNIT-3

Strings: Introduction to strings, Defining and Accessing strings, **Operations on string** - String slicing, Mathematical Operators for String, Membership operators on string, Removing spaces from the string, Finding Substrings, Counting substring in the given String, Replacing a string with another string, Splitting of Strings, Joining of Strings, Changing case

of a String, Checking starting and ending part of the string, checking type of characters present in a string. Illustrative examples on all the above topics.

Files: Opening files, Text files and lines, Reading files, Searching through a file, Using try, except and open, Writing files, debugging.

UNIT-4

Lists: Creation of list objects, Accessing and traversing the elements of list. **Important functions of list** – len(), count(), index(), append(), insert(), extend(), remove(), pop(), reverse() and sort(). **Basic Operations on list:** Aliasing and Cloning of List objects, Mathematical Operators for list objects, Comparing list objects, Membership operators on list, Nested Lists, List Comprehensions. Illustrative examples on all the above topics.

Tuples: Creation of Tuple objects, Accessing elements of tuple, Mathematical operators for tuple, Important functions of Tuple – len(),count(),index(), sorted(), min(), max(), cmp().Tuple Packing and Unpacking. Illustrative examples on all the above topics.

UNIT-5

Sets: Creation of set objects, Accessing the elements of set. Important functions of set – add(), update(), copy(), pop(),remove(),discard(),clear(). Basic Operations on set **-** Mathematical Operators for set objects, Membership operators on list, Set Comprehensions. Illustrative examples on all the above topics.

Dictionaries: Creation of Dictionary objects, Accessing elements of dictionary, Basic operations on Dictionary - Updating the Dictionary, Deleting the elements from Dictionary. Important functions of Dictionary – dict(), len(), clear(), get(), pop(), popitem(), keys(), values(), items(), copy(), setdefault(). Illustrative examples on all the above topics.

UNIT-6

Functions - Defining Functions, Calling Functions, Types of Arguments - Keyword Arguments, Default Arguments, Variable-length arguments, Anonymous Functions, Fruitful functions (Function Returning Values), Scope of the Variables in a Function - Global and Local Variables. Recursive functions, Illustrative examples on all the above topics**.**

Modules: Creating modules, **import** statement, from Import statement.

Regular Expressions: Character matching in regular expressions, Extracting data using regular expressions, Combining searching and extracting, Escape character.

TEXT BOOKS:

1) Python for Everybody: Exploring Data Using Python 3, 2017 Dr. Charles R. Severance

REFERENCE BOOKS:

1) Think Python, 2 Edition, 2017 Allen Downey, Green Tea Press
2) Core Python Programming, 2016 W.Chun, Pearson.
3) Introduction to Python, 2015 Kenneth A. Lambert, Cengages
4) https://www.w3schools.com/python/python_reference.asp
5) https://www.python.org/doc/

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II B.Tech, I-Sem (ME)

L	T	C
2	1	3

(A0303193) MECHANICS OF SOLIDS

COURSE OBJECTIVES:

The students will:

- Learn the basic concepts of mechanics of solids.
- Solve the problems on stresses and deformations of objects/solids/shells under external/internal loadings.
- Learn the design the beams by considering the bending stresses..
- Able to apply the knowledge of mechanics of solids to engineering applications

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to;

- Understand the basic concepts and principles of mechanics of solids.
- Determine stresses and deformations of objects/solids/shells under external/internal loadings.
- Design the beams properly.
- Apply the knowledge of mechanics of solids to engineering applications.
- Use the basic concepts of Mechanics of solids to support further study in machine design.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	1			2					1				
CO2	3	3	2	2			2					1				
CO3	3	3	2	1			2					1				
CO4	3	3	3	1			2					1				

UNIT-1

SIMPLE STRESSES & STRAINS: Rigid and Deformable bodies; Strength, Stiffness and Stability; Stresses- Tensile, Compressive and Shear ; Deformation of simple and compound bars under axial load – Thermal stresses; Elastic constants; Stress-strain diagrams for brittle and ductile materials - working stress; Strain energy and unit strain energy – Strain energy in uniaxial loads.

UNIT-2

SHEAR FORCE AND BENDING MOMENT: Types of beams- Supports and Loads- Relation between S.F, B.M and rate of loading at a section of a beam – Shear force and Bending Moment in beams – Cantilever, Simply supported and Overhanging beams subjected to point loads, UDL, Uniformly varying loads and combination of these loads- Point of Contra flexure.

UNIT-3

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

UNIT-4

BEAM DEFLECTION: Elastic curve of Neutral axis of the beam under normal loads – Evaluation of beam deflection and slope: Double integration method, Macaulay Method.

Columns: End conditions – Equivalent length of a column – Euler‟s equation – Slenderness ratio – Rankin's formula for columns.

UNIT-5

PRINCIPAL STRESSES & STRAINS: Principal stresses and Principal planes, Method of determining stresses on oblique sections, Mohr's circle.

UNIT-6

CYLINDERICAL SHELLS: Thin cylindrical shells – Derivation of formula for longitudinal and circumferential stresses –hoop, longitudinal stresses and volumetric strains.

TEXT BOOKS:

1) Strength of Materials by Ramamrutham.
2) Strength of Materials by R.K. Bansal, Laxmi publications (P) ltd.
3) James M. Gere, Barry J. Goodno, **Mechanics of Materials**, 7th edition, Cengage learning, 2009.
4) FERDINAND P. BEER, E. RUSSELL JOHNSTON, JR., JOHN T. DEWOLF and DAVID F. MAZUREK, **Mechanics of Materials,** fifth edition, McGraw Hill Education,2006.
5) Dr. B.C. Punmia, Ashok Kr. Jain, Arun Kr. Jain, **Mechanics of Materials,** Laxmi publications, New Delhi.
6) Andrew Pytel, Jaan Kiusalaas-Mechanics of Materials, Second Edition - Cengage Learning (2011).
7) R. C. HIBBELER, **Mechanics of Materials**, 13th EDITION, Prentice Hall, 2012.
8) Strength of materials by Bhavikatti, Lakshmi Publications.

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II B.Tech, I-Sem (ME)

L	T	C
2	1	3

(A0304193) MATERIAL SCIENCE AND METALLURGY

COURSE OBJECTIVES:

- To gain knowledge of different material crystal structures and their mechanical properties.
- To able to understand the phase transformations of metals and its alloys with help of equilibrium diagrams.
- Able to understand the characterization of the materials
- To able to select the suitable metals, nonferrous metals and alloys for the given application.

COURSE OUTCOMES:

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

- To understand basic concepts of crystallography of metals, material properties.
- Construct the Phase diagrams and interpret the data.
- Perform experiments to evaluate the properties of the Engineering Materials.
- Identify, formulate and solve material science and metallurgy problems.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	2	2	1	-	-	2	-	1	2	3	2	2
CO2	2	3	2	2	1	-	-	1	-	1	-	-	1	2	3	2
CO3	2	3	2	3	2	1	-	-	1	-	-	1	2	2	2	3
CO4	3	3	2	-	2	-	-	-	-	-	1	-	1	2	1	2

UNIT-1

Structure of Metals: Space lattice, Unit cell-Crystal structures (BCC, FCC and HCP)-Crystallization of metals, grain and grain boundaries, effect of grain boundaries on the properties of metal / alloys - Mechanical properties of Engineering materials.

Constitution of Alloys: Necessity of alloying, types of solid solutions, Hume Rothery‟s rules, intermediate alloy phases, and electron compounds.

UNIT-2

Testing of Engineering materials: Mechanism of plastic deformation, Slip and Twinning-Testing of materials under tension, Compression and shear loads, Hardness tests- Brinell, Vicker‟s and Rockwell, Impact test- Izod and Charpy tests, Fatigue and creep tests.

UNIT-3

Steels and Cast Iron: Allotropy and phase changes of pure iron- Iron-Iron carbide ($Fe-Fe_3C$) equilibrium diagram-Lever rule, Types of steels- Low, medium and high carbon steels, stainless steels, Alloy steels-Tool steels & die steels and their applications; Cast Irons, Types-White, grey, malleable and nodular cast irons and properties and applications.

UNIT-4

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

UNIT-5

Heat Treatment of Alloys: Effect of alloying elements on $Fe-Fe_3C$ system, Annealing, normalizing, Hardening, Tempering- Surface hardening methods.

UNIT-6

Powder Metallurgy: Introduction, advantages of Powder Metallurgy, Preparation of metal powders-Mixing, Blending, Compacting, Sintering & Hot-pressing – applications of powder metallurgy, examples of typical components produced.

TEXT BOOKS:

1) Introduction to Physical Metallurgy / Sidney H. Avener.TMH Publications, 2nd Edition, 1997

2) Engineering Materials and Metallurgy, R.K Rajput, S. Chand Ltd, 2006
3) Material Science and Engineering / V. Raghavan, 5th Edition, PHI Publications, 2011

REFERENCES:

1) Material Science and Metallurgy for Engineers by V.D kodgire, Everest publishing house, 2011.
2) Introduction to Engineering Materials, B.K Agarwal, 21st Reprint, TMH publications, 2007
3) Essential of Materials science and engineering/ Donald R.Askeland/Thomson publications, 2004

R G M COLLEGE OF ENGINEERING AND TECHNOLOGY
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DEPARTMENT OF MECHANICAL ENGINEERING

II B.Tech, I-Sem (ME)

L	T	C
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(A0305193) THERMODYNAMICS

(Use of Standard Steam Tables, Mollier Diagram & Psychometric Chart are Permitted in End Examinations**)**

COURSE OBJECTIVES:

The students completing this course are expected:

- Concepts of heat, work, energy and governing rules for conversion of one form to other.
- Applications of I & II law of thermodynamics.
- To understand concept of entropy for identifying the disorder and feasibility of a thermodynamic process.
- To familiarize steam properties to understand working of steam power plants.
- To familiarize psychometric properties to understand working of Refrigeration and Air conditioning systems.

COURSE OUTCOMES:

Students who have done this course will have a good idea of the basics of thermodynamics.

- The students will be able to apply energy balance to systems and control volumes, in situations involving heat and work interactions.
- The students will be able to evaluate the performance of energy conversion devices based on I and II law of thermodynamics.
- The students can evaluate changes in thermodynamic properties of substances.
- The students will be able to analyse the cycles for utilization in internal combustion engines.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	3	2	2	-	1	-	-	2	-	1	2	2	-	-	-
CO2	3	3	3	3	3	2	1	-	2	2	2	2	2	-	1	1
CO3	1	3	3	3	3	2	1	-	2	2	1	2	2	-	1	1
CO4	1	3	2	2	-	1	-	-	2	-	1	-	2	-	-	1

UNIT-1

Basic Concepts and Definitions: Classical and statistical thermodynamics, definitions of thermodynamic terms, quasi – static process, point and path functions, forms of energy, ideal gas and real gas, Zeroth law of thermodynamics.

Work and Heat: Non flow (P.dV) or displacement work in various reversible processes, Heat Transfer, comparison of work and heat.

UNIT-2

First Law of Thermodynamics: First law for a closed system undergoing a cycle and for a process, Joules experiment, PMM-I.

First Law Applied to Non-Flow and Flow Process, Corollaries and limitations of First Law of Thermodynamics. simple problems.

UNIT-3

Second Law of Thermodynamics: Kelvin-Plank statement, Clausius statement, equivalence of Kelvin-plank and clausius statements, Heat engine, heat pump and refrigerator, reversibility and irreversibility, Carnot Cycle, Carnot's Theorem, PMM-II - simple problems.

UNIT-4

Entropy: Clausius theorem, Definition of entropy, principle of entropy increase, T-s plot, change in entropy in various reversible processes.

Availability & Irreversibility: Definition of; exergy and energy, Availability in steady flow, non-flow processes and irreversibility.

UNIT-5

Properties of Steam : Formation of steam form ice to super-heated steam with reference to T-V, P-V & T-S diagrams, properties of steam, Quality of steam, expressions for the change in internal energy, enthalpy, work, heat, entropy in various processes, Use of steam Tables and Mollier's chart. Simple problems.

UNIT-6

Psychometry

Definitions of - Dry Bulb temperature, Wet-Bulb Temperatures, Specific humidity (or) Humidity Ratio, Dew Point Temperature, Degree of Saturation, Relative Humidity, Sensible Heating, Sensible cooling, Humidification and Dehumidification. Measurement of psychometric properties using psychometric chart. Simple Problems.

TEXT BOOKS:

1) P.K. Nag Engineering Thermodynamics, 6th Edition 2019 Tata McGraw Hill, New Delhi.
2) Cengel, Thermodynamics – An Engineering Approach, 6th Edition 2019 Tata McGraw Hill, New Delhi.
3) Engineering Thermodynamics – Prof. K.Rama Krishna, Anuradha Pulications.

REFERENCE BOOKS:

1) B.P Mistra, Engineering Thermodynamics.
2) E. Ratha Krishna, Fundamentals of Engineering Thermodynamics, PHI Publishers, New Delhi.
3) Thermodynamics – Yadav" Central Publishers.

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II B.Tech, I-Sem (ME) L T C
2 0 2

(A0010193) BIOLOGY FOR ENGINEERS

(Life Sciences)
(For branches CE, EEE, Mech, ECE & CSE)

COURSE OBJECTIVES:

- To familiarize about biological components and their applications
- To train the students on the principles and Mechanisms in Biological Chemistry
- To train the concepts of molecular structures of Biomolecules
- To introduce the basic principles of Cell Structures and Functions
- To apply the concepts in the development of biosensors for mankind.

COURSE OUTCOMES:

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

- Explain concept and function of cell and cell organelles
- Develop knowledge about various physiological processes in biological systems
- Explain about biomolecules, their structure and function and their role in living organisms. How biomolecules are useful in industry.
- Understanding about human physiology
- Identify and describe the functions of the skeletal system

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO2	2	-	2	-	-	-	2	-	-	-	-	1	-	-	-
CO3	2	-	2	-	-	-	-	1	-	-	1	1	-	-	-
CO4	2	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO5	2	1	-	-	-	-	-	-	-	-	-	1	-	-	-
Course	1	-	1	-	1	-	-	-	1	-	-	-	-	-	-

UNIT-1:

Cell Structure and Function - Cell theory, Ultra structure of eukaryotic cell (Cell wall, Cell membrane, Golgi complex, Endoplasmic Reticulum, Peroxisome, Lysosomes), Semi-autonomous cell Organelles (Mitochondria & Chloroplast) (5 periods)

Learning outcomes:

1. Understand the structure and importance of the cell.
2. Explain the importance of eukaryotic cell.
3. Explain the functions of cell organelles.

UNIT-2:

Human Physiology – Nutrition (Functions of micro & macro nutrients and their role), Respiration (Definition, Types, Respiration in humans), Digestion (Process and digestive organs in humans), Excretion (Definition, Urinary system in humans). (6 Periods)

Learning outcomes:

1. Understand the metabolism in living organism.
2. Explain about the importance of human physiological process.
3. Identify the nutritional values in human body.

UNIT-3:

Biomolecules - Proteins (Denaturation of proteins), Nucleic acids (Mechanism of Replication & Transcription), Vitamins (Classification & functions of vitamins in bio-systems). (5 Periods)

Learning outcomes:

1. Describe the denaturation of proteins.
2. Illustrate replication of nucleic acids.
3. Identify the importance of Vitamins in human body.

UNIT-4:

Biomaterials - Definition of biomaterials, Requirements of biomaterials, Classification of biomaterials, Physical and Mechanical properties of bio-materials, Comparison of properties of some common biomaterials. (5 Periods)

Learning outcomes

1. Understand the role of biomaterials for humans.
2. Understand the properties of biomaterials for organ substitution.

UNIT-5:

Skeletal System-Types of bones, Structure and composition of bone, artificial bone replacements with soft engineering materials. (6 Periods)

Learning outcomes

1) Understand bone structure and composition
2) Able to develop knowledge about bone replacement.

UNIT-6:

Applications of Biology- Stem Cells (Sources, Types and its Uses) Cancer Therapy, Basics of bio-sensors and bio-chips for bio-engineering. (5 Periods)

Learning outcomes

1) Understand the role of stem cells in biology.
2) Develop new type of biosensors, biochips etc.

TEXT BOOKS

1) Nelson, D. L. and Cox, M.M. (2008).Lehninger, Principles of Biochemistry, 5th Edition, W.H.Freeman and Company, N.Y., USA.
2) Ross & Wilson, Anatomy and Physiology, Churchill Livigstone publications (2014).

REFERENCE BOOKS

1) Voet, D. and Voet, J.G. (2004). Biochemistry, 3rd Edition, John Wiley & Sons, Inc. USA.
2) Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition, John Wiley & Sons. Inc.
3) De Robertis, E. D. P. and De Robertis R. E. 2009. Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia.
4) Cooper G. M. Hausman R. E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press and Sunderland, Washington D. C.; Sinnauer Academic Press.
5) L. Hench & E.C. Ethridge, Biomaterials – An Interfacial approach, Academic Press, 1982.

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II B.Tech, I-Sem (ME)

L	T	C
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(A0011193) APTITUDE, ARITHMETIC, REASONING AND COMPREHENSION

(Skill Development Course)
(For branches CE, EEE, Mech, ECE & CSE)

COURSE OBJECTIVES:

- To familiarize the students about the concepts of aptitude, arithmetic and reasoning
- To cope up the students to improve their employable skills

COURSE OUTCOMES:

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

- Understand number system, which helps to become well trained for recruitment drives.
- Analyze permutations and combinations concept.
- Obtain the knowledge of coding and decoding concept.
- Understand the topics related to clock and probability.
- Identify the topics related to Venn diagrams, reasoning and Non-verbal reasoning.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	-	-	-	-	-	-	-	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-
CO4	3	2	3	-	-	-	-	-	-	-	-	-
CO5	3	3	2	-	-	-	-	-	-	-	-	-

UNIT-1

Numbers, Number Systems Simple Equations, Ratio, Proportion, Variation Quadratic Equations, Progressions Percentages.

UNIT-2

Profit, Loss, Partnerships Averages, Mixtures & Allegations, Simple Interest, Compound Interest, Time and Work-Pipes, indices, surds, inequalities , Cisterns Time and Distance Geometry and Menstruation.

UNIT-3

Permutations & Combinations and Probability Data Interpretation & Data Sufficiency.

UNIT-4

Number & Letter Series, Analogies, Coding Decoding, Odd Man Out Blood Relations.

UNIT-5

Direction Sense, Symbols and Notations Deductions & Connectives Clocks, Calendars Analytical

UNIT-6

Reasoning (Verbal and Non-Verbal) , Venn Diagrams, Analytical Puzzles and Octal number system.

REFERENCES:

1) R.S.Agarwal. Quantitative Techniques. S.Chand Series.
2) Shankuntala Devi. Techniques of Reasoning. S.Chand Series.
3) https://www.fresherslive.com/online-test/verbal-ability-test/questions-and- answers
4) https://www.fresherslive.com/online-questions/verbal-ability-test/arithmetic-Reasoning

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II B.Tech, I-Sem (ME) P C
3 1.5

(A0594193) PYTHON PROGRAMMING LAB

(For branches CE, EEE, Mech, ECE & CSE)

COURSE OBJECTIVES:

- To be able to introduce core programming basics and various Operators of Python programming language.
- To demonstrate about Python data structures like Lists, Tuples, Sets and dictionaries
- To understand about Functions, Modules and Regular Expressions in Python Programming.

COURSE OUTCOMES:

- Student should be able to understand the basic concepts of scripting and the contributions of scripting language.
- Ability to explore python data structures like Lists, Tuples, Sets and dictionaries.
- Ability to create practical and contemporary applications using Functions, Modules and Regular Expressions.

MAPPING WITH COs & POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	-	-	-	-	-	1	-	-	-	1	1	1
CO2	3	3	2	-	-	-	-	-	1	-	-	-	1	1	1
CO3	3	1	2	-	-	-	-	-	1	-	-	-	1	1	1

1) Program to demonstrate basic data type in python
2) Program to demonstrate operators in python
3) A cashier has currency notes of denominations 10, 50, and 100.If the amount to be withdrawn is input through the keyboard using input() function in hundreds, find the total number of currency notes of each denomination the cashier will have to give to the withdrawer
4) Program to demonstrate list and tuple in python
5) Write a program in Python, A library charges a fine for every book returned late. For first 5 days the fine is 50 paisa, for 6-10 days fine is one rupee and above 10 days fine is 5 rupees. If you return the book after 30 days your membership will be cancelled. Write a program to accept the number of days the member is late to return the book and display the fine or the appropriate message
6) Write a program to calculate overtime pay of 10 employees. Overtime is paid at the rate of Rs.12.00 per hour for every hour worked above 40 hours. Assume that employee do not work for fractional part of an hour.
7) Two numbers are entered through the keyboard; write a program to find the value of one number raised to the power of another.
8) Write a function that receives marks received by a student in 3 subjects and returns the average and percentage of these marks. Call this function from main() and print the result in main
9) Write a program to read a file and display its contents.
10) Write a program to demonstrate Regular Expressions in python.

TEXT BOOKS:

1) Learning Python, Mark Lutz, Orielly, 3 Edition 2007.
2) Python Programming: A Modern Approach, Vamsi Kurama, Pearson, 2017.

REFERENCE BOOKS:

1) Think Python, 2 Edition, 2017 Allen Downey, Green Tea Press
2) Core Python Programming, 2016 W.Chun, Pearson.
3) Introduction to Python, 2015 Kenneth A. Lambert, Cengages
4) https://www.w3schools.com/python/python_reference.asp
5) https://www.python.org/doc/

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AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

II B.Tech, I-Sem (ME) P C
3 1.5

(A0392193) ENGINEERING MECHANICS AND MECHANICS OF SOLIDS LAB

COURSE OBJECTIVES:

- To understand some fundamental aspects and failure modes of engineering materials with the applications of sudden and gradually applied loads.
- To find out the hardness of the various materials with the help of Brinell's & Rockwell hardness testing machines
- To conduct the tests for elastic constants using flexural and torsional apparatus.
- To analyse the efficiency of the different types of lifting machines
- **To** Verify principle of Moments using bell crank lever apparatus, Lami's theorem, study Parallel Force apparatus (Simply supported type) and also determine the coefficient of friction

COURSE OUTCOMES:

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

- Determine the Elastic constants and strength of the given material using Tension compression, torsion & flexural tests.
- Determine the strain energy stored in the material under impact loads
- Determine the hardness of the given material
- Determine the efficiency of the lifting machines
- Verify principle of Moments using bell crank lever apparatus, Lami's theorem, study Parallel Force apparatus (Simply supported type) and also determine the coefficient of friction

MAPPING WITH COs & POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2	2				1	1		1	2	-	-	1
CO2	3	3	2	2	2				1	1		1	2	-	-	1
CO3	3	3	2	2	2				1	1		1				
CO4	3	3	2	2	2				1	1		1				
CO5	3	3	2	2	2				1	1		1				

LIST OF EXPERIMENTS: Conduct any FIVE experiments from each cycle for record

CYCLE: I

1) To study the stress-strain characteristics of Mild Steel Rod using Universal Testing Machine (UTM).
2) To find the compressive strength of a wood.
3) Torsion test on mild steel rod.
4) To conduct the Charpy & Izod Impact test on metal specimen.
5) To conduct the Hardness test on metals – using Brinnel & Rockwell hardness testing machine.
6) To conduct the Deflection test on beams.
7) To conduct the Compression & Tension test on helical spring.

CYCLE: II

1) Verification of Lami's Theorem.
2) To determine the support reactions of a simply supported beam and verify the same with analytical values.
3) To determine the Co-efficient of Friction for different materials.
4) To verify the principle of moments using the bell crank lever apparatus.
5) To determine the moment of Inertia of a flywheel.
6) To determine the Mechanical advantage, Velocity ratio and Mechanical efficiency of the simple wheel & Axle.

7) To determine the Mechanical advantage, Velocity ratio and Mechanical efficiency of a worm and worm wheel.

STUDY (EXPERIMENTS BEYOND CURRICULUM):

1) To determine the moment of inertia of a compound pendulum.
2) To verify the polygon law of coplanar Forces for a concurrent force system.
3) Verification of force transmitted by members of given truss.
4) To determine the coefficient of static friction between two surfaces.
5) To determine the coefficient of friction between the threads of the screw jack.

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AUTONOMOUS
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II B.Tech, I-Sem (ME) P C
3 1.5

(A0393193) MATERIAL SCIENCE LAB

COURSE OBJECTIVES:

- The student should be capable of mount the specimen and able to identify the given metal by observing the micro structure.
- To Distinguish the Ferrous and non-Ferrous structures.
- To study the effect of heat treatment on microstructures.

COURSE OUTCOMES:

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

- Gains the knowledge of preparing the sample for metallurgical observations.
- Identify the material based on its micro structure and also assess its mechanical properties.
- Realize the effect of heat treatment on the mechanical properties of the material.
- Understand the non-destructive testing methods.

MAPPING WITH COs & POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2	1	2	-	-	3	-	2	-	1	-	1	-
CO2	3	1	1	1	-	1	-	-	3	-	-	-	1	-	1	-
CO3	3	3	2	2	1	2	-	-	3	-	2	-	2	-	-	-
CO4	-	2	1	3	2	1	-	-	-	-	-	-	1	2	-	-

LIST OF EXPERIMENTS:

1) Preparation of mounted specimen using hydraulic specimen mounting press.
2) Preparation and study of the Micro Structure of pure metals like Iron, Cu and Al.
3) Preparation and study of the Microstructure of Mild steels, low carbon steels, high – Carbon steels.
4) Study of the Micro Structures of Cast Irons.
5) Study of Micro Structure of Austenitic- stainless steel.
6) Study of Micro Structure of High-Speed steel.
7) Study of the Micro Structures of Non-Ferrous alloys (Al-alloy, Cu-alloy).
8) Study of the Micro structures of Heat-treated steels.
9) Determination of hardenability of steels by Jomny End Quench Test.
10) Determination of the hardness of untreated steels.
11) Magnaflux testing method.

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AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

II B.Tech, II-Sem (ME) L T C
2 1 3

(A0204193) BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

(For branches CE & Mech)

COURSE OBJECTIVES:

- This course introduces the basic concepts in electric circuits and networks
- This course also introduces the working principles of D.C Generator, DC motor.
- It also helps to study the operating principles of Transformers and their working.
- To understand the fundamental principles of basic electronic devices.
- To provide theoretical prerequisites necessary to do lab work on DC machines and Electronic Devices.

COURSE OUTCOMES:

At the end of the course student is able to

- To know the basic knowledge of conducting materials and electrical circuit parameters.
- Understand the principles of dc machines.
- Analyze the working operation of Transformer.
- Determine the efficiency of machines, half wave and full wave rectifiers.
- Able to observe the different tests and calculations of all machines.
- Applications of dc machines, transformers and rectifiers.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	-	-	-	-	2	-	1	2
CO2	3	3	1	2	-	-	-	-	2	-	1	2
CO3	3	1	2	3	-	-	-	-	1	-	2	1
CO4	3	3	2	2	-	-	-	-	2	-	2	2
CO5	3	3	1	2	-	-	-	-	1	-	2	2
CO6	3	1	3	2	-	-	-	-	2	-	1	1

UNIT-1

Electrical DC Circuits: Basic definitions (electrical conductor, insulator, semiconductor, electrical circuit, electric current, electric potential, EMF and electric potential difference) - Types of elements (active and passive elements)- Ohm's Law and its limitations- electric power-electrical energy- Kirchhoff's Laws- Resistances in series- Resistances in parallel- Star to delta and delta to star transformations- simple problems.

UNIT-2

DC-Generator: Construction and Operation: D.C Generators-Working Principle – construction of DC Generator - Action of commutator, types of armature windings, induced emf equation, – Classification of DC Generators-separately excited, self-excited- series, shunt, short & long shunt compound generator-simple problems regarding EMF.

UNIT-3

DC Motor: DC motors-principle of operation -back emf –voltage and power equation of dc motor, condition for maximum power -types of DC Motors- series, shunt, short & long shunt compound motor, torque & speed equation –speed control of DC Shunt Motor –armature control method, field control method-losses in DC machines- efficiency calculation –simple problems.

UNIT-4

Transformers: Necessity of transformer-classification of transformers-Principle of operation of single-phase transformers- Theory of an Ideal Transformer –Constructional features – core type & shell type transformers, induced emf equation, transformation ratio's-losses in a transformer- efficiency of transformer-transformer on no-load & R-load –simple problems.

UNIT-5

Diode and its Characteristics: Formation of n- type and p-type semiconductor – Construction of P-n junction diode, symbol - V-I Characteristics- Diode Applications- Rectifiers – Half Wave-Full wave-mid-point only-simple Problems.

UNIT-6

Transistors and CRO: Formation of PNP and NPN transistors – CE configuration of NPN and PNP transistors- applications -Transistor as an amplifier- construction and Principle of CRO (operation only)-Applications.

TEXT BOOKS:

1) Kothari D.P and Nagrath I.J., (2019),"Basic Electrical Engineering", 4th edition. McGraw-Hill Education., India
2) Naidu M.S and Kamakshaiah S., (1995),"Introduction to Electrical Engineering", McGraw-Hill Education (India) Pvt Limited., India

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DEPARTMENT OF MECHANICAL ENGINEERING

II B.Tech, II-Sem (ME)

L	T	C
2	1	3

(A0306194) MANUFACTURING TECHNOLOGY

COURSE OBJECTIVES:

- The primary objective of this course is to introduce the concept of manufacturing technology with the help of various processes widely employed in industries.
- The course consists of casting, welding, sheet metal forming, extrusion and forging processes with the related details of equipment and applications.
- To understand various metal working process. To appreciate the capabilities, advantages and the limitations of the processes.
- To understand the various concepts of metal forming and forging along with their applications.

COURSE OUTCOMES:

After completing the course, the student can able to;

- Design patterns, cores and gating system for metal casing.
- Acquire knowledge and hands-on competence in applying the concepts of manufacturing science in the design and development of mechanical systems.
- Design near net shaped components from metal to meet societal needs within realistic constraints.
- Develop joints using solid state and fusion joining and soldering techniques and also able to develop components form plastic.

MAPPING OF COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3				3	2	2	-	3	2	1	-	3	3	2	1
CO2	3				3	2	2	-		1	3	-	2	3	2	-
CO3	3				2	2	2	-	3	2	3	-	3	3	2	-
CO4	3				3	2	2	-	2	1	3	-	3	3	2	-

UNIT-1

METAL CASTING PROCESSES: Introduction, Steps involved in making a casting, casting terms, Pattern making - types of patterns, pattern materials, and pattern allowances. Mould making - type of moulding sands, moulding sand properties, methods of sand testing, moulding machines – types of moulding machines. Core making - Core sands, Types of cores, Core prints, Chaplets, Chills, Risers and Gating systems used in casting.

UNIT-2

SPECIAL CASTING PROCESSES: Shell Moulding, Precision Investment Casting, Permanent Moulding Casting, Die Casting, Vacuum Die Casting, Low Pressure Die Casting, Centrifugal Casting, Continuous Casting, Squeeze Casting. Melting of metals in casting- Cupola furnace, Casting Cleaning Casting Defects - Causes and Remedies.

UNIT-3

WELDING PROCESSES: Classification of welding processes, types of welded joints and their characteristics, Gas welding, Different types of flames and uses, Oxy – Acetylene Gas cutting. Basic principles of Arc welding, Manual metal arc welding, submerged arc welding, and Inert Gas welding- TIG & MIG welding. Resistance welding, Solid state welding processes- Friction welding, Friction stir welding, Forge welding, Explosive welding; Thermit welding, Plasma welding, Laser welding, electron beam welding, Soldering & Brazing. Welding Defects – Causes and Remedies.

UNIT-4

METAL FORMING PROCESSES: Plastic deformation in metals and alloys, Hot working and Cold working, Strain hardening and Annealing.

Bulk forming processes: Forging - Types Forging, Smith forging, Drop Forging, Roll forging, Forging hammers, Rotary forging, forging defects; Rolling – fundamentals, types of rolling mills. Extrusion and its characteristics. Types of extrusion, Impact extrusion, Hydrostatic extrusion; Wire drawing and Tube drawing.

UNIT-5

SHEET METAL FORMING: Shearing operations- Punching, Blanking and piercing- Bending and forming- Drawing and its types- wire drawing and tube drawing- coining- Hot and cold spinning- Types of presses and press tools.

UNIT-6

PROCESSING OF PLASTICS: Types of Plastics, Properties, Applications and Plastic processing methods – Compression moulding, Transfer moulding, Injection moulding, Blow moulding, Rotomoulding, Extrusion, Thermoforming, Calendaring and Casting.

TEXT BOOK:

1) P N. Rao, "Manufacturing Technology", Vol-I, 4th Edition, Tata McGraw-Hill Publishing Limited,
2) P. Ghosh, A., and Malik, A. K., "Manufacturing Science, Affiliated East west Press Pvt. Ltd.2010
3) S. Kalpakjian, Manufacturing Processes for Engineering Materials, Fifth edition. Pearson Education, 2009

REFERENCE BOOKS:

1) P.C. Sharma, "A text book of production technology", S. Chand and Company, 2014
2) Begman, „Manufacturing Process", John Wilely & Sons,2011
3) Production Technology by K.L. Narayana, J.K. International Publications.3rd Edition,2014
4) Rajput R.K, "A text book of Manufacturing Technology", Lakshmi Publications, 2015
5) Hajra Choudhury, "Elements of Workshop Technology, Vol. I and II", Media Promoters Pvt. Ltd.Mumbai, 2020
6) Production Technology by R.K Jain, 6th edition, 2020.

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II B.Tech, II-Sem (ME)

L	T	C
2	1	3

(A0307194) THEORY OF MACHINES

COURSE OBJECTIVES:

- To understand the kinematics machine components
- To understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link
- To be able to design some linkage mechanisms and cam systems to generate specified output motion
- To understand the kinematics of gear trains

COURSE OUTCOMES:

After completing the course, the student can able to

- Understand and design various linkage mechanisms for obtaining specific motion.
- Analyze the mechanism for optimal functioning
- Conduction investigation on the functionality of the mechanisms and machinery
- Apply mechanisms and machines in the field of research of motion control.

MAPPING WITH COs & POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	3	2	-	-	-	-	-	1	-	3	3	3	1
CO2	2	3	2	2	2	2	-	2	2	-	1	-	3	2	2	1
CO3	2	2	2	3	3	1	-	-	3	-	1	1	3	3	2	1
CO4	3	2	3	2	3	2	-	1	1	1	1	1	2	1	1	1

UNIT-1

MECHANISMS: Elements or Links–Classification – Rigid Link, flexible and fluid link– Types of kinematic pairs – sliding, turning, rolling, screw and spherical pairs – lower and higher pairs – closed and open pairs –constrained motion – completely, partially or successfully constrained and incompletely constrained.

MACHINES: Mechanism and machines – classification of machines – kinematic chain – inversion of mechanism – inversions of quadric chain, single and double slider crank chains,- Grubler's criterion.

UNIT-2

KINEMATICS: Velocity and acceleration–Motion of link in machine – Determination of Velocity and acceleration diagrams – Graphical method – Application of relative velocity method four bar chain.

UNIT-3

CAMS: Definitions of cam and followers – their uses – Types of followers and cams – Terminology –Types of follower motion - Uniform velocity – Simple harmonic motion and uniform acceleration. Maximum velocity and maximum acceleration during outward and return strokes in the above three cases.

UNIT-4

TOOTHED GEARING: Toothed gears – types – law of gearing, condition for constant velocity ratio for transmission of motion, Forms of teeth: cycloidal and involute profiles. Phenomena of interferences–Methods of reducing interference. Condition for minimum number of teeth to avoid interference, expressions for arc of contact and path of contact.

GEAR TRAINS: Introduction – Train value – Types – Simple and reverted wheel train – Epicyclic gear Train. Methods of finding train value or velocity ratio – Epicyclic gear trains.

UNIT-5

GYROSCOPE AND BALANCING: Gyroscopes, effect of precession motion on the stability of aero planes and ships, moving vehicles such as motor car, motor cycle. **Balancing:** Introduction, Static balancing, dynamic balancing, balancing of several masses

rotating in the same plane, balancing of several masses rotating in different planes. Balancing of reciprocating masses.

UNIT-6

Dynamics Analysis of slider crank Mechanism, Introduction to flywheel, turning moment diagrams for I.C. Engine and multi cylinder engine. Fluctuation of energy, Coefficient of Fluctuation of energy, coefficient of Fluctuation of speed. Energy stored in fly wheels and their design.

Vibrations: Free and forced vibration of single degree of freedom systems, effect of damping, Vibration isolation & Transmissibility.

TEXT BOOKS:

1) Theory of Machines, S.S Ratan,5th Edition MGH,2011
2) Theory of Machines and Mechanisms, P.L Ballaney, 25th Edition, Khanna Publications, 10th reprint, 2018.
3) Theory of Machines, R.S Khurmi & Gupta, S.Chand pub.3rd Edition, 2005
4) Theory of Mechanisms and Machines, Ghosh A. and Mallick A.K , East-West Pvt. Ltd, 3rd Edition, 2017

REFERENCES:

1) Shigley J. E. and John Joseph Uicker, Theory of Machines and Mechanisms, 2nd Edition McGraw-Hill 2003.
2) Theory of Machines, Thomas Bevan, CBS Publishers. 3rd Edition, 2005.
3) R. L. Norton, Kinematics and dynamics of machinery (SIE),Tata McGraw-Hill (P) Ltd, New Delhi, 2011.

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II B.Tech, II-Sem (ME) L T C
2 1 3

(A0302193) FLUID MECHANICS AND HYDRAULIC MACHINERY

(For branches: EEE & Mech)

COURSE OBJECTIVES:

- To give insight knowledge on fluid statics and fluid dynamics.
- To teach different types of fluid flow, and boundary layer phenomena.
- To teach operation and working principles of fluid machinery.

COURSE OUTCOMES:

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

- Apply conservation laws to fluid flow problems in engineering applications
- Compute drag and lift coefficients using the theory of boundary layer flows.
- Analyze and design free surface and pipe flows
- Design the working proportions of hydraulic machines

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2	-	2	-	-	-	-	-	2	3	-	-	1
CO2	2	1	3	2	-	1	2	1	-		-	1	2	1	-	1
CO3	3	2	3	2	1	-	1	-	-			1	1	-	1	-
CO4	2	1	3	1	1	2	1	-	-	-		1				

UNIT-1

Fluid Statics: Dimensions and units: fluid properties, atmospheric pressure, gauge pressure and vacuum pressure –measurement of pressure- Piezometer, U-tube and differential manometers. Hydrostatic force on a plane area (Horizontal and vertical position), introduction to Buoyancy.

UNIT-2

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

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

UNIT-3

Closed conduit flow: Laminar and turbulent flow through pipes: Reynolds experiment significance of Reynolds's number, formulae for laminar flow through circular pipes, turbulent flow-Darcy Weisbach equation, chezy's formula, friction factor - Minor losses in pipes- pipes in series and pipes in parallel- total energy line-hydraulic gradient line.

Measurement of flow: Pitot tube, venturi meter, and orifice meter (Only derivations).

UNIT-4

Boundary Layer Flow: Introduction, Definitions, Drag force on a flat plate due to Boundary layer, Turbulent Boundary layer on a flat plate, Analysis of Turbulent Boundary layer, Separation of Boundary layer.

UNIT-5

Basics of Hydraulic Machinery: Hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency.

UNIT-6

Hydraulic Turbines: Classification of turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design –draft tube theory-functions and efficiency, Unit and specific quantities, characteristic curves.

Hydraulic Pumps: Working principle of Centrifugal and Reciprocating pump. (No-derivations and No-problems)

TEXT BOOKS

1) Fluid Mechanics and Hydraulic Machinery MODI and SETH, 14th Edition, Standard Book House, New Delhi 2002.
2) Fluid Mechanics and Hydraulic Machines by R.K. Bansal, Lakshmi Publications, New Delhi, revised ninth edition,2010.
3) Introduction to Fluid Mechanics and Fluid Machines, S.K. Som and G. Biswas, Tata McGraw-Hill, revised second editions,2008.

REFERENCES:

1) Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria & Sons.
2) Fluid Mechanics and Machinery by Jagadeesh lal.
3) Hydraulic Machines by Banga & Sharma, Khanna Publishers.
4) Fluid Mechanics and Hydraulic Machines by R. K. Rajput, Lakshmi Publications.
5) Instrumentation for Engineering Measurements by James W. Dally, William E. Riley, John Wiley & Sons Inc. (Chapter 12 – Fluid Flow Measurements).

WEBSITES:

1) https://nptel.ac.in/courses/112/105/112105269/
2) https://nptel.ac.in/courses/112/105/112105171/
3) https://nptel.ac.in/courses/112/105/112105206/
4) https://nptel.ac.in/courses/112/105/112105183/
5) https://nptel.ac.in/courses/112/106/112106200/

R G M COLLEGE OF ENGINEERING AND TECHNOLOGY
AUTONOMOUS
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II B.Tech, II-Sem (ME)

L	T	C
2	1	3

(A0308194) APPLIED THERMODYNAMICS

(Note: Steam Tables and Mollier Chart are permitted in the examinations)

COURSE OBJECTIVES:

- To learn about IC engines and , theory of combustion
- To learn about vapor cycles and their first law and second law efficiencies
- To learn about gas dynamics of steam through nozzles
- To learn the about reciprocating compressors with and without inter cooling

COURSE OUTCOMES:

- They will be able to understand the IC engines and, theory of combustion
- They will be able to Conduct the performance test and estimating the performance of an I.C Engines
- The students will get a good understanding of vapor power cycles.
- They will be able to analyze energy conversion in various thermal devices such as, nozzles, and reciprocating compressors

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	3	2	2	-	1	-	-	2	-	1	2	2	-	2	1
CO2	3	3	3	3	3	2	1	-	2	2	2	2	2	-	2	1
CO3	1	3	3	3	3	2	1	-	2	2	1	2	2	-	2	1
CO4	1	3	2	2	-	1	-	-	2	-	1	-	2	-	-	1

UNIT-1

Air Standard Cycles: Air Standard Otto Cycle, Diesel Cycle, Thermal Efficiency, Comparison of Otto and Diesel. Simple problems on Otto & diesel cycles.

Introduction to IC Engines: Energy conversion, Classification of I.C. Engines, Working principle of two stroke and four stroke engines & application of I.C Engines.

UNIT-2

Combustion in I.C Engines: Stages of combustion in SI & CI Engines - Importance of flame speed and factors influencing the flame speed in SI engines- Importance of ignition delay period and factors affecting the ignition delay period in CI Engines- Abnormal Combustion - pre-ignition- Phenomenon of Knocking SI & CI, Summary of Engine variables affecting the knocking, Comparison of knock in SI & CI Engines.

UNIT-3

Testing and Performance: Engine Performance Parameters - Emissions from Diesel & Petrol Engines, BS-Norms - Simple problems on performance and heat balance sheet.

UNIT-4

Vapor power cycles: Rankine cycle with superheating, reheating and regeneration. Supercritical and ultra super-critical Rankine cycle. Combined gas and vapor power cycles. Simple problems on Rankine Cycle.

UNIT-5

Steam Nozzles: Introduction - types, Steam flow through nozzles- condition for maximum discharge (critical pressure ratio), Nozzle efficiency - Simple problems.

Air Compressors: Introduction, Classification **-** Reciprocating compressors, optimal pressure ratio, effect of inter cooling, minimum work for multistage reciprocating compressors- Introduction to rotary compressors.

UNIT-6

Refrigeration & Air Conditioning: Working principle of vapor compression & Vapor Absorption refrigeration system, – summer and winter air conditioning system.

TEXT BOOKS:

1) Thermal Engineering, R.K. Rajput, 7/e, Lakshmi Publications, 2009.
2) Thermal Engineering, R.S Khurmi & JS Gupta, S.Chand.
3) Thermodynamics and Heat Engines, R.Yadav, Central Book Depot.

REFERENCES:

1) Fundamentals of Thermodynamics, . Sonntag, R. E, Borgnakke, C. and Van Wylen.
2) Thermal Engineering - M.L.Mathur & Mehta, Jain bros.
3) 3., Fundamentals of Engineering Thermodynamics, Moran, M. J. and Shapiro.

R G M COLLEGE OF ENGINEERING AND TECHNOLOGY
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DEPARTMENT OF MECHANICAL ENGINEERING

II B.Tech, II-Sem (ME)

L	T	C
1	2	0.5

(A0016194) DESIGN THINKING FOR INNOVATIONS

(Skill Development Course)
(For Branches: CE, Mech, EEE, ECE & CSE)

COURSE PRE-REQUISITES: None

COURSE OBJECTIVES:

- To create awareness of design thinking among students of engineering
- To teach a systematic approach to identifying and defining a problem before brainstorming for a solution
- To instil a sense of significance towards applying creativity to product and service design
- To motivate students to apply design thinking while implementing a project focusing on local or global societal problems

COURSE OUTCOMES:

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

- Identify design principles from an engineering perspective.
- Cultivate sensitivity towards design aspects of Activities, Environments, Interactions, Objects, and Users (A-E-I-O-U) in daily life.
- Validate problem statements through user empathisation with societal and environmental consciousness.
- Devise visual design and documentation to communicate more effectively.
- Develop project management skills in a multidisciplinary environment

STUDENTS' RESPONSIBILITIES:

1. Forming diverse teams of 3–5 members each to work collaboratively throughout the semester.
2. Proactively engaging to observe the objects and interactions in their daily life and society from a design perspective.
3. Identifying general societal and social problems that may be effectively addressed using design thinking principles
4. Presenting and reporting the tasks to the concerned faculty members using their creative communication and people skills.

UNIT-1:

Design Thinking Overview and Motivation

Introduction, What is Design thinking, Why design, Design is Everywhere, – Various perspectives, Four principles of successful innovation, A model of design Innovation process, Seven Modes of the Design Innovation Process, Understanding. Design Engineering vs. Engineering Design

UNIT-2:

Sense Intent and Know Context

Sense Intent: Mindsets, Sensing Changing Conditions, Seeing Overviews, Foreseeing Trends, Reframing Problems, Forming an Intent. Methods: Buzz Reports, Popular Media Scan, Key Facts, Innovation Sourcebook, Trends Expert Interview, Keyword Bibliometrics, Ten Types of Innovation Framework, Innovation Landscape, Trends Matrix, Convergence Map, From…To Exploration, Initial Opportunity Map, Offering-Activity-Culture Map, Intent Statement

Know Context: Mindsets, Knowing Context History, Understanding Frontiers, Seeing System Overviews, Understanding Stakeholders, Using Mental Models, Know Context: Methods, Contextual Research Plan, Popular Media Search, Publications Research, Eras Map, Innovation Evolution Map, Financial Profile, Analogous Models, Competitors-

Complementors Map, Ten Types of Innovation Diagnostics, Industry Diagnostics, SWOT Analysis, Subject Matter Experts Interview, Interest Groups Discussion.

UNIT-3:

Know People & Frame Insights

Know People: Mindsets, Observing Everything, Building Empathy, Immersing in Daily Life, Listening Openly, Looking for Problems and Needs, Know People: Methods, Research Participant Map, Research Planning Survey, User Research Plan, Five Human Factors, POEMS, Field Visit, Video Ethnography, Ethnographic Interview, User Pictures Interview, Cultural Artifacts, Image Sorting, Experience Simulation, Field Activity, Remote Research, User Observations Database,

Frame Insights: Mindsets, Exploring Systems, Looking for Patterns, Constructing Overviews, Identifying Opportunities, Developing Guiding Principles, Frame Insights: Methods, Observations to Insights, Insights Sorting, User Observation Database Queries, User Response Analysis, ERAF Systems Diagram, Descriptive Value Web, Entities Position Map, Venn Diagramming, Tree/Semi-Lattice Diagramming, Symmetric Clustering Matrix, Asymmetric Clustering Matrix, Activity Network, Insights Clustering Matrix, Semantic Profile, User Groups Definition, Compelling Experience Map, User Journey Map, Summary Framework, Design Principles Generation, Analysis Workshop

UNIT-4:

Explore Concepts

Explore Concepts: Mindsets, Challenging Assumptions, Standing in the Future, Exploring Concepts at the Fringes, Seeking Clearly Added Value, Narrating Stories about the Future, Explore Concepts: Methods, Principles to Opportunities, Opportunity Mind Map, Value Hypothesis, Persona Definition, Ideation Session, Concept-Generating Matrix, Concept Metaphors and Analogies, Role-Play Ideation, Ideation Game, Puppet Scenario, Behavioral Prototype, Concept Prototype, Concept Sketch, Concept Scenarios, Concept Sorting, Concept Grouping Matrix, Concept Catalog.

UNIT-5:

Frame Solutions

Frame Solutions: Mindsets, Conceiving Holistic Solutions, Conceiving Options, Making Value Judgments, Envisioning Scenarios, Structuring Solutions, Frame Solutions: Methods, Morphological Synthesis, Concept Evaluation, Prescriptive Value Web, Concept-Linking Map, Foresight Scenario, Solution Diagramming, Solution Storyboard, Solution Enactment, Solution Prototype, Solution Evaluation, Solution Roadmap, Solution Database, Synthesis Workshop

UNIT-6:

Realize Offerings

Realize Offerings: Mindsets, Reiterating Prototypes, Evaluating in Reality, Defining trategies, Implementing in Reality, Communicating Vision, Realize Offerings: Methods, Strategy Roadmap, Platform Plan, Strategy Plan Workshop, Pilot Development and Testing, Implementation Plan, Competencies Plan, Team Formation Plan, Vision Statement, Innovation Brief

TEXT BOOKS:

1. Vijay Kumar, “101 Design Methods: A Structured Approach for Driving Innovation in Your Organization”, John Wiley & Sons (2012) (ISBN: 978-1118083468)
2. Jeanne Liedtka and Tim Ogilvie , Designing for Growth: A Design Thinking Tool Kit for Managers, Columbia Business School Publishing, E-ISBN 978-0-231-52796-5
3. B. K. Chakravarthy, Janaki Krishnamoorthi, Innovation By Design: Lessons from Post Box Design & Development, Springer India, 2013

4. Donald A. Norman, "The Design of Everyday Things", MIT Press, 2013 (ISBN: 978-0262525671)

REFERENCES:

1. Tim Brown, "Change by Design", Harper Business, 2012 (ISBN: 978-0062337382)
2. Daniel Ling, "Complete Design Thinking Guide for Successful Professionals", Create Space Independent Publishing, 2015 (ISBN: 978-1514202739)
3. Bruno Munari, "Design As Art", Penguin UK, 2009 (ISBN: 978-0141035819)
4. Tom Kelly, Jonathan Littman, "The Art of Innovation", HarperCollins Business, 2002 (ISBN: 978-0007102938)
5. Thomas Lockwood, "Design Thinking: Integrating Innovation, Customer Experience, and Brand Value", Allworth Press, 2009 (ISBN: 978-1581156683)
6. Joost Groot Kromelink, "Responsible Innovation: Ethics, Safety and Technology", 2nd ed., TU Delft, Faculty of Technology, Policy and Management, 2019 (e-Book ISBN: 978-9463662024)
7. Jimmy Jain, "Design Thinking for Start-up's: A Handbook for Readers and Workbook for Practitioners", Notion Press, 2018 (ISBN: 978-1642495034)
8. Beverly Rudkin Ingle, "Design Thinking for Entrepreneurs and Small Businesses: Putting the Power of Design to Work", A Press, 2013 (ISBN: 978-1430261810)

R G M COLLEGE OF ENGINEERING AND TECHNOLOGY
AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

II B.Tech, II-Sem (ME) L T C
2 0 0

(A0015194) ENVIRONMENTAL SCIENCE

(Mandatory Learning - I)
(For branches: CE, EEE, Mech, ECE & CSE)

COURSE OBJECTIVES:

- Creating the awareness about environmental problems among people.
- Imparting basic knowledge about the environment and its allied problems.
- Developing an attitude of concern for the environment.
- Motivating public to participate in environment protection and environment improvement.
- Acquiring skills to help the concerned individuals in identifying and solving environmental problems.
- Striving to attain harmony with Nature.
- Environmental education should be compulsory, right from the primary up to the post graduate stage.
- Environmental education should have an interdisciplinary approach by including physical, chemical, biological as well as socio-cultural aspects of the environment. It should build a bridge between biology and technology.
- Environmental education should take into account the historical perspective, the current and the potential historical issues.
- Environmental education should emphasize the importance of sustainable development i.e., economic development without degrading the environment.
- Environmental education should emphasize the necessity of seeking international cooperation in environmental planning.

COURSE OUTCOMES:

At the end of the course student is able to

- Understand environmental problems arising due to developmental activities.
- Realize the importance of ecosystem and biodiversity for maintaining ecological balance.
- Identify the natural resources and suitable methods for conservation and sustainable development.
- Identify the environmental pollutants and abatement devices.
- Adopt practices that help in promoting balance in nature by making judicious utilization of recourses.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	-	-	-	-	1	3	2	-	-	-	2	2	-	-	1
CO2	1	2	-	-	-	-	3	1	2	-	-	2	1	-	-	2
CO3	1	-	-	-	1	1	3	1	1	-	1	2	2	-	-	2
CO4		1	1	-	2	1	1	1	-	-	1	2	1	-	-	2
CO5		1	1	-	-	-	2	1	-	-		2	1	1	-	1

UNIT-1

Multidisciplinary nature of environmental science:

Environment -Definition, Scope and importance, Segments of Environment (Atmosphere, Lithosphere, Hydrosphere and Biosphere) - Importance, Productivity, Aesthetical & Optional values of nature, Need for public awareness. (8 periods)

UNIT-2

RESOURCES AND UTILIZATION

Renewable and Non-renewable resources.

a) Natural Resources: Soil & Water sources (salinity intrusion –conflicts of over utilization of water Resources-water logging, Hydro power project-problems), forest & mineral resources – Utilization-problems.
b) Non-conventional resources of energy (Solar Energy, wind energy and their applications)
c) Chemical fertilizers and pesticides-problems. (8 periods)

UNIT-3

a) **CONCEPTS OF ECO-SYSTEM**
Structure and functions of an ecosystem: Producers, Consumers and Decomposers- Interaction between biotic and abiotic factors in an ecosystem- Energy flow and its importance- Trophic levels- Food chain- Food web –Ecological Pyramid, Ecological succession

b) TYPES OF ECOSYSTEM
Understanding the types of ecosystem: (i) Terrestrial (forest and grassland) (ii) Aquatic (fresh water and salt water) with an example of each. (8 periods)

UNIT-4

BIODIVERSITY

Introduction – Definition - genetic, species and ecosystem diversity- Biogeographical classification of India- Value of biodiversity - Biodiversity at global, National and Local levels- India as a mega diversity nation - Hot-spots of biodiversity- Threats to biodiversity- IUCN Red data book. Conservation of bio diversity (IN-SITU and EX-SITU conservation) (8 periods)

UNIT-5

ENVIRONMENTAL POLLUTION:

Introduction - Cause, effects and control measures of

a) Air pollution
b) Water pollution
c) Soil pollution
d) Marine pollution
e) Noise pollution
f) Thermal pollution
g) Nuclear hazards

Municipal Solid Waste Management: Sources and Disposable methods.
Disaster management: Floods, Earthquake, Cyclone. (8 periods)

UNIT-6

HUMAN POPULATION:

a) Population and Environment:- Definition of species, community, population; Population growth rate curves, Sex ratio, From unsustainable to sustainable development,
b) Diseases- AIDS, Malaria, COVID, Cancer.
c) Human rights, Fundamental duties and Value education.
d) Women and Family welfare Programs. (8 periods)

SOCIAL ISSUES:

a) Climatic changes
b) Greenhouse effect and global warming.
c) Ozone layer depletion.
d) Acid rain.
e) Resettlement and rehabilitation of people.
f) Sustainability- water conservation methods- Rain water harvesting.

TEXT BOOKS:

1) Deswal S and Deswal A(2004), "A Basic Course in Environmental Studies" Dhanpat Rai & Co, Delhi
2) Anubha Kousik and Kousik C.P., New age international publishers.

REFERENCES:

1) Garg, S.K and Garg R., (2006), "Ecological and Environmental Studies"., Khanna Publishers, Delhi.
2) Chauhan A.S., (2006), "Environmental Studies"., Jain Brothers, New Delhi
3) Agarwal K.C., (2001) "Environmental Biology"., Nidi Publ. Ltd. Bikaner.
4) Bharucha Erach., "The Biodiversity of India"., Mapin Publishing Pvt. Ltd., Ahmedabad –380 013, India, Email:mapin@icenet.net (R)
5) Brunner R.C., (1989), "Hazardous Waste Incineration"., McGraw Hill Inc. 480p
6) Clark R.S., "Marine Pollution.," Clanderson Press Oxford (TB)
7) Cunningham W.P., Cooper T.H., Gorhani E., and Hepworth.,(2001), M.T. "Environmental
8) Encyclopedia"., Jaico Publ. House, Mumabai, 1196p
9) De A.K., "Environmental Chemistry"., Wiley Eastern Ltd.

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AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

II B.Tech, II-Sem (ME) P C
3 1.5

(A0394194) MANUFACTURING TECHNOLOGY LAB

COURSE OBJECTIVES:

- The student should understand some fundamental aspects and design concepts of manufacturing, pattern and pattern makings for the casting process.
- To determine the sand Viz., strengths and permeability of a sand materials and moisture percentages of green sand.
- To teach techniques adopted in welding processes like arc, gas, spot, plasma and brazing processes and also deep drawing process for making a small size part with the help of blanking, piercing operations.
- To extrusion operations, bending and processing of plastics like injection moulding and blow moulding.
- The student should be prepared to continue the study and analysis of the production machine parts.

COURSE OUTCOMES:

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

- Imparting intensive and extensive practical knowledge of the lab so that students can understand the importance of machines.
- Enriching the student's knowledge towards production of machines elements
- Developing theoretical/practical capabilities of students so that they can characterize, transform, use and apply in engineering from the knowledge gained in solving related engineering problems.

MAPPING WITH POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	-	-	-	-	-	-	3	1	-	-	1	-	-	-
CO2	1	3	-	-	-	-	-	-	3	1	-	-	3	-	-	1
CO3	1	3	-	-	-	-	-	-	3	1	-	-	2	1	-	1

I. METAL CASTING LAB:

1) Pattern Design and Making: 1 Exercise - for one casting
2) Sand Properties Testing: 2 Exercises - Strength and Permeability
3) Casting: 1 Exercise

II. WELDING LAB:

1) Arc Welding: 3 Exercises (Lap joint, Butt Joint & T- Joint)
2) Spot welding: 1 Exercises
3) Soldering of thin sheets: 1 Exercises
4) Plasma Welding and Brazing: 2 Exercises (Water Plasma Device)

III. MECHANICAL PRESS WORKING:

1) Hydraulic Press: Deep Drawing: 1 Exercise
2) Pipe Bending: 1 Exercise

IV. PROCESSING OF PLASTICS:

1) Injection Moulding: 1 Exercise
2) Blow Molding: 1 Exercise

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AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

II B.Tech, II-Sem (ME) P C
3 1.5

(A0391193) FLUID MECHANICS AND HYDRAULIC MACHINERY LAB

(For branches: EEE & Mech)

COURSE OBJECTIVES:

- This course "Fluid Mechanics and Hydraulic Machines" lab imparts intensive and extensive practical knowledge of the lab so that students can understand the importance of concepts of "Fluid Mechanics and Hydraulic Machines" in the field of engineering. The student should able to develop theoretical / practical capabilities so that they can characterize, transform, use and apply in engineering from the knowledge gained in solving related engineering problem.

COURSE OUTCOMES:

- Calibrate flow measuring devices used in pipes, channels and tanks
- Determine fluid flow properties
- Characterize laminar and turbulent flows
- Determine the performance characteristics of various fluid machines like pumps, turbines etc.
- Establish the specific energy curve
- Determine Energy loss in Hydraulic jump

MAPPING WITH COs & POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	-	-	-	-	-	-	3	1	-	-
CO2	1	3	-	-	-	-	-	-	3	1	-	-
CO3	1	3	-	-	-	-	-	-	3	1	-	-
CO4	2	3	-	-	-	-	-	-	3	1	-	-
CO5	2	3	-	-	3	-	-	-	3	1	2	-
CO6	2	3	-	-	3	-	-	-	3	1	2	-

LIST OF EXPERIMENTS:

1. Verification of Bernoulli's Equation
2. Calibration of Mouthpiece/orifice
3. Calibration of Triangular/Rectangular Notch
4. Calibration of Venturi meter
5. Calibration of Orifice meter
6. Determination of Friction Factor for a given pipe line
7. Impact of Jet on Vanes
8. Performance Test on Pelton Wheel
9. Performance Test on Francis Turbine
10. Performance Test on Kaplan Turbine
11. Performance Test on Single Stage Centrifugal Pump
12. Performance Test on Reciprocating Pump

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AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

II B.Tech, II-Sem (ME) P C
3 1.5

(A0395194) THERMAL ENGINEERING LAB

COURSE OBJECTIVES:

- Imparting intensive and extensive knowledge of the Lab so that students can understand the role of Thermal Engineering in the field of Engineering.
- Developing theoretical/practical capabilities of students so that they can characterize, transform and use Thermal Engineering in Engineering and Apply knowledge gained in solving related Engineering problems.
- The student should able to know the use of various air compressors.
- The student should able to know the use of refrigeration systems.
- The student should able to know the use of air conditioning systems.

COURSE OUTCOMES:

At the end of the Lab work the student should have knowledge on/off:

- Applying the practical skills in designing and testing the thermal engineering related equipment.
- How to estimate the performance of a boiler.
- How to estimate the performance of an air compressor.
- Conducting and estimating the performance of a refrigerator and air conditioning systems.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	-	2	2	3	2	-	3	-	1	3	2	-	-	1
CO2	3	3	-	2	2	3	2	-	3	-	1	3	1	-	-	-
CO3	3	3	-	2	2	3	2	-	3	-	1	3	-	-	-	-
CO4	3	3	-	2	2	3	2	-	3	-	1	3	2	-	-	1

LIST OF EXPERIMENTS:

(Conduct any Five from each cycle for Record)

CYCLE: I

1) Determination of Volumetric & Isothermal Efficiency of Multi Stage Reciprocating Air Compressor Test Rig.
2) Performance test on Centrifugal/axial flow air compressor test rig.
3) Determination of COP of a Vapor Compression Refrigeration Test Rig.
4) Determination of COP of a Summer/winter Air Conditioning Test Rig.
5) Determination of Calorific Value of a liquid/gaseous fuels.
6) Determination of Kinematic & Dynamic Viscosities of liquid fuels by using Redwood & Say Bolt Viscometer.
7) Determination of flash & Fire Points of Liquid Fuels by using Cleveland's & Ables apparatus.

CYCLE: II

1) Draw the Actual Valve & Port timing Timing Diagrams of a four stroke Diesel/ two stroke petrol Engines.
2) Performance Test on 4S Single Cylinder/Multi Cylinder Petrol / Diesel Engine test rigs.
3) Performance Test on VCR Computerized Multifuel Research Engine test rig.
4) Determination of Engine friction Power by Morse, retardation & Willan's line test Methods.
5) To draw the HBS/HBC on 4S Single Cylinder/Multi Cylinder Petrol / Diesel Engine test rigs.
6) To draw the HBS/HBC on VCR Computerized Multifuel Research Engine test rig.
7) Measurement of I.C Engine Exhaust Gas Emissions from Petrol/Diesel Engines.

STUDY:

1) Study of I.C Engine Parts.

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DEPARTMENT OF MECHANICAL ENGINEERING

III B.Tech, I-Sem. (M.E) L T C
2 1 3

[A0309195] INDUSTRIAL MANAGEMENT AND ACCOUNTANCY

COURSE OBJECTIVES:

- To impart knowledge on work study techniques towards productivity improvement industrial engineering concepts towards manufacturing management quality engineering and reliability tools.
- To impart knowledge on the material management.
- This course will introduce various concepts and methods of economic analysis in engineering, including the time value of the money and its effect on economic decisions, economic equivalence, cash flow analysis and cost accounting.

COURSE OUTCOMES:

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

- Understand where the plant is to be located based on facilities available and plant layout and also plant layout design to facilitate material flow and processing of a product in the most efficient manner through the shortest possible time.
- Apply various work study techniques towards productivity improvement apply in IE&M concepts in real life environment for goal achievement.
- Understand the importance and function of inventory and apply selected techniques for its control and management under dependent and independent demand circumstances, importance of Inventory control to ensure their availability with minimum capital lock up.
- Apply the basic principles of group dynamics and associated concepts required for HRM in organizations. Design a simple sampling plan, construct its OC curve and evaluate its effectiveness on a given sampling process.
- Perform analysis of financial statements and inputs therein will help them to make sound and effective decisions under different economic environment and market situations.
- Perform financial accounting and its analysis.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	-	-	-	-	-	-	-	-	-	1	-	-	-
CO2	-	-	3	3	2	2	-	-	-	-	-	-	1	1	-	1
CO3	-	-	-	-	-	1	3	3	-	-	2	2	2	-	-	2
CO4	3	-	-	3	2	-	-	-	-	-	2	-	2	-	-	1
CO5	3	2	1	-	-	-	-	-	-	-	-	-	1	-	-	-
CO6	-	-	-	2	-	3	-	2	1	-	1	2	1	2	-	1

UNIT-I

INTRODUCTION: Introduction to Management, Concept of Industrial Management, Functions of Management.

PLANT LOCATION & LAYOUT: Introduction, factors affecting the plant location, comparison of rural and urban sites- methods for selection of plant. Types of production systems; Plant Layout – objectives and types of plant layout.

UNIT-II

WORK STUDY: Introduction, objectives of work study, steps in work study, purpose of method study, procedure of method study, recording techniques. Work measurement-purpose of work measurement, time study procedure-performance rating, standard time calculations (simple problems).

UNIT-III

MATERIALS MANAGEMENT: Objectives, Inventory – functions, types, associated costs, inventory control techniques-ABC and VED analysis. Purchase management, duties of

purchase of manager, associated forms, purchase procedure, methods of purchasing**.** Stores Management and Stores Records.

UNIT-IV

QUALITY CONTROL: Meaning, process control, SQC control charts, single, double and sequential sampling.

JOB EVALUATION AND MERIT RATING: Job Evaluation - Objectives, Methods of job evaluation. Merit Rating - Objectives and methods of merit rating.

UNIT-V

ELASTICITY OF DEMAND: Introduction, Types, measurement and significance of elasticity of Demand.

BREAK EVEN ANALYSIS (BEA) - Determination of breakeven point (simple problems) - managerial significance and limitations of BEA.

BUSINESS AND NEW ECONOMIC POLICY: Characteristics of business, features and evaluation of forms of business organization based on ownership, Nature of the economy, structure of the economy, economic policies, new economic policy 1991, economic conditions.

UNIT-VI

ACCOUNTANCY: Accounting principles, Procedure-Double entry system-journal-ledger, Trail balance –cash book-preparation of trading, profit and loss Account-Balance sheet.

TEXT BOOKS:

1. Dr. Ravi Shankar: Industrial Engineering and management/Galgotia publications pvt. Ltd.
2. Khanna O.P.: Industrial Engineering

REFERENCE BOOKS:

1. Industrial engineering and operations management by S.K. Sharma and Savita Sharma.
2. T.R. Banga: Industrial Engineering and Management
3. M. Mahajan: Industrial engineering and production management, Dhanpat Rai & Co.
4. Ashwatappa. K “Business Environment”
5. Aryasri “Managerial Economics and Financial Accounting”
3. Agarwal AN, “Indian Economy “Wiley Eastern Ltd, New Delhi.
4. Jain and Narang “Accounting part-1” Kalyani publishers.
5. Arora, M.N.” Cost Accounting”, Vikas publications.

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III B.Tech, I-Sem (M.E) L T C
2 1 3

[A0310195] DESIGN OF MACHINE ELEMENTS - I

(Note: Design Data Books are not permitted in the examination)

COURSE OBJECTIVES:

- To develop an ability to apply the knowledge of materials and mechanics
- To develop an ability to design a system/component to meet desired needs within realistic constrains using suitable design methodology
- To utilize various theories of design and methods of standardization.
- Apply the concept of design and validation by strength analysis.

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

- Understand the concepts of stresses, failure theories to analyze and design the machine components subjected to static loads.
- Formulate and Design machine elements subjected to dynamic loads.
- Design and solve Riveted joints and welded joints.
- Achieve an expertise in the design of screw fasteners, keys, cotter and different joints
- Have an expertise in design of shafts and couplings for different industrial applications
- Apply the skills in the design of helical springs and laminated-leaf springs.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	-	2	-	1	1	-	1	2	3	3	1
CO2	3	3	3	2	1	-	2	-	1	1	-	1	2	3	3	1
CO3	3	3	3	3	1	-	2	-	1	1	-	1	2	3	3	1
CO4	3	3	3	3	1	-	2	-	1	1	-	1	2	3	3	1
CO5	3	3	3	3	1	-	2	-	1	1	-	1	2	3	3	1
CO6	3	3	3	3	1	-	2	-	1	1	-	1	2	3	3	1

UNIT-I

INTRODUCTION: The art and science of machine design - Types of design methods - stages in machine design selection of engineering materials based on mechanical properties- Types of loads, Factor of safety.

STRESSES IN MACHINE MEMBERS (DESIGN AGAINST STATIC LOADS): Simple stresses - Combined stresses – Torsional and bending Stresses – impact stresses– Various theories of failure – Design for strength and rigidity, eccentric loading.

UNIT-II

STRENGTH OF MACHINE ELEMENTS (DESIGN AGAINST DYNAMIC LOADS): Stress concentration–notch sensitivity, Fatigue stress concentration factor – Design for fluctuating stresses – Endurance limit, S-N Curve – Estimation of Endurance strength – Goodman's criteria – Soderberg's criteria- Gerber's curve.

UNIT-III

RIVETED JOINTS: Types of riveted joints - modes of failure-strength and efficiency of riveted joints, pitch of the rivets, design stresses - boiler joints, - Riveted joints under eccentric loading.

WELDED JOINTS: Types of welded joints, strength of welds, Design of simple welded joints- Welded joints under eccentric loads.

UNIT-IV

BOLTED JOINTS – Different Forms of Screw threads- Stresses in Screw fasteners - Design of bolts with pre-stresses – Design of joints under eccentric loading – Bolts of uniform strength.

Keys, Cotters and Knuckle Joints: Types of Keys, stresses in Keys, design of rectangular and square Keys. Design of Cotter joints- spigot and socket, sleeve and cotter, jib and cotter joints-Knuckle joints.

UNIT-V

DESIGN OF SHAFTS AND COUPLINGS- Design of solid and hollow shafts for strength and rigidity – Design of Shafts for combined bending, Torsional and axial loads.

Design of Rigid couplings: Muff, Split muff and Flange couplings.

UNIT-VI

MECHANICAL SPRINGS: Classification of springs-Stress and deflections of helical Springs- Springs for fatigue loading -Energy storage capacity- Leaf springs-Coaxial springs.

TEXT BOOKS:

1. Bhandari V.B, "Design of Machine Elements", 6th Edition, Tata McGraw-Hill Book Co, 2007
2. R S Khurmi and J K Gupta "Machine Design" 25th Edition, S chand publications, New Delhi, 2008.

REFERENCES:

1. Shigley J.E, Mischke C. R., "Mechanical Engineering Design", 6th dition, Tata McGraw-Hill, 2003
2. Spotts M.F., Shoup T.E, "Design and Machine Elements" Pearson Education, 2004.
3. Schaum's outlines "Machine Design", TMH Publishing company Ltd., New Delhi, 2008.
4. Black and Adams, Machine Design, McGraw Hill publishing Co, New Delhi.
5. Pandya and Shah Machine Design, 20th Edition, 2015, Charotar Publishers, Anand, India.
6. Kanniah, Machine Design, 2nd Edition, 2010, Scitech publishers, Hyderabad.

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AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

III B.Tech, I-Sem (M.E)

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[A0311195] METAL CUTTING AND MACHINE TOOLS

COURSE OBJECTIVES:

- The course provides students with fundamental knowledge and principles in material removal processes.
- In this course, the student should understand some fundamental aspects of an overview of machine tools & metal cutting theory, including Components of the Engine lathe, Turret and capstan lathes, Grinding machine, Drilling and Boring Machines, Milling machine, shaping slotting and planning machines.
- To demonstrate the fundamentals of machining processes and machine tools.
- To develop knowledge and importance of metal cutting parameters.
- The student should able to apply the knowledge to solve more complicated problems and study the effect of process parameters and able to describe the construction and working of different types machine tools.

COURSE OUTCOMES:

Upon successful completion of this course, the students will be able to:

- Apply the fundamental knowledge and principles in material removal process.
- Apply the practical knowledge on operations in conventional, automatic, Capstan and turret lathes.
- Analyse the skills on working principles and operations of shaping, slotting and planning.
- Apply the practical knowledge on drilling, boring, broaching and grinding operations..
- Analyze the skills on indexing the milling machine for gear cutting
- Analyze the skills on working principles and operations grinding and super finishing process

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	2				2	1	2	2	1	1	2
CO2	3	2	3	1	1	2				1	1	1	1	1	1	1
CO3	3	3	3	2	2	2				1	1	1	1	1	1	1
CO4	3	2	3	2	2	2				1	1	2	1	1	2	1
CO5	3	3	3	3	3	2				2	1	2	2	1	1	2
CO6	3	2	2	1	2	1				1	2	2	1	1	1	1

UNIT – I

Geometry of single point cutting tool and angles-Mechanism of chip formation in machining ductile and brittle materials- types of chips –Built-up-Edge (BUE) formation and its effects, Use of Chip breaker in machining-principles and methods of chip breaking. Mechanics of Orthogonal cutting - Merchant's Force diagram, cutting forces – cutting speeds, feed, depth of cut, Tool wear.

UNIT – II

Engine lathe – Principle of working, specifications of lathe – types of lathes – work holders, tool holders – Box Tools, Taper turning, thread turning and attachments for Lathes. Turret and capstan lathes – collect chucks –tool holding devices –tool layout.

Principal features of automatic lathes – classification – Single spindle and multi-spindle automatic lathes– tool layout. Alignment tests on lathe.

UNIT – III

Shaping, Slotting and planning machines – their Principles of working – Principal parts – specifications, classification, Operations performed-Machining time calculations. Shaper size, shape mechanism, Crank and slotted link mechanism, Whit worth quick return mechanism, Hydraulic shaper mechanism. Alignment tests on shaping and slotting.

UNIT – IV

Drilling and Boring Machines – Principle of working, specifications, types, operations performed – tool holding devices – twist drill – Boring machines – Fine boring machines – Jig Boring machine-deep hole drilling machine. Alignment tests on drilling.

UNIT – V

Milling machine – Principle of working – specifications – classifications and principle features of milling machines – machining operations, Types and geometry of milling cutters– methods of indexing –Director Rapid indexing, Plain or simple indexing, Compound indexing, Differential indexing and angular indexing. Alignment tests on milling.

UNIT – VI

Introduction to grinding, lapping, honing and broaching machines-classification- comparison of grinding, lapping and honing- Lapping, Honing and Broaching machines- Grinding wheel: Different types of abrasives – bonds, specification and selection of a grinding wheel. Alignment tests on surface grinding.

TEXT BOOKS:

1. Elements of Workshop Technology: Vol: II Machine Tools; By Choudhury, S. K. Hajara, Choudhury, A. K. Hajara & Roy, Nirjhar.
2. Workshop Technology – Vol II, B.S. Raghuvamshi.

REFERENCE BOOKS

1. Manufacturing science by Amitab Ghosh and Ashok Kumr Mallik, Tata-McGraw-Hill Publications
2. Metal cutting by Bhattacharya.

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AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

III B.Tech, I-Sem (ME) L T C
2 1 3

[A0312195] ENGINEERING METROLOGY AND MECHANICAL MEASUREMENTS

COURSE OBJECTIVES:

- The student should understand the some fundamental aspects of system of limits and fits, measurement of linear, angular dimensions, including limit gauges.
- Emphasis is placed on understanding of surface roughness & described mathematically. The screw thread, gear measurement methods are also considered in some detail..
- The student should able to apply the knowledge to solve more complicated problems and study the effect of problem parameters and able to describe the construction and working of different types of metrology machines and also plot the performance curves.
- The student should be prepared to continue the study and analyze the metrology and surface engineering to solve the complicated practical problems.
- The students should get knowledge of force, pressure and temperature measuring devices and their applications.

COURSE OUTCOMES: At end of the end of the course, the student should be able to

- Apply the knowledge of the limits, fits and tolerances for the Design the go and NOGO gauges
- Understand the metrology instruments & use the same for both linear and angular measurements.
- Understand the measurement principles of comparators and transducers.
- Measure and analyze the various elements of screw thread and gear using different methods.
- Analyze the geometrical irregularities and use the suitable surface finish measurement instruments.
- Apply the skills to select the suitable measuring devices to measure force, pressure, temperature

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	-	-	1	1	1	-	-	-	2	3	-	-	1
CO2	2	-	-	-	-	1	1	1	-	-	-	2	-	-	-	1
CO3	3	-	-	-	-	1	1	1	-	-	-	2	-	-	-	1
CO4	3	-	2	1	-	2	1	1	-	-	-	1	2	-	-	1
CO5	2	3	1	-	-	1	1	1	-	-	-	1	2	-	-	1
CO6	1	1	-	-	-	1	1	1	-	-	-	1	-	-	-	1

UNIT – I

LIMITS, FITS, TOLERANCES AND GAUGES: Introduction, Limits, tolerance, tolerance build-up, compound tolerances, terminology for limits and fits, system of writing tolerance, Unilateral, Bi-lateral systems; Relation between tolerance and cost; types of fits, hole and shaft basis systems, standard limit systems-Indian standard system, interchangeability and selective assembly. Taylor's principle – Design of go and No go gauges, plug, ring, snap, gap, taper, profile and position gauges.

UNIT – II

STANDARDSOFMEASUREMENTS: Line standards, End standards and Wave length standards.

LINEAR AND ANGULAR MEASUREMENT: Vernier caliper, vernier height gauge, micrometers, telescopic gauge, dial bore gauge, slip gauges, vernier and optical bevel

protractor, sine principle and sine bars, angle gauges, sprit level, clinometers, rollers and spheres used to determine the tapers.

UNIT –III

COMPARATORS: Introduction; Need of comparators; Basic Principles of Operation, uses, essential characteristics; classification of comparators- Mechanical, optical, mechanical optical, Electrical and Electronic Comparators, pneumatic comparators, multi check comparators, Eden-Rolt-Millionth comparator and their uses in mass production- linear variable differential transformer (LVDT);Transducers.

UNIT – IV

SCREW THREAD MEASUREMENT: Screw thread terminology, errors in threads; pitch errors; measurement of various elements of thread; measurement of major, minor and effective diameter; Tool maker's microscope and its uses, optical projector.

GEAR METROLOGY: Terminology of gear tooth, measurement of tooth thickness-chordal thickness method-constant chord method-base tangent method-measurement over pins or balls Parkinson gear tester.

UNIT – V

SURFACE TEXTURE: Introduction, factors affecting the surface roughness, reasons for controlling surface texture, orders of geometrical irregularities, Elements of surface texture, methods of measuring surface finish, analysis of surface traces, Surface Protection.

UNIT – VI

MEASUREMENT OF FORCE, PRESSURE, AND TEMPERATURE

Force measurement – Direct, Indirect, Load cells; Measurement of pressure – Bourdon gauge, Diaphragm, Bellows, Piezoelectric sensor; Temperature measurement – Thermocouple, Resistance Temperature Detectors, Thermistor, liquid in glass thermometer, bimetallic strip thermometers, and pyrometers.

TEXT BOOKS:

1. Engineering Metrology / R.K. Jain / Khanna Publishers.
2. A text book of Metrology / M. Mahajan. / Danpath Rai & Co.

REFERENCE BOOKS:

1. Engineering Metrology and Measurements/ N.V. Raghavendra & L. Krishnamurthy/ Oxford University Press, 2013.

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AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

III B.Tech, I-Sem (ME) L T C
2 1 3

[A0313195] HEAT TRANSFER

(Note: The use of Heat transfer data book along with steam tables is permitted in the examinations**)**

COURSE OBJECTIVES:

- Understand and analyze the various modes of heat transfer in physical environment. Identify the heat transfer process in practical life. Use analytical methods to calculate the heat transfer by various processes.

The student is able to know the:

COURSE OUTCOMES:

At the end of the course work the student should have the knowledge on:

- Understand, analyze and able to solve heat transfer problems by conduction
- Know the convection process and to solve the heat transfer problems by forced convection.
- Apply the knowledge to solve the heat transfer problems by free convection and understand the process of boiling and condensation.
- Understand and estimate the performance of various types of heat exchangers.
- Explain the radiation laws and & to estimate the radiation heat transfer between different solids.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	1	-	-	-	-	1	1	2	3	3	1
CO2	3	3	3	2	1	1	-	-	-	-	1	1	2	3	3	1
CO3	3	3	3	3	1	1	-	-	-	-	1	1	2	3	3	1
CO4	3	3	3	3	1	1	-	-	-	-	1	1	2	3	3	1
CO5	3	3	3	3	1	1	-	-	-	-	1	1	2	3	3	1

UNIT – I

INTRODUCTION: Modes of heat transfer – Basic laws of heat transfer – General applications of heat transfer. **CONDUCTION HEAT TRANSFER:** Fourier rate equation – General heat conduction equation in Cartesian, Cylindrical coordinates - Heat conduction through plane walls and composite walls - hollow and composite cylinders - hollow and composite spheres - critical thickness of insulation – Problems.

UNIT II

FINS: Heat flow through extended surfaces - infinite long fin – fin insulated at the tip- fin losing heat at the tip - Efficiency and effectiveness of the fin.

ONE DIMENSIONAL TRANSIENT HEAT CONDUCTION: Heat conduction in solids having infinite thermal conductivity (negligible internal resistance) – Significance of Biot and Fourier Numbers - Chart solutions - Problems.

UNIT – III

CONVECTIVE HEAT TRANSFER: Non-dimensional numbers - Significance of non-dimensional numbers - correlations for convective heat transfer.

FORCED CONVECTION: Introduction to hydrodynamic boundary layer - Concepts and definitions - thermal boundary layer - correlations for forced convection – flow over flat plates and walls - flow inside pipes - turbulent flow over flat plate, cylinders - Problems.

UNIT IV

FREE CONVECTION: Bulk mean temperature and mean film temperature – local and average heat transfer coefficients - correlations for free convection – horizontal plates, cylinders – problems.

Heat Transfer with Phase Change: Boiling – Regimes (Theory only),

Condensation: Film wise and drop wise condensation (Theory only).

UNIT: V

HEAT EXCHANGERS: Classification of heat exchangers – overall heat transfer Coefficient and fouling factor

– Concepts of LMTD and NTU methods – effectiveness - Problems using LMTD and NTU methods.

UNIT VI

RADIATION HEAT TRANSFER:

Introduction - surface emission properties - absorptivity, reflectivity, and transmissivity - concept of black body & grey body - Stefan Boltzmann law - Kirchhoff, Wein & Lambert‟s cosine law - shape factor and silent featuresof shape factor.

TEXT BOOKS:

1. Heat and Mass Transfer, R.K.Rajput, S.Chand & Company Ltd.
2. Fundamentals of Engg. Heat and Mass Transfer, R.C.Sachdeva, 3/e, New Age International

REFERENCE BOOKS:

1. Heat and Mass Transfer, D.S.Kumar.SK Kataria & Sons.
2. Fundamentals of Engg. Heat and Mass Transfer, R.C.Sachdeva, 3/e, New Age International
3. Heat Transfer, P.K.Nag, 2/e, TMH, 2010
4. Fundamentals of Heat and Mass Transfer, Kondandaraman, C.P., 3/e, New Age Publ.
5. Thermal Engineering Data Book, B.S.Reddy and K.H.Reddy Rev/e, I.K. International.
6. Heat and Mass Transfer by JP Holman.TMH Publications.

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III B.Tech, I-Sem (M.E)

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[A0314195] COMPUTER AIDED MACHINE DRAWING

[Skill Development Course]

COURSE OBJECTIVES:

- To create the awareness among the students of making use of computers for drafting purpose.
- To train the student to make use of CAD software package.
- To improve the quality of the machine drawings.

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

- Understand the national and international standards pertaining to machine drawing.
- Make use of 2D drawing software package
- Apply drawing primitives and editing / Modify commands to draw part modeling
- Understand and apply the importance of the linking functional and visualization aspects in the preparation of the part drawings.
- Design and drawing of drawings in mechanical components with codes, standards and symbols.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	2	-	-	-	-	2	2	-	1	-	2	1
CO2	3	2	-	2	2	-	-	-	-	2	-	-	1	-	2	1
CO3	3	3	-	-	2	1	-	-	-	2	2	-	1	-	1	-
CO4	2	2	-	2	-	-	-	-	-	3	-	1	-	-	2	1
CO5	3	2	-	2	2	-	-	-	-	2	-	-	1	-	2	1

UNIT – I:

Introduction to Auto CAD: The Auto CAD screen - the X-Y co-ordinate system - angular measurement - entering points in Auto CAD - functional keys. Code of practice for Engineering Drawing.

UNIT – II:

Introduction to machine drawing & modelling – commands – Accurate Input – O snaps – learn about line, circle, offset, undo, erase, print – drawing lines to exact points.

UNIT – III:

Object Properties & selection sets – and dimensioning – know about crossing selection – window selection – crossing polygon – crossing window – fence – quick select – changing the object Properties – colour – line type – line weight.

UNIT – IV:

Inquiry tools & layers – isometric views – measure distances – mass properties – area & information of selected objects – how to lock, hide and freeze the layers.

UNIT – V:

Advanced drawing and modifying commands – isometric views and dimensioning: rectangle – trim – extend – offset – scale – text etc. Sketchers – Shear plate – Friction plate – latch plate – Gear arm -Gasket of vacuum pump – C washer – special Cam

UNIT: VI

Modelling and editing of solids – extrude – revolve – sweep – copy faces – offset – loft – imprint etc., Modelling of machine part: cut of holder – Socket bearing – Truck Wheel – Index Guide – Anchor Clip

TEXT BOOKS:

1. Working Auto-CAD, Singh,TMH
2. Introduction to Auto-CAD 2D & 3D Design, Alf Yarwood

LIST OF EXERCISES:

1. Draw a simple entity using absolute co-ordinate method.

2. Draw a simple entity using relative co-ordinate method.
3. Draw a simple entity using direct distance method.
4. Using offset command & draw the given sketch.
5. By using Array command compute the drawing.
6. Draw simple machine element using fillet and chamfer command.
7. Exercise on mirror command.
8. Compute the drawing and specify dimensions.
9. Using copy commands compute the isometric views.
10. Exercise on isometric views.
11. Using revolve command complete the model.
12. Using extrude, sweep & loft command complete the model.

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DEPARTMENT OF MECHANICAL ENGINEERING

III B.Tech, I-Sem (M.E)

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[A0017194] INDIAN HERITAGE AND CULTURE

[Mandatory Learning Course-II]
(For Branches CE, EEE, Mech., ECE, CSE)

INTRODUCTION:

- Indian Heritage is an ancient facet pertaining to bygone ages. It reflects strong ethical culture and embodiment of nature in life style. It had its deep roots in great Indian epics and Upanishads. It has been transformed and strengthened by many kings and queens. It is received by erudite writers. The glory of Indian Heritage & culture have been ignored or distorted in wake of western culture. The present generation ought to know their indigenous culture and heritage.

COURSE OBJECTIVES:

- To enable the students to have an insight into and understanding of the great heritage and culture of India.
- To sensitize them towards preservation and progression of the same.

COURSE OUTCOMES:

- Equip themselves with knowledge about the heritage and culture of India.
- Apply the ancient wisdom to become successful professionals.

UNIT I

Origin of Indian Culture - Indus valley & Vedic Culture Evolution - Political unification of India under Mauryas and Guptas - Cultural achievements - Cultural conditions under the Sathavahanas - Contribution of Pallavas and Cholas to art and letters.

UNIT II

Influence of Islam on Indian Culture - The Sufi, Bhakti and Vishnavite Movements - Cultural achievements of Vijayanagara rulers - Contribution of Shershah and Akbar to the evolution of administrative system in India - Cultural Developments under Mughals - Great Indian Monuments.

UNIT III

Great Indian Epics - Ramayana and Mahabharata - Upanishads - Vedas - Pathanjali - Yoga - Principles of Jainism and Buddhism.

UNIT IV

Indian Literature - Rabindranath Tagore - Arundhathi Roy - RK.Narayan - Sri Sri - Gurajada -Jashuva - Western Impact on India - Introduction of Western Education - End of the Gurukulas educational system.

UNIT V

Social and Cultural awakening and social reform movements - Raja Rama Mohan Roy - Dayananda Saraswathi -Theosophical Society - Ramakrishna Paramahamsa and Vivekananda - Iswara Chandra Vidyasagar and Kandukuri Veeresalingam - Emancipation of women and struggle against Caste.

UNIT VI

Mahatma Gandhi - Non-violence and Satyagraha - Great leaders of Freedom struggle - Post Independent Era.

TEXT BOOK

1) Madanlal Malpani & Shamsunder Malpani (2016), ***Indian Heritage and Culture,*** New Delhi: Kalyani Publishers.

REFERENCE BOOKS

1) Romila Thapar (2018), Indian Cultures as Heritage: Contemporary Pasts, India.

2) Anurag Mathur (2017), Indian Culture & Heritage, Create space independent publishing Platform, 2017.
3) P.R.Rao & P. Raghavendra, Indian Heritage and culture, Sterling Publication Pvt. Ltd.
4) Madhukar kumar Bhagat, Indian Heritage and culture, Access Publications.
5) Dhirendra Singh, Indian Heritage and culture, APH Publications.
6) http://www.indiaculture.nic.in/
7) http://www.indiaculture.nic.in/world-heritage

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AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

III B.Tech, I-Sem (M.E) P C
3 1.5

[A0396195] DYNAMICS AND INSTRUMENTATION LAB

COURSE OBJECTIVES:

- To understand the concepts of different modes and types of vibrations and vibrating systems
- To analyse different types of governors.
- To understand the principles of a Gyroscope
- To know the calibration of instruments used for measuring different physical quantities.

COURSE OUTCOMES:

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

- Apply the fundamental concepts to find the natural frequency of a spring-mass system
- Determine the Gyroscopic Couple from its principles
- Understand and apply the CAM jump phenomena in industrial applications
- Evaluate the sensitivity of different governors
- Calibrate the different types of instruments for measuring the physical quantities (Load, displacement. temp, speed etc.)

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	3	2	-	1	-	-	-	-	-	2	2	2	1
CO2	3	3	2	3	2	-	1	-	-	-	-	-	2	2	2	1
CO3	3	3	2	3	2	-	1	-	-	-	-	-	2	2	2	1
CO4	3	3	2	3	2	-	1	-	-	-	-	-	2	2	2	1
CO5	3	3	2	3	2	-	1	-	-	-	-	-	2	2	2	1
CO6	2	2	1	3	2	1	1	-	-	-	-	-	2	2	2	1

Note: Conduct any FIVE experiments form each cycle

Cycle-I [Dynamics Lab]

1. Longitudinal vibrations of a spring-mass system.
2. To Measure the Amplitude and Frequency of Simple Harmonic Motion
3. To study the damping effect on Vibration with Oil Damper
4. Motorized Gyroscope- study of gyroscopic effect and couple.
5. Critical speed or whirling speed of a shaft.

Experiments beyond the Curriculum:

1. Determination of Mass moment of inertia using Bi-filer suspension.
2. To measure Natural Frequency and Modal Shape of simply supported by the Method of Hammer Impact.
3. Experiments on Governors- Determination of range sensitivity, effort etc.,
4. (Watt, Porter, Proell and Hartnel Governors)
5. Cam Jump Analysis: Cam profile drawing and study of jump phenomenon.
6. Static and Dynamic balancing of rotary masses

Cycle-II [Instrumentation Lab]

1. Study and calibration of LVDT transducer for displacement measurement.
2. Calibration of Pressure Gauges
3. Calibration of strain gauge for strain measurement.
4. Study and calibration of photo and magnetic speed pickups for the measurement of speed.
5. Study and calibration of load cell for load measurement.

Experiments beyond the Curriculum:

1. Calibration of thermistor for temperature measurement.
2. Calibration of thermocouple for temperature measurement.
3. Calibration of resistance temperature detector for temperature measurement.

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AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

III B.Tech, I-Sem (M.E) P C
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[A0397195] METROLOGY AND MACHINE TOOLS LAB

COURSE OBJECTIVES:

- This course "metrology and machine tools" lab imparts intensive and extensive practical knowledge of the lab so that students can understand the importance of concepts of "metrology and machine tools" in the field of engineering.
- The student should able to develop theoretical / practical capabilities so that they can characterize, transform, use and apply in engineering from the knowledge gained in solving related engineering problem.

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

- Enable the students to use knowledge of metrology and machine tools" for practical applications.
- Students are able to understand the working function of various devices used in metrology
- Students can understand the working functions of sine bar, bevel protractor, gear teeth caliper and profile projector.
- Students can understand the working functions of lathe machines.
- Students can understand the working functions of drilling and milling machines.
- Student can understand the working functions of shaping and slotting machines

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2	1	2	2	2	1	1	1	2	2	1	1	2
CO2	3	3	2	1	2	3	1	1	1	1	2	2	2	1	1	2
CO3	3	2	2	3	2	2	2	2	2	2	1	2	2	1	1	2
CO4	3	3	2	2	3	1	2	1	1	1	1	2	2	1	1	2
CO5	3	3	2	3	3	2	1	1	1	1	1	2	2	1	1	2
CO6	3	3	2	3	3	1	2	2	1	1	2	2	2	1	1	2

LIST OF EXPERIMENTS:

1. Measurements of length, height, depth, diameters by vernier calipers, vernier height gauge and micrometers.
2. Measurement of bores by dial bore gauge.
3. Use of gear teeth vernier caliper and checking the chordal addendum and chordal height of spur gear.
4. Measurement of angle by sine bar and bevel protractor.
5. Measurement of pitch, major diameter, minor diameter, pitch, threads angle, effective diameter and depth of thread of a given threaded component.
6. Perform Thread cutting and knurling operation on a cylindrical work piece using lathe machine.
7. Perform Drilling and tapping operation on a given work piece using radial drilling machine.
8. Produce maximum size of the square on a given cylindrical work piece using Shaping machine.
9. Machine slots on a given hollow work piece using slotting machine.
10. Machine a slot on a given work piece using a milling machine

Experiments beyond the Curriculum:

1. Perform Machine tool alignment tests on lathe.
2. Perform Step turning and taper turning operation on a cylindrical work piece using lathe machine.

R G M COLLEGE OF ENGINEERING AND TECHNOLOGY
AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

III B.Tech, I-Sem (M.E)

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[A0398195] HEAT TRANSFER LAB

(Note: Heat Transfer Data Books are permitted in the Examinations)

COURSE OBJECTIVES:

- To analyze various modes of heat transfer experimentally
- To measure the heat transferred by conduction
- To measure the heat transferred by convection
- To measure the heat transferred by radiation

COURSE OUTCOMES:

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

- Analyze the different mode of heat transfer
- Evaluate the thermal conductivity through composite wall, lagged pipe, insulting sphere and metal rod.
- Determine out the efficiency and effectiveness of fin by convection process
- Determine the overall heat transfer coefficient of the heat exchanger.
- Evaluating the emissivity of the test plate
- Understanding the boiling and condensation process, and estimating the overall heat transfer coefficient.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	1	-	-	-	-	-	2	2	3	3	1
CO2	3	3	3	2	1	1	-	-	-	-	-	2	2	3	3	1
C03	3	3	3	3	1	1	-	-	-	-	-	2	2	3	3	1
CO4	3	3	3	3	1	1	-	-	-	-	-	2	2	3	3	1
CO5	3	3	3	3	1	1	-	-	-	-	-	2	2	3	3	1
CO6	3	3	3	3	1	1	-	-	-	-	-	2	2	3	3	1

LIST OF EXPERIMENTS:

1. Thermal conductivity of insulating powder through Concentric Sphere apparatus.
2. Thermal conductivity of insulating material through lagged pipe apparatus.
3. Overall heat transfer co-efficient through Composite Slab Apparatus.
4. Thermal Conductivity of Metal Rod (conductor).
5. Heat transfer coefficient in natural convection.
6. Effectiveness of Pin-Fin by forced convection.
7. Experiment on Parallel and counter flow heat exchanger.
8. Emissivity of a given test plate by Emissivity apparatus.
9. Experiment on Stefan Boltzmann Apparatus.
10. Experiment on Critical Heat flux apparatus.

Experiments beyond the Curriculum:

1. Study of heat pipe and its demonstration.
2. Heat transfer in drop and film wise condensation.
3. Effectiveness of Pin-Fin by Natural Convection Process.

R G M COLLEGE OF ENGINEERING AND TECHNOLOGY
AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

III B.Tech, II-Sem (M.E)

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[A0315196] INDUSTRIAL SAFETY ENGINEERING

COURSE OBJECTIVES:

- The objective of this course is to impart knowledge on different facets and aspects of engineering systems safety, focusing on tools, techniques and methodologies needed for prevention of occurrences of unsafe operations and accidents under different industrial settings.

COURSE OUTCOMES:

Upon completion of the course, the students will be able to;

- Perform the Hazard analysis and determine system risk.
- Determine the root causes and probability of occurrence of a specified undesired event and identify and evaluate the sequence of events in a potential accident scenario. Also perform qualitative analysis.
- Find the quantification of basic events to decrease the failure rate of events.
- Apply the quantitative aspects of system analysis find the quantification of basic events to decrease the failure rate of events.
- Apply different controls for safer production system
- Conduct the Accident/incident analysis with different techniques

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	-	3	-	1	-	2	3	-	2	-	-	2	1	2	-	1
CO2	3	3	-	-	-	1	-	-	1	-	-	2	2	2	-	2
CO3	3	3	3	-	-	1	-	-	1	-	-	2	2	2	-	2
CO4	3	-	3	-	-		-	-	1	-	1	2	2	-	-	2
CO5	1	-	2	-	3	2	3	-		-	-	2	2	-	-	-
CO6	-	2		3	3	2	3	-	3	-	-	2	2	3	-	-

UNIT-I:

Introduction to industrial safety engineering; Key Concepts and Terminologies-Hazards, Mishap and Risk; Risk Assessment and Control, Hazard analysis techniques-Hazard and Operability Study (HAZOP)- Failure Mode and Effect Analysis.

UNIT-II

Fault Tree Analysis (FTA) – Construction-Gate by Gate Method-Cut- Set Method; Event Tree Analysis (ETA); Fault Tree Analysis Importance Measures; Bow – Tie concept; Common Cause Cut Sets; Cut Sets for Accident Scenarios.

UNIT-III

Risk Assessment; Consequence Assessment; Energy Control Model and Hazard Control Hierarchy; Safety Function Deployment; Ranking of Design Solutions: AHP Approach; Quantification of Basic Events for Non – repairable Components– Hazard Rate- Exponential Distribution-Weibull Distribution.

UNIT-IV

Quantification of Basic Events for Failure to Repair Process- Repairable Components-failure and repair intensities-Computation of combined process parameters: Laplace transform analysis; Quantification of Systems Safety and Reliability Block Diagram-Truth Table Approach-Structure Function-Minimal Cut and Minimal Path Representation Using Structure Function.

UNIT-V

Human Error, Classification and Causes-Human Error Identification-Human Reliability Assessment-Human Error Quantification from Expert's opinions - Fuzzy Set Approach;

UNIT-VI

Accident Investigation; Accident Investigation & Analysis: Descriptive Analytics-Control Chart Analysis- Regression- Classification Tree. Safety Performance Indicators; Energy Isolations.

BOOKS:

1. Hiromitsu Kumamoto, Ernest. J. Henley, Probabilistic Risk Assessment and management for Engineering and Scientists, , 2nd Edition, IEEE Press, 1995.
2. Clifton A. Ericson, Hazard Analysis Techniques for system safety, 1st edition, Wiley-Inter science, 2005

REFERENCES:

1. Heinrich et al., Industrial Accident Prevention, McGraw Hill, 1980.
2. Techniques for safety management - A systems approach, Petersen D, ASSE 1998.

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AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

III B.Tech, II-Sem (ME)

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[A0316196] DESIGN OF MACHINE ELEMENTS - II

(**Note: The use of Design Data book is permitted in the examinations**)

COURSE OBJECTIVES:

- Able to understand and analyse mechanical systems and select the proper machine elements (bearings, gears, pulley, belts,) from commercial catalogues for a required application.
- To develop ability to execute original designs of machine elements.
- To learn and implement design procedures to design and complete the projects individually or in a team.
- The student is expected to communicate design ideas by producing the CAD drawings, writing technical reports and making oral presentations.

COURSE OUTCOMES:

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

- Analyse and design Sliding contact Bearing and Rolling contact Bearings and its selection from manufacturer's catalogue.
- Understand and apply the principles involved in Design and develop I.C Engine parts.
- Achieve an expertise in design of curved beams for various industrial applications.
- Design Belt, Rope and Chain drives for various industrial applications.
- Understand and apply the principles in Design and analysis of Spur and helical gears.
- Apply the skills in design of power screws for different engineering applications.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	1	2	1	3	2	1	2	2	3	3	1
CO2	3	3	3	2	1	1	2	1	3	2	1	2	2	3	3	1
CO3	3	3	3	3	1	1	2	1	3	2	1	2	2	3	3	1
CO4	3	3	3	3	1	1	2	1	3	2	1	2	2	3	3	1
CO5	3	3	3	3	1	1	2	1	3	2	1	2	2	3	3	1
CO6	3	3	3	3	1	1	2	1	3	2	1	2	2	3	3	1

UNIT – I

BEARINGS: Types of Journal bearings – Lubrication – Bearing Modulus–Bearing materials – Journal bearing design – Ball and roller bearings – Static & dynamic load capacity of ball & roller bearings, bearing life and reliability.

UNIT – II

DESIGN OF I.C ENGINE PARTS: Design connecting rod-stress due to whipping action on Connecting rod –design of trunk type piston for I C engine – Design of crank and crankshafts-overhang crank shaft, Centre crank shaft.

UNIT – III

DESIGN OF CURVED BEAMS: Introduction, stresses in curved beams, Expression for radius of neutral axis for rectangular, circular, trapezoidal and T-Section. Design of crane hooks, C–clamps**.**

UNIT – IV

POWER TRANSMISSIONS SYSTEMS: Design of Flat belt drives, V-belt drives & rope drives. Selection of wire ropes- Design procedure for chain drives.

UNIT-V

SPUR & HELICAL GEARS: Classification of gears, design of spur gears, Lewis equation – bending strength, dynamic load and fatigue of gear tooth- Design of Helical gears.

UNIT-VI

DESIGN OF POWER SCREWS: Design of Power screws- Square, ACME, Buttress screws- Efficiency of the screw. Design of nut, compound screw, differential screw, ball screw- possible failures.

TEXT BOOKS

1. Bhandari V.B, "Design of Machine Elements", 6th Edition, Tata McGraw-Hill Book Co, 2007
2. Kanniah, Machine Design, 2nd Edition,2010, Scitech publishers, Hyderabad.

REFERENCES:

1. Shigley J.E, Mischke C. R., "Mechanical Engineering Design", 6th dition, Tata McGraw-Hill, 2003
2. R S Khurmi and J K Gupta "Machine Design" 25th Edition, S chand publications, New Delhi, 2008.
3. Sadhu Singh, "Machine Design", Khanna Publishers, New Delhi, 2005.
4. Sundararajamoorthy T.V, Shanmugam. N, "Machine Design", Anuradha publications, Chennai, 2003.
5. S Spotts M.F., Shoup T.E, "Design and Machine Elements" Pearson Education, 2004.
6. Pandya and Shah Machine Design, 20th Edition, 2015, Charotar Publishers, Anand, India.

DESIGN DATA HAND BOOK:

1. Mahadevan and Balaveera Reddy, Machine Design Data Hand Book, CBS Publishers

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III B.Tech, II-Sem (ME)

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[A0512195] CORE JAVA PROGRAMMING

(For Branches: EEE, Mech & ECE)

COURSE OBJECTIVES:

After taking this course, the student should be able to:

- Describe the Windows event-driven programming model
- Build simple JAVA applications according to the model
- Write fluent JAVA code for creating classes
- Use JAVA variables, data, expressions and arrays
- Design and create forms, menus and controls
- Write clear, elementary Java programs (applets and applications)
- Use a Java-enabled browser and/or the applet viewer to execute Java applets
- Use the Java interpreter to run Java applications
- Design and construct effective graphic user interfaces for application software.
- Use Java Beans, RMI to build complex business applications

COURSE OUTCOMES:

- Understand the syntax and concepts of JAVA
- Write JAVA programs to implementing Object Oriented Concepts
- Able to build directories and manage applications with interfaces
- Write JAVA programs that use data from flat files and databases
- Develop programs with error free and Multi-tasking.
- Program assignment utilizing Java GUI components, event listeners and event-handlers.

MAPPING: WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	3	1	2				1		2	2	2	2	
CO2	2	1	3	2	2			1				3	1	2	1
CO3	1	2	2	1	1							2		1	
CO4	1	1	2	1	2			1			2	2		2	1
CO5	2	2	2		2			1			1	2	2	2	
CO6		1	1		2							1		1	1

UNIT-I

Introduction To Java – Introduction to OOP, OOP Concepts, History of Java, Java buzzwords, How Java differs from C , Structure of Java Program, data types, variables, constants, type conversion and casting, enumerated types, scope and life time of variables, operators, expressions , control flow- conditional statements, break and continue, simple java program, arrays, parameter passing, static fields and methods, access control, this, overloading methods and constructors, recursion, garbage collection.

UNIT-II

Inheritance –Inheritance concept, Super and Sub classes, Member access rules, types of Inheritance, super uses, final classes and methods, casting, polymorphism- dynamic binding, method overriding, abstract classes and methods, the Object class and its methods.

UNIT-III

Interfaces – Interfaces vs. Abstract classes, defining an interface, implementing interfaces, accessing implementations through interface references, extending interface.

Packages- Defining, Creating and Accessing a Package, Understanding CLASSPATH, importing packages.

UNIT-IV

Files – streams, text Input/output, binary input/output, random access file operations, File management using File class, Using java.io.

Strings: Strings, string functions.

UNIT-V

Exception handling – benefits of exception handling, exception hierarchy, checked exceptions and unchecked exceptions, usage of try, catch, throw, throws and finally, rethrowing exceptions, built in exceptions, creating own exceptions.

Multithreading - Differences between multiple processes and multiple threads, thread states, creating threads, interrupting threads, thread priorities, synchronizing threads, interthread communication, thread groups, daemonthreads, thread deadlock.

UNIT-VI

Event Handling - Events, Event sources, Event classes, Event Listeners, Relationship between Event sources and Listeners, Delegation event model, handling mouse and keyboard events, Adapter classes.

TEXT BOOKS:

1. Java; the complete reference, 7th editon, Herbert schildt, TMH.
2. Understanding OOP with Java, updated edition, T. Budd, pearson eduction.

REFERENCES:

1. An Introduction to programming and OO design using Java, J.Nino and F.A. Hosch, John wiley &sons.
2. Programming in Java, Sachin Malhotra, Saurabh Choudhary, Second Edition.
3. An Introduction to OOP, second edition, T. Budd, pearson education.
4. Introduction to Java programming 6th edition, Y. Daniel Liang, pearson education.
5. An introduction to Java programming and object oriented application development, R.A. Johnson-Thomson.
6. Core Java 2, Vol 1, Fundamentals, Cay.S.Horstmann and Gary Cornell, seventh Edition, PearsonEducation.
7. Core Java 2, Vol 2, Advanced Features, Cay.S.Horstmann and Gary Cornell, Seventh Edition, PearsonEducation.

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III B.Tech, II-Sem (ME)

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2	1	3

[A0317196] POWER PLANT ENGINEERING

[Open Elective-I]

COURSE OBJECTIVES:

The student is able to know the:

- This subject gives student wide knowledge about different types of generating plants and their operation
- The course is designed to give fundamental knowledge of construction and working of various types of thermal power plants i.e. steam turbine, gas turbine, nuclear etc.
- To understand the power plant economics and power distribution.
- To develop an ability to identify, formulate, and solve engineering problems.

COURSE OUTCOMES:

At the end of the course work the student should know the:

- Understand the generation of power by using various sources like coal, water, liquid/gas fuel and nuclear fuels.
- Analyse the performance of various components present in the different power plants.
- Understand the concept of fixing the tariff.
- Understand the methods of disposal of waste material from various power plants.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	1	1	3	2	1	1	3	2	1	3	-	2	1
CO2	3	2	-	2	1	3	2	1	1	2	2	2	2	-	1	2
CO3	3	3	-	2	1	3	2	1	1	2	3	1	2	-	2	2
CO4	3	1	-	1	1	3	3	3	1	2	3	1	2	-	3	3

UNIT – I

Introduction on different Sources of Energy (Conventional and Non-conventional)

STEAM POWER PLANT: Layout & Selection of site for Modern Steam Power Plant, working of different circuits- Coal Storage- Classification of coal handling, pulverizing fuel system and its components, simple problems on steam generation to power.

UNIT II

STEAM POWER PLANT: Overfeed and Underfeed fuel beds, Traveling grate, spreader grate and retort grate stoker firing systems - different types of burners - cyclone furnace- Ash handling systems, Dust collectors-Cooling Towers.

UNIT – III

HYDRO ELECTRIC POWER PLANT: Hydrological cycle – Hydrographs - flow duration curve - mass curve – Classification of Dams, Spill ways and Surge Tanks.

HYDRO PROJECTS AND PLANT: Classification of Hydro Electric Power Plants – Typical Layout & Selection of Site for Hydro Electric Power Plant – plant auxiliaries – plant operation.

UNIT – IV

NUCLEAR POWER PLANT: Nuclear fuel, Fissile and Fertile materials– Breeding – Nuclear reactor & operation.

TYPES OF REACTORS: Pressurized Water Reactor, Boiling Water Reactor, Sodium-Graphite Reactor, Fast Breeder Reactor, Homogeneous Reactor and Gas Cooled Reactor - Radiation hazards and shielding – radioactive & waste disposal.

UNIT V

GAS TURBINE POWER PLANT: Introduction – Plant Layout – Classification – Working of Simple Gas Turbine Power Plant– Constant pressure and constant volume Gas Turbine Power Plants –Combination of Gas Turbine Cycles.

UNIT – VI

POWER PLANT ECONOMICS: Definitions of connected load, Maximum demand, demand factor, average load, load factor, diversity factor, utilization factor, Plant capacity factor and plant use factor - Types of loads - Load curve and load duration curve - general arrangement of power distribution –Different types of tariff for Electrical energy - Simple problems.

TEXT BOOK:

1. A Text Book of Power Plant Engineering, Rajput. R.K., 4/e, Laxmi Publications.
2. A Course in Power Plant Engineering, Arora and S. Domkundwar.

REFERENCES:

1. Power Plant Engineering, P.K.Nag, 2/e, TMH.
2. Power Plant Engineering, Nagpal,
3. Power plant Engineering, Ramalingam, Scietech Publ.
4. Power Plant Engineering, C. Elanchezian and others, I.K. International.

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III B.Tech, II-Sem (ME) L T C
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[A0318196] NON-DESTRUCTIVE TESTING AND EVALUATION

[Open Elective-I]

COURSE OBJECTIVES:

This subject provides students with

- An understanding the various Non-Destructive Evaluation and Testing methods, theory and their industrial applications.
- The knowledge to use the non-destructive testing methods, magnetic particle testing & ultra-sonic testing and some case studies.
- The knowledge selects appropriate nondestructive testing technique.

COURSE OUTCOMES:

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

- Classify various non-destructive testing.
- Perform non-destructive tests like: Liquid penetrant test, Magnetic particle test, Ultrasonic test,
- Perform non-destructive tests like: X-ray and Gamma ray radiography, Leak Test, Thermography and Eddy current test.
- Identify defects by using relevant NDT methods.

MAPPING WITH COS & POS

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1	1	1	1	1	1	1	1	-	-	2	1		1
CO2	1	1	1	1	1	1	-	-	-	-	-	-	1	2		1
C03	1	1	-	-	-	-	2	2	2	2	-	-	1	2		1
CO4	1	1	1	1	1	1	1	1	1	1	3	3	2	1		1
CO5	3	3	1	1	1	1	1	1	1	1	-	-	2	1		1
C06	1	1	1	1	1	1	-	-	-	-	-	-	2	1		1

UNIT I

INTRODUCTION TO NON DESTRUCTIVE TESTING (NDT): Fundamentals of and introduction to destructive and non-destructive testing, Scope and limitations of NDT, Selection of NDT methods, visual inspection, leaks testing, liquid penetration inspection.

UNIT II

MAGNETIC PARTICLE INSPECTION: Important terminologies related to magnetic properties of material, principle, magnetizing technique, procedure, and equipment, fluorescent magnetic particle testing method, sensitivity, application and limitations.

UNIT III

ULTRASONIC TESTING: Basic principles of sound propagation, types of sound waves, Principle, Ultrasonic transducers, Ultrasonic Flaw detection Equipment, Modes of display A-scan, B-Scan, C- Scan, their advantages , limitations & Applications

UNIT IV

THERMOGRAPHY AND EDDY CURRENT TESTING: Thermography- Principles, Contact and non-contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation – infrared radiation and infrared detectors, Instrumentations and methods, applications. Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation.

UNIT V

RADIOGRAPHY TESTING: X-ray and Gamma-Ray radiography, their principles, methods of generation, Industrial radiography techniques, inspection techniques, applications, limitations, Types of films, screens and penetrometers. Interpretation of radiographs, Safety in industrial radiography.

UNIT VI

CASE STUDIES, COMPARISON AND SELECTION OF NDT METHODS: Case studies on defects in cast, rolled, extruded, welded and heat treated components. Comparison and selection of various NDT techniques. Codes, standards, specification and procedures.

REFERENCES:

1. Baldev Raj, Jeya kumar. T., Thavasimuthu. M., "Practical Non Destructive Testing" Narosa publishing.
2. Ultrasonic Testing of Materials, J. Krautkramer & Herbert Krautkramer, Narosa Publishing House, New Delhi.
3. Peter J. Shull "Non Destructive Evaluation: Theory, Techniques and Application "Marcel Dekker.
4. Treaties on Non-destructive testing, Vol. 1,2 & 3 Edited by Dr. E.G. Krishnadas Nair, NDT Centre, Hal, Bangalore .
5. Non-destructive testing, Warren J. Mc Gonnagle, Gordon Breach, Science Publishers Ltd.
6. Non-destructive testing, R. Hatmshaw.
7. Ultrasonic Methods of Testing Materials, Leszek Filipezynski, Zdzislaw Pawlowski & Jerzywehr, Butterworths, London.

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DEPARTMENT OF MECHANICAL ENGINEERING

III B.Tech, II-Sem (ME)

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[A0319196] TOOL DESIGN

[Open Elective-I]

COURSE OBJECTIVES:

- Able to understand various manufacturing methods and to inculcate basic knowledge of tool design and the student should design single point cutting tools for various machining processes.
- To inculcate basic knowledge of tool design and the student should design multi point cutting tools for various machining processes
- The student should gain the Knowledge of designing jigs and fixtures.
- The student should gain the Knowledge of design considerations for blanking dies and piercing dies
- The student should gain the Knowledge of design considerations for progressive dies and drawing dies
- The student should gain the Knowledge for finding tool life of different tools in machining

COURSE OUTCOMES:

At the end of the course, the student will be

- CO1 Design and assess the tools for quality improvement, and able to design and develop Single point cutting tools
- CO2 Apply the skills to design and develop multi point cutting tools.
- CO3 Design jigs and fixtures for Industrial applications
- CO4 Design blanking dies and piercing dies for a particular application.
- CO5 Design and development of progressive dies and drawing dies for a particular application.
- CO6 Determine the tool life of different tools in machining

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	2	2	1	1	1	1	2	2	1	1	2
CO2	3	3	3	3	2	2	1	1	1	1	1	2	2	1	1	2
CO3	2	2	2	1	1	1	1	1	2	2	1	1	2	1	1	3
CO4	3	3	2	1	1	1	2	1	1	1	1	2	2	1	1	3
CO5	3	2	3	1	1	2	1	1	2	1	1	2	2	1	1	3
CO6	3	3	3	3	2	2	1	1	2	1	1	2	2	1	1	3

UNIT –I

DESIGN OF SINGLE POINT CUTTING TOOLS: Design of single point cutting tools such as solid tools, tipped tools, coated tipped tools, throw away type tools and diamond tools.

THERMAL ASPECTS IN MACHINING: Sources of heat generation in machining and its effects, temperature measurement techniques in machining, types of cutting fluids, Functions of cutting fluid, Characteristics of cutting fluid, Application of cutting fluids.

UNIT - II

DESIGN OF MULTIPOINT TOOLS: Design of plain milling cutter, gear milling cutters, hobs, gear shaping tools, broaches, drills, reamers, taps & dies for thread cutting, boring tools, flat form tools, circular form tools. Standard tool holders & standard tooling and their design for turrets and automates

UNIT -III

DESIGN OF JIGS AND FIXTURES: Basic principles of location and clamping, locating, methods and devices, jigs, definitions, types, general consideration in the design of jigs, drills bushing, methods of construction, fixtures-vice fixtures milling, boring, and lathe grinding fixtures.

UNIT-IV

DESIGN OF SHEET METAL BLANKING AND PIERCING: Fundamentals of die cutting operating, power press types, General press information, Material handling equipment, cutting action in punch and die operation. Die clearance, and types of Die construction. Die design fundamentals-blanking and piercing die construction, pilots, striper and pressure pads presswork material, strip layout, short run tooling for piercing.

UNIT-V

DESIGN OF SHEET METAL BENDING, FORMING AND DRAWINGS DIE: Bending dies, drawing dies, forming dies, drawing operations, variables that effect metal flow during drawing. Determination of blank size, drawing force, single and double action draw dies.

UNIT -VI

TOOL LIFE AND TOOL WEAR: theories of tool wear-adhesion, abrasive and diffusion wear mechanisms forms of wear, tool life criteria and Mach inability index, tool wear criterion, measurement of tool wear. Introduction to Plastic tooling-commonly used plastic tooling materials.

TEXT BOOKS:

1. Tool Engineering & Design , G.R.Nagpal
2. Tool Design, Donaldson, Lecain and Goold, TMH.
3. Principles of Metal cutting, A Bhattacharya, New Central Book Agency, Calcutta

REFERENCES:

1. Production Engineering Design (Tool Design), Surendra Kenav and Umesh Chandra, Satyaprakashan, New Delhi .
2. Design of Cutting Tools. Use of Metal Cutting Theory, Amitabh Bhattacharya and Inyong Ham, ASTME publication Michigan USA.
3. Fundamentals of Machining and Machine Tools, RK Singal and Others, I.K. International.
4. Metal Cutting Principles, Shaw, Oxford Univ. Press.
5. Production Technology, P.C Sharma.

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AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

III B.Tech, II-Sem (ME)

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[A0320196] AUTOTRONICS

[Professional Elective-I]

COURSE OBJECTIVES:

- To develop and understand the principles of conversion in design, construction and working of mechanical systems and electronic systems in automobiles.
- To solve multi-disciplinary problems and will be part of future developments in industries.

COURSE OUTCOMES:

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

- Understand the functionality of different parts of an automobile
- Understand the fuel supply system used in petrol/ diesel engines
- Have familiarity of Micro-processor and micro computers used in automobiles
- Understand the various sensors and actuators used in automobile and understanding their role in the management of vehicle control.
- Understand the functions of electronic fuel injection system and Ignition system
- Understand the working of electric and hybrid vehicles.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	2	1	3	2	1	-	-	-	-	1	2	1	1	2
CO2	1	1	1	1	2	2	1	-	-	-	-	1	2	1	1	2
CO3	1	1	1	1	3	2	2	-	-	-	-	1	2	1	1	3
CO4	1	1	1	1	3	2	2	-	-	-	-	1	2	1	1	3
CO5	1	1	1	1	3	2	2	-	-	-	-	1	2	1	1	3
CO6	1	1	1	1	3	2	2	-	-	-	-	1	2	1	1	3

UNIT- I

Introduction to Automobile: Components of an automobile – chassis and body – power unit – rear wheel drive, front wheel drive, 4 wheel drive – types of automobile engines, engine construction, oil filters, oil pumps – crank case ventilation-Fuel gauge – oil pressure gauge, Engaine température indicator.

UNIT-II

Introduction to Electric Vehicles:

Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

UNIT-III

Fundamentals of Automotive Electronics: Microprocessor and micro Computer applications in automobiles; components for engine management System; electronic management of chassis system; vehicle motion control; electronic panel meters.

UNIT-IV

Sensors & Actuators: Introduction; Basic sensor arrangement; Types of Sensors such as oxygen sensors, Crank angle position sensors, fuel metering/vehicle speed sensors and detonation sensors, altitude sensors, flow Sensors, throttle position sensors, solenoids, stepper motors, relays.

UNIT-V

Electronic Fuel Injection & Ignition System: Introduction; feedback carburetor system;, throttle body injection and multi point fuel injection System, injection system controls-advantage of electronic ignition systems, types of solid state system and their principle of operation, electronic spark timing

UNIT-VI

Automotive Electrical: Batteries; starter motor & drive mechanism; D.C. generator and alternator; regulation for charging; lighting design; dashboard instruments; horn, warning system and safety devices.

TEXT BOOKS:

1. Automobile Engineering, – Vol.1 & Vol.2, Kirpal Singh. 13th edition, 2018, Standard publishers-Distributors- Delhi,
2. Tom Denton, Automobile Electrical and Electronic Systems, 4th edition, Butterworth-Heinemann, 2014.
3. P. L. Kohli, Automotive Electrical Equipment‖, 27th reprint., Tata McGraw Hill, 2006

REFERENCE:

1. Automotive Electronics Handbook**,** Ronald K. Jurgen, McGraw Hill Publishing Co., ISBN 0-07-034453-1.
2. Automotive Electricity and Electronics, Al Santini, Delmar Publishers, NY, ISBN 0-8273-6743-0.
3. Automobile Electrical & Electronic Equipments, Young, Griffitns, Butterworth Publication, London.
4. Understanding Automotive Electronics**,** Bechfold, SAE 1998.
5. https://nptel.ac.in/courses/108/103/108103009/

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AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

III B.Tech, II-Sem (ME)

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[A0321196] MECHANICAL VIBRATIONS

[Professional Elective-I]

COURSE OBJECTIVE:

- The objective of this course is: for students to learn how to treat the vibration phenomena by transforming the physical model into a mathematical model and solve it by using the appropriate mathematical operations to find the response and analyze this response and bring it back to its physical concept.

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

- Formulate governing equations of motion for the analysis of free single degree of freedom system.
- Analyze system with forced vibration, analysis of rotating and reciprocating unbalance systems.
- Analyze and design machine supporting structures, vibration isolators.
- Understanding the whirling of shaft and analysis of critical speeds.
- Determine the frequencies and mode shapes of free and forced vibration responses of Two degree freedom system
- Analyze the free and forced vibration responses of multi degree freedom systems using modal analysis.
- Understand and apply the principles of vibration measuring instruments.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	1	1	-	-	-	-	1	1	1	2	2	1	3
CO2	3	3	2	2	2	-	-	-	-	1	1	1	2	2	1	3
CO3	3	3	2	3	2	-	-	-	-	1	1	1	2	2	1	3
CO4	3	3	2	2	3	-	-	-	-	1	1	1	2	2	1	3
CO5	3	3	2	2	3	-	-	-	-	1	1	1	2	2	1	3
CO6	3	3	2	2	3	-	-	-	-	1	1	1	2	2	1	3

UNIT-I

Introduction: Causes and effects of vibration, Classification of vibrating system, Modes of Vibrations, Degree of freedom, physical and mathematical formulation of undamped free SDF Spring -mass system and damped free SDF Spring-mass system.

UNIT -II

Forced vibration of SDF system: Response to harmonic excitations, solution of differential equation of motion, Magnification factor, Resonance, Rotating/reciprocating unbalances, Force Transmissibility, Motion Transmissibility.

UNIT-III

Critical Speed of Shaft: Whirling of rotors, Computation of critical speeds, influence of bearings, Critical speeds of Multi rotor systems.

UNIT-IV

Two degree of freedom systems: Introduction, Formulation of equation of motion, Free vibration response, Eigen values and Eigen vectors, Normal modes and mode superposition, Coordinate coupling, decoupling of equations of motion, Natural coordinates, Response to initial conditions, free vibration response case studies, Forced vibration response, undamped vibration absorbers, Case studies on undamped vibration absorbers.

UNIT-V

NUMERICAL METHODS FOR MULTI DEGREE FREEDOM SYSTEMS:

Introduction, Influence coefficients, Maxwell reciprocal theorem, Dunkerley's equation. Method of determination of all the natural frequencies using Matrix iteration, Rayleigh's, and stodola's, method.

UNIT-VI

Vibration Measurement: Basics of Vibration Pickup, Vibrometer, Velocity pickup, accelerometer, Phase distortion and frequency measurement.

TEXT BOOK:

1. W.T. Thomson and Marie Dillon Dahleh Theory of Vibration with Applications:, Pearson Education 5th edition, 2007
2. Mechanical Vibrations by G.K. Groover, Pearson Education 6th edition, 2018
3. V P Singh, Mechanical Vibrations, Dhanpat Rai & Company Pvt. Ltd, 3rd edition, 2006.

REFERENCES:

1. Singiresu S Rao, Mechanical Vibrations. 4th Ed., Pearson education, 2011
2. Clarence W. de Silva , Vibration: Fundamentals and Practice, CRC Press LLC, 2000
3. Mechanical Vibrations – Schaum series

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AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

III B.Tech, II-Sem (ME)

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2	1	3

[A0322196] CRYOGENIC ENGINEERING

[Professional Elective-I]

COURSE OBJECTIVES:

- To provide the knowledge of production of low temperature
- To give the knowledge on the properties of materials at low temperature
- To deliver the design aspects of cryogenic storage and transfer lines
- To provide the knowledge of cryogenic insulation and applications

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

- To understand gas liquefaction system and gas cycle cryogenic refrigeration system
- To comprehend gas separation and gas purification system
- To understand the behavioural changes in materials at low temperature
- To have detailed knowledge of cryogenic insulation
- To analyze the storage and transfer systems of cryogenic liquids
- To study applications of cryogenics and to embark on cryogenic fluid

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	2	1	-	-	-	-	1	3	3	2	2
CO2	3	3	3	3	1	2	1	-	-	-	-	1	2	2	2	2
CO3	3	2	2	2	2	2	1	-	-	-	-	1	2	2	1	1
CO4	3	2	3	2	2	2	2	-	-	-	-	1	3	2	1	2
CO5	3	2	3	3	1	2	1	-	-	-	-	1	2	2	2	2
CO6	3	2	2	2	1	2	1	-	-	-	-	1	2	2	1	2

UNIT-1:

Introduction to cryogenic refrigeration systems: Review of basic thermodynamics, liquefaction systems, ideal, Cascade, Linde - Hampson and Claude cycles and their derivatives; Refrigerators: Stirling, Gifford- McMahon cycles and their derivatives.

UNIT-2:

Gas separation and gas purification systems: Thermodynamic ideal separation system, Properties of mixtures, principles of gas separation, Linde single column air separation, Linde double column air separation, Argon and Neon separation systems.

UNIT-3:

Properties of materials at low temperature: Specific heat, thermal conductivity, electrical conductivity, magnetic and mechanical properties of materials at low temperature

UNIT-4:

Cryogenic Insulations: Heat Transfer due to conduction, evacuated porous insulation Powder & Fibers Opacified powder insulation, Gas filled powders & Fibrous materials Multilayer super-insulation, Composite insulation.

UNIT-5:

Cryogenic fluid storage and transfer systems: Design of cryogenic fluid storage vessels, Inner vessel, Outer Insulation, Suspension system, Fill and drain lines. Cryogenic fluid transfer, External pressurization, Self-pressurization, Transfer pump.

UNIT-6:

Applications of cryogenic systems: Cryogenic application for food preservation – Instant Quick-Freezing Techniques, Super conductive devices, Cryogenic applications for space technology. Application of cryogenic systems, super conducting devices, space technology, nuclear technology, cryogenics in biology and medicine.

TEXT BOOKS:

1. K. D. Timmerhaus and T. M. Flynn, *Cryogenic Process Engineering,* 1st Edition, 1989 Springer, New York, US.
2. Randall F. Barron, *Cryogenics Systems*, 2nd Edition, 1985, Oxford University Press, New York, US.

REFERENCES:

1. Graham Walker, *Cryocooler- Part 1: Fundamentals*, 1983, Springer, New York, US
2. Marshall Sittig & Stephen Kidd, *Cryogenics: research and applications*, 1963, Van Nostrand Reinhold Inc., U.S.

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AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

III B.Tech, II-Sem (ME)

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[A0323196] PARAMETRIC MODELLING-I

(Skill Development Course)

COURSE OBJECTIVES:

- To train the student to make use of Pro-E software package
- To improve the quality of the Engineering Drawing.

COURSE OUTCOMES:

- 2D drawings and 3D drawings can be drawn using pro-E software package
- Able to create 3D assemble drawings.
- Useful to increase the productivity of an industry.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2	1	-	-	-	1	-	-	-	1	-	3	-
CO2	3	3	3	2	1	-	-	-	1	-	-	-	-	-	3	-
CO3	3	3	2	2	1	-	-	-	1	-	-	-	1	-	1	-

UNIT – I:

Introduction to Pro/E & sketching: What is parametric modelling – setting up working directory – different file extensions in Pro/E – sketch tools – create and edit dimensions – constraints.

UNIT – II:

Part Modeling: Feature creations – protrusion & cut – solid and thin features – shell – dress up features – pattern chamfer – fillet.

UNIT – III:

Assembly: Introduction to top-down & bottom-up assembly – assembly constraints – Skelton model – exploded views.

UNIT – IV:

Drafting: Introduction to drafting with / without templates – placing views – placing dimensions – bill of materials.

UNIT – V:

Surface modeling: Datum curves – points – plans – co-ordinate systems – sketch based features – extrude – trim – offset – merge.

UNIT – VI:

Sheet metal – flat walls – extrude walls – creating walls – punches – notches – forms – dies – bending the sheet.

TEXT BOOKS:

1. Parametric Modeling, Randy H Shih.
2. Pro/Engineer Wildfire,Dr. Zuomin Dong, Department of Mechanical Engineering, University of Victoria.

LIST OF EXERCISES:

1. Draw the sketch with given dimensions.
2. Draw the sketch and specify dimensions.
3. Create a part using extrude and revolve features.
4. Create a part using chamfer and fillets features.
5. Create a part using sweep, blend tools & pattern features.
6. Complete the part using revolve and rib tools features.
7. Modify the dimensions and regenerate the existing part.
8. Draw the simple parts and assemble.
9. Draw all parts of machine component and complete the assembly.
10. Generate views for specified part.
11. Create views, dimensions and bill of materials for specified assembly modelling.
12. Draw the surface and convert it into solid.

Soft Ware Package Required: Pro-Engineer.

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AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

III B.Tech, II-Sem. (M.E)

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(A0018194) CONSTITUTION OF INDIA

(Mandatory Learning Course-III)
(For Branches CE, EEE, Mech, ECE & CSE)

COURSE OBJECTIVES:

- To understand the structure and composition of Indian Constitution
- To understand and analyze federalism in the Indian context.
- To study the Panchayati Raj institutions as a medium of decentralization
- To study and analyze the three organs of the governance in the contemporary scenario.

COURSE OUTCOMES: Students will be able to

- Be aware of historical background of the constitutional making and its importance for building a democratic India.
- Possess the knowledge of the History, features of Indian constitution, the role of Governor and Chief Minister, role of state election commission, the decentralization of power between central, state and local self-government.
- Know the status of Indian government, the structure of state government, the local Administration.
- Able to know the functioning of governments at the rural and national level and role of the electoral bodies.

UNIT-I

History of Indian Constitution: History of Making of the Indian Constitution - History Drafting Committee - Composition & Working of Constitution.

UNIT-II

Philosophy of the Indian Constitution: Preamble Salient Features of Indian Constitution.

UNIT-III

Contours of Constitutional Rights & Duties: Fundamental Rights: Right to Equality - Right to Freedom - Right against Exploitation - Right to Freedom of Religion - Cultural and Educational Rights - Right to Constitutional Remedies - Directive Principles of State Policy.

UNIT-IV

Organs of Governance: Parliament - Composition - Qualifications and Disqualifications Powers and Functions of Executive - President - Governor - Council of Ministers – Judiciary – Qualifications, Appointment and Transfer of Judges.

UNIT-V

Local Administration: Role and Importance of Municipal Corporation Role and Importance Pachayati raj: Role and Importance Zilla Pachayat: Position and role - Village level: Role of Elected and Appointed officials - Importance of grass root democracy.

UNIT-VI

Election Commission: Role and Functioning of Election Commission Role and Functioning of Chief Election Commissioner and Election Commissioners - Role and Functioning of State Election Commission.

BOOKS :

1. M.P.Singh, Constitution of India with 101st Amendment,5th New Edition, Delhi Law House
2. V.N.Shukla, Constitution of India, 13th Edition,2017, Eastern book Company.
3. Gopal Sankaranarayan, Eastern Book Company, 14th Edition.
4. Subhash C.Kashyap, Constitution of India- A Handbook for Students, First Edition, (Jan 2019), Vista Publishing Pvt. Ltd.
5. Dr.B.R.Ambedkar, The Constitution of India, Sudhir Prakashan, Ist Edition,jn 2020.

REFERENCES: (URL)

1. https://legislative.gov.in/constitution-of-india
2. http://www.ilo.org

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III B.Tech, II-Sem (ME) P C
3 1.5

[A0581195] CORE JAVA PROGRAMMING LAB

(For Branches: Mech & ECE)

COURSE OBJECTIVES:

- To make the student operating systems.
- Learn object oriented way of solving problems.
- To teach the student to write programs in Java to solve the problems

COURSE OUTCOMES:

After Completion of the Lab Course student should be able:

- Student can able to write a programs using classes and objects.
- Student can able to develop the polymorphic behaviour of objects.
- Students can able to design a software using object oriented approach.
- Able to implement the programs handling built in exceptions and creating custom exceptions.
- Able to develop the Mutli thread programming.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	2	1	3	1	2				1		2	2	3	2	1
CO2	2	1	3	2	2							3	2		
CO3	1	2	2	1	1							2	3	2	
CO4	1	2	1	1					2		2	2		2	1
CO5	2	2	2		2						1	2		2	

RECOMMENDED SYSTEMS/SOFTWARE REQUIREMENTS:

- Intel based desktop PC with minimum of 166 MHZ or faster processor with at least 64 MB RAM and100 MB free disk space.
- JDK Kit. Recommended

1) a) Write a Java program that prints all real solutions to the quadratic equation ax2 + bx + c = 0. Read in a, b, c and use the quadratic formula. If the discriminate b2 - 4ac is negative, display amessage stating that there are no real solutions.
   b) The Fibonacci sequence is defined by the following rule: The first two values in the sequence are 1 and 1. Every subsequent value is the sum of the two values preceding it. Write a Java program that uses both recursive and non- recursive functions to print the nth value in the Fibonacci sequence.
2) a) Write a Java program that prompts the user for an integer and then prints out all Prime numbers up to that integer.
   b) Write a Java program to multiply two given matrices.
3) Write a Java Program that reads a line of integers, and then displays each integer, and the sum of all theintegers (Use String Tokenizer class of java. until)
4) Write a Java program to find both the largest and smallest number in a list of integers.
5) Write a Java program to illustrate method overloading.
6) Write a Java program that implements the Sieve of Eratosthenes to find prime numbers.
7) Write a Java program to sort a list of names in ascending order.
8) Write a Java program to implement the matrix ADT using a class. The operations supported by this ADT are:
   a. Reading a matrix.
   b. Printing a matrix.
   c. Addition of matrices.
   d. Subtraction of matrices.

e. Multiplication of matrices.

9) Write a Java Program to solve Tower's of Hanoi problem.
10) Write a Java Program that uses a recursive function to compute ncr. (Note: n and r values are given)
11) Write a Java program to perform the following operations:
    a. Concatenation of two strings.
    b. Comparison of two strings.
12) Implement the complex number ADT in Java using a class. The complex ADT is used to represent complexnumbers of the form c=a+ib, where a and b are real numbers. The operations supported by this ADT are:
    a. Reading a complex number. d) Subtraction of complex numbers.
    b. Writing a complex number. e) Multiplication of complex numbers.
    c. Addition of Complex numbers. f) Division of complex numbers.
13) Write a Java program that makes frequency count of letters in a given text.
14) Write a Java program that uses functions to perform the following operations:
    a. Inserting a sub-string in to the given main string from a given position.
    b. Deleting n characters from a given position in a given string.
15) a) Write a Java program that checks whether a given string is a palindrome or not. Ex: MADAMis a palindrome.
    b) Write a Java program to make frequency count of words in a given text.
16) a) Write a Java program that reads a file name from the user, then displays information about whether the file exists, whether the file is readable, whether the file is writable, the type of fileand the length of the file in bytes.
    b) Write a Java program that reads a file and displays the file on the screen, with a linenumber before each line.
    c) Write a Java program that displays the number of characters, lines and words in atext file.
    d) Write a Java program to change a specific character in a file.
    Note: Filename, number of the byte in the file to be changed and the new character are specified on the command line.
17) Write a Java program that:
    i) Implements stack ADT.
    ii) Converts infix expression into Postfix form
    iii) Evaluates the postfix expression.
18) a) Write a Java program that creates three threads. First thread displays "Good Morning" every one second, the second thread displays "Hello" every two seconds and the third threaddisplays Welcome" every three seconds.
    b) Write a Java program that correctly implements producer consumer problem usingthe concept of inter thread communication.

REFERENCES:

1. Java; the complete reference, 7th editon, Herbert schildt, TMH.
2. An Introduction to programming and OO design using Java, J.Nino and F.A. Hosch, John wiley &sons.
3. Programming in Java, Sachin Malhotra, Saurabh Choudhary, Second Edition.
4. An Introduction to OOP, second edition, T. Budd, pearson education.
5. Introduction to Java programming 6th edition, Y. Daniel Liang, pearson education.

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AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

III B.Tech, II-Sem (ME) P C
3 1.5

[A0383196] NUMERICAL SIMULATION LAB

COURSE OBJECTIVES:

- To train the student to make use of MatLab/Sci lab software package
- To solve engineering problem involving Matrix algebra
- To improve the quality of the engineering learning through simulation of problem

COURSE OUTCOMES:

At the end of the lab sessions, the student shall be able to:

- Apply built-in functions in MATLAB to solve numerical problems.
- Develop code for solving problems involving different types of mathematical models and equations (ODE, PDE, Linear and nonlinear equations).
- Solve simulation problems encountered in mechanical design, vibration analysis and CAD
- Write codes with functions and scripts
- Perform Curve fitting and interpolation of experimental data
- Model a system and Develop a simulation code towards a mini project

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PS01	PS02	PS03	PS04
CO1	2	2	3	2	1	2	-	1	2	-	-	2	2	2	-	-
CO2	3	2	3	3	2	2	-	2	2	-	-	2	2	3	-	-
CO3	3	2	3	3	3	2	-	1	2	-	-	2	2	3	-	-
CO4	3	2	3	3	3	2	-	1	1	-	-	2	2	3	-	-
CO5	3	2	3	3	3	2	-	-	1	-	-	1	2	3	-	-
CO6	2	2	3	3	3	2	-	1	-	-	-	1	2	3	-	-

Detailed Syllabus: List of Experiments conducted in this lab:

1. Introduction to MAT LAB and practice
2. Practice session on handling basic arithmetic etc.
3. Writing codes with control loops, functions and scripts
4. Developing codes for visualization and plotting
5. Solving problems involving linear equations
6. Solving problems involving curve fitting and interpolations
7. Solving problems involving ordinary and partial differential equations
8. Solving problems related to optimization
9. Solving problems involving numerical differentiation and integrations
10. Case studies and working on projects

Text book:

1. Getting started with MatLab by Rudra Pratap Singh, 2010

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AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

III B.Tech, II-Sem (ME) P C
3 1.5

[A0082196] MINI PROJECT – I

EPICS (Engineering Projects in Community Services)

COURSE OBJECTIVES:

- To give a platform for the students to apply the theoretical knowledge they gained during the course and conduct analysis/manufacture working models.
- To enable the students to use different design platforms for design and analysis of project.
- To give a chance to improve communication skills and enable the students to express the theoretical knowledge to defend
- To impart theoretical knowledge about wind tunnels and experimental fluid mechanics.
- To give the students a feel of working in a team environment and contribute to the success of the project.

COURSE OUTCOMES:

- Ability to effectively gather and interpret information from literature survey. And use this knowledge to identify, formulate, analyse and solve complex problems and to evaluate and interpret various solutions.
- Ability to communicate effectively with written, oral, and visual means in a technical setting.
- Ability to use modern design and analysis tools.
- Students will be able to carry out calculations involved in design, consider and evaluate alternate assumptions, approaches, and procedures. Ability to fabricate system components related to engineering problems giving consideration to environment and society.
- Ability to serve as effective team member to plan and complete the project/task within a specified budget and time.

There shall be two Mini-Projects, in collaboration with an industry/EPICS (Engineering Projects In Community Services) (wherever is possible) of their specialization, to be taken up during the vacation (data collection, components etc.) after II year II and III Year II Semester examination and implementation/simulation shall be carried out in III year II semester and IV Year I Semester during lab classes. Implementation or fabrication/simulation of mini projects will be treated as laboratory. However, the mini project and its report shall be evaluated in III year II Semester and IV Year I semester. The mini project shall be submitted in the report form and should be presented before the committee, which shall be evaluated for 50 marks. The committee consists of an external Examiner, Head of the Department and the supervisor of mini project. There shall be 25 internal marks for mini project which will be awarded based on the performance and involvement of the student during mini project period.

R G M COLLEGE OF ENGINEERING AND TECHNOLOGY
AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

III B.Tech, II-Sem (ME) P C
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[A0099196] INTERNSHIP

The student has an option of going for internship in IV year –II Sem in a reputed organization (The finalization of the internship organization will be as per college guidelines (HOD, two Senior faculty members of the department and same will be recommended to the Principal for approval). In case any student opted for intern ship he/she need not attend the classes however he/she has to write internal and external examination of subjects when ever conducted in that semester and acquire the required credits. The project work in the final semester may be carried out during the internship and same may be submitted for evaluation.
Student has to acquire 01 credit by going for internship (minimum of Two weeks) / carrying out internal project work/ study project report on any industry/ attending work shop in reputed institutions for two weeks. Certificate from the organization has to be submitted to this effect attested by Head of the Department and Internship in charge to the academic section before the commencement of 4-1 semester. Student is expected to carry out the activities mentioned here during the summer break before the commencement of 4-1 semester.

R G M COLLEGE OF ENGINEERING AND TECHNOLOGY
AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

IV B.Tech, I-Sem. (M.E)

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[A0324197] CAD/CAM

COURSE OBJECTIVES:

- To impart the knowledge on current advances in Computer-aided design/ Computer aided manufacturing (CAD/CAM) and also about Numerical control machines and the process planning.
- It is to introduce geometric modelling techniques, data structure design and algorithms for solid modelling.
- It also covers the machining theory, automated CNC machining, and process control.
- It gives the information of quality control.

COURSE OUTCOMES:

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

- Understand the impact of CAD/CAM in modern manufacturing industries.
- Understand geometric transformation techniques in CAD.
- Model engineering components using surface and solid modeling techniques.
- Develop CNC programs to manufacture industrial components
- Understand the concept of part classification and coding.
- Understand the concept of Quality Control techniques.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1	2	3	1	2	-	-	-	2	1	2	2	2	2
CO2	3	2	2	2	3	1	-	-	2	-	1	1	2	2	2	2
CO3	2	2	1	2	3	1	-	-	-	-	-	1	2	1	2	2
CO4	3	2	1	2	3	2	1	-	-	3	2	1	2	1	2	2
CO5	2	3	2	2	3	1	-	-	-	-	1	1	2	2	1	2
CO6	3	2	1	2	3	2	1	-	-	-	2	1	2	1	2	2

UNIT – I

Product cycle, Basic structure, CPU, input devices, output devices, Memory types, Application of computers for design, benefits of CAD, storage devices hard copy devices. Reasons for implementing CAD, benefits of computer aided design.

UNIT – II

Computer Graphics & Drafting: Raster scan graphics coordinate system, DDA Algorithm, database structure for graphics modeling, transformation of geometry,2D, 3D transformations, Geometric commands, layers, display control commands, editing, dimensioning.

UNIT – III

Geometric modeling: Wire frame models, Surface frame models, Solid models, Wire frame entities, Surface frame entities, Solid entities, curve representation, parametric representation of synthetic curves.

UNIT –IV

Numerical control: Basic components of an NC, Classifications- CNC, DNC, classification of several output devices used in NC systems, feedback devices, NC coordinate systems, NC motion control systems, application of NC, Machining center, turning center, NC Part Programming, A.P.T- language.

UNIT – V

Group Tech: Part family, coding and classification, production flow analysis, advantages and limitations, Computer Aided Processes Planning, Retrieval type and Generative type.

UNIT – VI

Computer Aided Quality Control: Terminology in quality control, the computer in QC, contact inspection methods, non-contact inspection methods-optical non-contact inspection methods-non-optical computer aided testing, integration of CAQC with CAD/CAM.

TEXT BOOKS:

1. CAD/CAM, A Zimmers & P.Groover, PE, PHI.1984.
2. CAD/CAM-Principles and applications, P.N. Rao, McGraw Hill, 2017.

REFERENCES:

1. Automation, Production systems & Computer integrated Manufacturing, P. E. Groover, 2016.
2. CAD/CAM/CIM, Radhakrishnan and Subramaniah, New Age, 2007.
3. Principles of Computer Aided Design and Manufacturing, Farid Amirouche, Pearson, 2004.
4. CAD/CAM Theory and Practice, R. Sivasubramaniam, McGraw Hill,2009.
5. Computer Aided Design and Manufacturing, Lalit Narayan, PHI. 2008.
6. Computer Aided Manufacturing, T.C. Chang, Pearson.3/e, 2005.
7. A text book of CAD/CAM, CSP Rao, Hitech Publ., 2017.

R G M COLLEGE OF ENGINEERING AND TECHNOLOGY
AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

IV B.Tech, I-Sem. (M.E)

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[A0331197] FINITE ELEMENT METHODS

[Professional Elective-II]

COURSE OBJECTIVES:

The course should enable the students to learn:

- To equip the students with the Finite Element formulation Techniques.
- To characterize the different finite elements used in FEM technology
- To Equilibrium equation, Stress-strain relation for isotropic and orthotropic materials.
- To apply different boundary conditions to solve structural problems and heat transfer problems using Finite Element Techniques.

COURSE OUTCOMES:

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

- Understand the given problem; apply the basic concepts and different approaches to solve the complex problem.
- Understand the local and Global coordinate system, formulation of shape functions and finite element equation.
- Apply finite element techniques to analyse the one dimensional Bar Element and Two dimensional Truss structures.
- Apply FEM techniques to solve Beam structures.
- Achieve expertise to solve two dimensional problems using CST and Axi-symmetric finite element formulation.
- Solve heat transfer problems by Ally FEM formulation techniques.

MAPPING WITH COS & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2	3	1	-	1	3	2	3	2	3	2	2	2
CO2	3	3	2	2	3	-	-	1	3	3	3	2	3	3	2	3
CO3	3	3	2	3	3	2	-	2	3	3	3	2	3	3	2	3
CO4	3	3	2	3	3	2	-	2	3	3	3	2	3	3	2	3
CO5	3	3	2	3	3	2	-	2	3	3	3	2	3	3	2	3
CO6	3	3	2	3	3	2	-	2	3	3	3	2	3	3	2	3

UNIT-I

Fundamental concepts in finite element methods, advantages and applications of FEM, steps followed in FEM- Stress and Equilibrium. Strain – Displacement relations. Stress – strain relations. Plane stress, plane strain conditions, Variational and weighted residual methods- the Rayleigh Ritz method, Galerkin's method.

UNIT-II

Finite element technique: Finite element modeling, coordinates-Local and Global coordinates and shapes functions- Principle of minimum Potential Energy- Assembly of Global stiffness matrix and load vector, Finite element equations, Treatment of boundary conditions, Quadratic shape functions.

UNIT-III

Analysis of Bar and Truss Structures: One-dimensional Bar element- derivation of element stiffness matrix, simple problems on bar element, Thermal stresses in 1-D bar element- Two-dimensional truss element, stiffness matrix for two-dimensional truss, simple problems on two-dimensional truss structures.

UNIT-IV

Analysis of Beam Structures: Beam elements, stiffness matrix for beam element, simple problems on beam structures – stresses and deflection of beams – cantilever and simply supported beams.

UNIT-V

Two-Dimensional Stress Analyses: Finite element modeling for two-dimensional stress analysis, element stiffness matrix for constant strain triangle (CST) and treatment of boundary conditions, formulation of Axi-symmetric problems.

UNIT-VI

Steady State Heat Transfer Analysis: Derivation of basic differential equation, One-dimensional heat transfer through a fin and composite wall.

TEXT BOOKS

1. Introduction to Finite Element in Engineering, Tirupati Chandrapatla and Bellagundu Pearson Education, New Delhi, 2011.
2. A Introduction to Finite Element Method, J. N. Reddy McGraw Hill, International Edition, 2005.

REFERENCES

1. Finite Element Analysis, C.S. Krishna Moorthy, McGraw Hill Publishers, New Delhi., 1987.
2. Finite Element Methods, S. S. Rao, Pergamom Press, New York, 6th edition , 2017.
3. Introduction of finite element Analysis, S. Md. Jalaluddin, Anuradha Publishers, Chennai, 2016.
4. Hutton Fundamentals of Finite Element Analysis, V. David McGraw Hill Publishers, New Delhi, 2010.
5. Introduction to the Finite Element Methods, Desai and Abel, CBS Publishers, New Delhi, 2005.

R G M COLLEGE OF ENGINEERING AND TECHNOLOGY
AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

IV B.Tech, I-Sem. (M.E)

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2	1	3

[A0332197] MICRO AND NANO MANUFACTURING

[Professional Elective-II]

COURSE OBJECTIVES:

- Understand design-and-analysis methods and tools used for micro and nano manufacturing

COURSE OUTCOMES:

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

- Understand manufacturing considerations at the micro and nano scale
- Select suitable manufacturing methods, techniques and process parameters to create micro sized components
- Select suitable manufacturing methods , techniques and process parameters to create nano sized components
- Design and select industrially-viable processes, equipment and manufacturing tools for specific industrial products
- Characterize nanostructures for industrial application
- Select manufacturing methods, techniques and process parameters for material processing quality

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	1	1				2		2	2	2	2	1	1
CO2	2	2	2	3	2				2		2	2	2	2	2	2
C03	2	2	2	2	2				2		2	2	2	2	2	2
CO4	3	2	2	2	3				2		2	3	2	2	1	1
CO5	3	3	3	2	3				2		2	2	1	2	1	1
CO6	2	2	3	2	2				2		2	2	2	2	1	1

UNIT - I

Introduction: Importance of Nano-technology, Emergence of Nanotechnology, Bottom-up and Top-down approaches, challenges in Nanotechnology, Scaling Laws/Sizing effects.

Nano-materials Synthesis and Processing: Methods for creating Nanostructures; Processes for producing ultrafine powders- Mechanical grinding; Wet Chemical Synthesis of nano-materials- sol-gel process, Liquid solid reactions; Gas Phase synthesis of nano-materials- Furnace, Flame assisted ultrasonic spray pyrolysis; Gas Condensation Processing (GPC), Chemical Vapour Condensation(CVC)- Cold Plasma Methods, Laser ablation, Vapour – liquid –solid growth, particle precipitation aided CVD, summary of Gas Condensation Processing(GPC).

UNIT - II

Micro fabrication Techniques: Lithography, Thin Film Deposition and Doping, Etching and Substrate Removal, Substrate Bonding, MEMS Fabrication Techniques, Bulk Micromachining, Surface Micromachining, High- Aspect-Ratio Micromachining.

UNIT - III

Nanofabrication Techniques: E-Beam and Nano-Imprint Fabrication, Epitaxy and Strain Engineering, Scanned Probe Techniques, Self-Assembly and Template Manufacturing. Honing and Lapping nano-finishing processes.Abrasive flow finishing process and variants, Elastic emission machining, Elasto abrasive finishing, Focused ion beam nano finishing for ultra-thin TEM sample preparation.

UNIT - IV

Hybrid Nano finishing Process: Electrochemical grinding, electrochemical magnetic abrasive finishing, Electro discharge diamond grinding, Fine finishing of gears by electrochemical honing process and Ultrasonic assisted abrasive flow machining.

UNIT - V

Structural Characterization: X-ray diffraction, Small angle X-ray Scattering, Optical Microscope and their description, Scanning Electron Microscopy (SEM), Scanning Probe Microscopy (SPM), TEM and EDAX analysis, Scanning Tunnelling Microscopy (STM), Atomic force Microscopy (AFM).

UNIT - VI

MEMS devices and applications: Pressure sensor, inertial sensor, Optical MEMS and RF-MEMS, Micro-actuators for dual-stage servo systems.

TEXT BOOKS:

1. MEMS and Microsystems: Design and Manufacture, Tai-Ran Hsu, McGraw- Hill, 2008.
2. Fundamentals of Microfabrication: The Science of Miniaturization Marc Madou, , Second Edition
3. CRC Press, 2002.
4. Microfabrication and Nano manufacturing, Mark James Jackson, CRC Press, 2005.

REFERENCE BOOKS:

1. Introduction to Nanoscience and Nanotechnology, Gabor L. Hornyak, H.F Tibbals, Joydeep Dutta &
2. John J Moore, CRC Press, 2009.
3. Physical Principles of Electron Microscopy: An Introduction to TEM, SEM, and AEM, Ray F. Egerton,
4. Springer, 2005.
5. Thermal Analysis of Materials, Robert F Speyer, Marcel Dekker Inc, New York, 1994.
6. Elements of X-Ray Diffraction, B.D. Cullity, 3 rd edition, Prentice Hall, 2002.

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AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

IV B.Tech, I-Sem. (M.E)

L	T	C
2	1	3

[A0333197] RAPID PROTOTYPING

[Professional Elective-II]

COURSE OBJECTIVES:

The course should enable the students to learn:

- An understanding of the various rapid prototyping, rapid tooling, and reverse engineering technologies.
- The knowledge to select appropriate technologies for product development purposes.

COURSE OUTCOMES:

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

- Identify suitable time compression techniques for rapid product development
- Understand SLS machines and FDM machines with their operational principles and applications.
- Understand the operational details of LOM material manufacturing machines.
- Explore different types of printers used for modelling.
- Understand different types of tooling used in rapid prototyping
- Exposure to different types of software used for RP, STL file formulation and influence of machining factors on the accuracy of the part.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	3	3	3	2	-	2	3	1	-	2	3	3	2	1
CO2	1	1	3	3	3	2	-	2	3	1	2	2	3	3	2	1
CO3	1	2	3	3	3	2	-	2	3	1	2	2	3	3	2	1
CO4	1	1	2	1	3	-	-	-	2	1	2	2	3	2	1	1
CO5	1	1	2	1	3	-	-	-	2	1	2	2	3	2	1	1
CO6	1	1	2	1	3	-	-	-	2	1	2	2	3	2	1	1

UNIT-I

INTRODUCTION: Need for the compression in product development, history of RP systems, Survey of applications, Growth of RP industry, and classification of RP systems. **STEREO LITHOGRAPHY SYSTEMS**: Principle, Process parameter, Process details, Data preparation, data files and machine details, Application.

UNIT-II

SELECTIVE LASER SINTERING: Type of machine, Principle of operation, process parameters, Data preparation for SLS, Applications.

FUSION DEPOSITION MODELLING: Principle, Process parameter, Path generation, Applications.

UNIT-III

SOLID GROUND CURING: Principle of operation, Machine details, Applications. Laminated Object Manufacturing-Principle of operation, LOM materials. Process details, application.

UNIT-IV

CONCEPTS MODELERS: Principle, Thermal jet printer, Sander's model market, 3-D printer. GenisysXs printer HP system 5, object Quadra systems.

UNIT-IV

RAPID TOOLING: Indirect Rapid tooling, Silicone rubber tooling, Aluminum filled epoxy tooling, Spray metal tooling, Cast Kirk site, 3Q keltool, etc. Direct Rapid Tooling Direct. AIM.

Quick cast process, Copper polyamide, Rapid Tool, DMILS, Prometal, Sand casting tooling, Laminate tooling soft Tooling vs. hard tooling.

UNIT-VI

SOFTWARE FOR RP: STL files, Overview of Solid view, magics, imics, magic communicator, etc. Internet based software, Collaboration tools.

RAPID MANUFACTURING PROCESS OPTIMIZATION: factors influencing accuracy. Data preparation errors, Part building errors, Error in finishing, influence of build orientation.

TEXT BOOKS:

1. Stereo Lithography and other RP & M Technologies, Paul F. Jacobs: SME, NY, 1995.
2. Rapid Manufacturing, Flham D.T &Dinjoy S.S Verlog London, 2017.

REFERENCES

1. Rapid Prototyping, Terry Wohlers Wohler's Report "Wohler's Association, 1996.
2. Rapid Prototyping Materials**,** Gurumurthi, IISc Bangalore, 2017
3. Rapid Automated, Lament wood. Indus press New York, 1993.

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IV B.Tech, I-Sem. (M.E) L T C
2 1 3

[A0328197] REFRIGERATION AND AIR CONDITIONING

[Professional Elective-III]

(Use of Standard Refrigeration and Air Conditioning Data Book along with Steam Tables are Permitted in End Examinations**)**

COURSE OBJECTIVES:

- Introduce the students how real systems used in commercial, industrial refrigeration and air conditioning industries.
- Expose the students on various refrigeration methods like vapour compression refrigeration, vapour absorption refrigeration and latest developments.
- Know the various air conditioning methods like summer, winter and year round air conditioning
- Make the student to understand the practical applications of refrigeration and air conditioning systems.

COURSE OUTCOMES:

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

- Analyze various refrigerating cycles.
- Evaluate the performance of vapour compression refrigeration and vapour absorption refrigeration systems
- Illustrate the working of various components of the steam jet refrigeration system
- Perform the cooling load calculations and select the appropriate process and equipment for the required comfort and industrial air conditioning

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	1	-	1	1	1	2	1	1	2	2	2	2	1
CO2	3	2	2	2	1	2	3	1	2	1	2	2	2	2	1	2
CO3	3	2	2	2	1	2	1	1	2	1	1	2	2	2	1	2
CO4	3	3	2	2	1	1	1	1	2	1	1	-	2	2	2	2

UNIT–I

INTRODUCTION TO REFRIGERATION: Necessity and Applications, Carnot Refrigerator, Unit of Refrigeration, COP, EER, Different Refrigeration Methods.

AIR REFRIGERATION: Bell-Coleman Cycle, Ideal and Actual Cycles, Open and Dense Air Systems - Numerical Problems - Boot Strap Air Evaporative Cooling System.

UNIT–II

VAPOUR COMPRESSION REFRIGERATION (VCR) SYSTEM: Basic Cycle - Working Principle and Essential Components of The Plant - COP - Representation of Cycle On T-S and P-h Charts - Expander Vs. Throttling, Effect of Sub Cooling and Super Heating - Cycle Analysis - Construction and Use of Ph Charts - Numerical Problems. Refrigerants - Desirable Properties - Classification of Refrigerants Used - Nomenclature- Secondary Refrigerants- Lubricants - Ozone Depletion - Global Warming- Newer Refrigerants.

UNIT–III

VAPOR ABSORPTION REFRIGERATION (VAR) SYSTEM: Description and Working of NH3 - Water System and LiBr -Water System -Calculation of Max COP, - advantages and disadvantages of VAR over VCR- Principle of Operation of domestic Electrolux system.

UNIT–IV

STEAM JET REFRIGERATION SYSTEM: Working Principle and Basic Components - Principle and operation of:

(i) Thermo-Electric Refrigerator
(ii) Vortex tube or Hilsch tube
(iii) Acoustic refrigeration system.

UNIT–V

INTRODUCTION TO AIR CONDITIONING: Psychrometric Properties & Processes - Characterization of Sensible and Latent Heat Loads - Need for Ventilation - Infiltrated air - Heat Load concepts - RSHF, GSHF-Problems.

Air Conditioning equipment: Humidifiers - Dehumidifiers - Air Filters, Fans and Blowers.

UNIT–VI

COMFORT AIR CONDITIONING: Requirements of human comfort and concept of Effective Temperature- Comfort chart -Comfort Air Conditioning - summer, winter & year round air conditioning - Simple Problems.

Heat Pump : Heat sources - different heat pump circuits

TEXT BOOKS:

1. Refrigeration and Air Conditioning, CP Arora, McGraw-Hill, 4/e, 2020.
2. A Course in Refrigeration and Air conditioning, SC Arora & Domkundwar, Dhanpatrai,2018.

REFERENCES:

1. Refrigeration and Air Conditioning, Manohar Prasad, New Age, 3/e, 2021.
2. A text book of Refrigeration and Air Conditioning, R.S. Khurmi & J. K. Gupta, S. Chand & Co. 2019.
3. Principles of Refrigeration, Dossat, Pearson Edu. 4/e 2002
4. Refrigeration and Air Conditioning, P. L. Ballaney, Khanna Publ. 1972
5. Refrigeration and Air Conditioning, R. C. Arora, PHI. 2010
6. Basic Refrigeration and Air-Conditioning – Ananthanarayanan, McGraw-Hill ,2013.

R G M COLLEGE OF ENGINEERING AND TECHNOLOGY
AUTONOMOUS
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IV B.Tech, I-Sem. (M.E)

L	T	C
2	1	3

[A0342198] COMPUTATIONAL FLUID DYNAMIC

[Professional Elective-III]

COURSE OBJECTIVES:

- To familiarize students with the basic steps and terminology associated with CFD.
- To introduce students to computational modeling and numerical methods.
- To develop a clear understanding of how computational methods, algorithms and boundary condition chosen affect the approximate solution.
- To impart use of modern CFD software, including geometry building, mesh generation, solution techniques, and flow visualization

COURSE OUTCOME:

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

- Develop mathematical models for flow phenomena
- Analyze mathematical and computational methods for fluid flow and heat transfer simulations.
- Solve computational problems related to fluid flows and heat transfer
- Address complex problems using CFD with the specific focus on developing practical skills in using a commercial CFD package
- Develop flow simulation code for fluid flow and heat transfer problems
- Simulate simple CFD models and analyze its results.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2	3	1	2		2	1		1	1	1	2	1	1
CO2	2	1	2	3	1	2		1	1		2	1	2	1	2	1
CO3	1	1	2	3	1	1		2	1		1	1	2	2	1	2
CO4	2	1	1	3	1	2		1	1		2	2	2	1	2	2
CO5	2	2	1	2	1	1		1	1		1	2	1	2	1	2
CO6	3	2	2	3	1	2		1	1		1	1	2	1	2	1

UNIT- I

Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momemtum and Energy equations – Physical boundary conditions – Time-averaged equations for Turbulent Flow – Turbulent–Kinetic Energy Equations – Mathematical behavior of PDEs on CFD.

UNIT-II

Methods of Deriving the Discretization Equations - Taylor Series formulation – Finite difference method – Control volume Formulation – Spectral method. Solution methodologies: Direct and iterative methods, Thomas algorithm, Relaxation method, Alternating Direction Implicit method.

UNIT-III

Heat conduction - Finite difference and finite volume formulation of steady/transient one-dimensional conduction equation, Source term linearization, Incorporating boundary conditions, Finite volume formulations for two and three dimensional conduction problems.

UNIT-IV

Convection and Diffusion -Finite volume formulation of steady one-dimensional convection and Diffusion problems, Central, upwind, hybrid and power-law schemes - Discretization equations for two dimensional convection and diffusion.

UNIT - V

Finite Differences, discretization, consistency, stability, and Fundamentals of fluid flow modeling: Introduction, elementary finite difference quotients, implementation aspects of finite-difference equations, consistency, explicit and implicit methods.

UNIT-VI

Steady flow, dimensionless form of Momentum and Energy equations, Stokes equation, conservative body force fields, stream function- Vorticity formulation, Boundary-layer theory, Buoyancy – Driven Convection and stability.

TEXT BOOK:

1. Computational fluid dynamics, Basics with applications, John. D. Anderson, McGraw Hill, 1995.
2. Introduction to computational fluid dynamics, P. Niyogi, S. K. Chakrabartty, M. K. Laha, Pearson Education Publications, 2006.

REFERENCE BOOKS:

1. Numerical Heat Transfer and Fluid Flow, Suhas V, Patankar Hema, Shava Publishers and McGraw Hill, New Delhi, 1980.
2. Computational Fluid Flow and Heat Transfer, Muralidharan, Nasora Publications, New Delhi, 1995.
3. Fundamentals of Computational Fluid Dynamics, Tapan K. Sengupta, Universities Press, New Delhi, 2004
4. Numerical Heat Transfer and Fluid Flow, Patankar, S.V, McGraw-Hill, 1980.

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DEPARTMENT OF MECHANICAL ENGINEERING

IV B.Tech, I-Sem. (M.E)

L	T	C
2	1	3

[A0343198] ADVANCE WELDING TECHNOLOGY

[Professional Elective-III]

COURSE OBJECTIVES:

On successful completion of this course the student will:

- understand the recent developments in welding technology and where these new processes can be used
- understand the physical principles behind the operation of these processes
- understand the physical and engineering principles behind each application and the methods for maximizing process efficiency
- Understand how to select the most appropriate welding system for a particular application and analyze the economic benefits.
- understand Safe Practices in Welding

COURSE OUTCOMES:

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

- understand and analyze Welding Process
- Analyze the Advanced Welding Techniques and its application in different working ambience
- Design welding techniques according to required application
- Thermal and Metallurgical analysis of welding.
- Understand inspection methods for determination of Weld defects and its remedial measures

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	1	-	1	1	-	-	-	-	1	2	1	1	1
CO2	2	1	1	2	-	1	-	-	-	-		1	2	2	2	1
CO3	2	1	2	3	1	-	-	-	-	-	-	1	2	1	2	1
CO4	2	3	2	1	1	1	1	-	-	-	-	1	2	2	1	2
CO5	2	2	2	1	1	-	1	-	-	-	-	1	2	2	1	2

UNIT I

Introduction: Importance and application of welding, classification of welding process, Selection of welding process.

Review of Conventional Welding Process: Gas Welding, Arc Welding, MIG, TIG Welding, SAW, Resistance Welding, Electro slag Welding, Friction Welding.

UNIT II

Advanced Welding Techniques – Principle, working and application of advanced welding Techniques such as Plasma Arc Welding, Laser Beam Welding, Electron beam welding, Ultrasonic Welding.

UNIT III

Advanced Welding Techniques – Principle, working and application of advanced welding Techniques such as explosive welding/ cladding, under- water welding, spray welding hard facing.

UNIT IV

Weld Design: Weld defects and distortion and its remedies, Inspection / testing of welds, Macrostructure & microstructure of welds, HAZ Weld Design, Welding of pipelines and pressure vessels, Life prediction. Techniques for welding of specific materials like steel, copper, Titanium.

UNIT V

Thermal and Metallurgical Consideration: Thermal consideration for welding, temperature Distribution. Analytical analysis, Metallurgical consideration of Weld, HAZ and Parent metal, Structure solidification of weld.

UNIT VI

Welding defects- types, causes, inspection and remedial measures; testing of welded joints by visual inspection, dye-penetration (DP) test, ultrasonics and radiography. Safe Practices in Welding.

TEXT BOOKS:

1. A Text Book of Welding Technology, O.P. Khanna, Dhanpat Rai & Sons, 2021.
2. Welding Engineering and Technology, R.S. Parmar, Khanna Publishers, 2013.

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AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

IV B.Tech, I-Sem. (M.E)

L	T	C
2	1	3

[A0334197] PRODUCTION AND OPERATIONS MANAGEMENT

[Professional Elective-IV]

COURSE OBJECTIVE:

- The objective of production operation management is to produce the quality product at the right time and the right manufacturing cost.

COURSE OUTCOMES:

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

- understand Quality products production with minimum cost
- Evaluate the legal, social, and economic environments of business.
- Apply knowledge of business concepts and functions in an integrated manner.
- Apply knowledge of fundamental concepts of operations management.
- Apply knowledge of approaches to operational performance improvement.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	-	-	1	2	-	3	-	-	1	2	1	1	2
CO2	2	2	1	1	-	1	2	-	3	-	-	1	2	1	2	2
CO3	2	2	2	1	-	1	2	-	3	-	-	1	2	1	2	2
CO4	2	2	2	1	-	1	2	-	3	-	-	1	2	1	2	1
CO5	2	2	2	1	-	1	2	-	3	-	-	1	1	1	2	1

UNIT – I

Forecasting – Importance of forecasting – Types of forecasting, their uses – Demand patterns-methods of forecasting: qualitative methods and quantitive methods (simple moving average, weighted moving average, Exponential smoothing, adjusted exponential smoothing, linear trend line, seasonal and adjustments)-Forecast accuracy and control (mean absolute deviation, cumulative error, mean sum of squares, bias and tracking signal).

UNIT – II

Introduction to Materials requirement Planning [MRP] - terms used in materials requirement planning [MRP] -dependent and independent, continuous and lumpy demand-lead time-structure of MRP system-working principle of MRP-benefits and drawbacks of MRP-LOB (Line of Balance), JIT inventory: JIT philosophy-push pull and KANBAN systems, contrasts between MRP and JIT-Benefits and evaluation of JIT.

UNIT – III

Routing – Definition – Routing procedure –Route sheets – Bill of material – Factors affecting routing procedure. Schedule –definition – Difference with loading.

Scheduling: introduction- scheduling rules for 'n' jobs on one machine – Types of scheduling (forward and backward).

UNIT –IV

Introduction to PERT / CPM : Project management, network modeling-probabilistic model, various types of activity times estimation-programme evaluation review techniques- Critical Path-probability of completing the project, deterministic model, critical path method (CPM)-critical path calculation-crashing of simple of networks.

UNIT-V

Line Balancing: Introduction-terminology in line balancing-methods of line balancing (Ranked positional weight method).

Aggregate planning: concept of aggregate planning-kinds of costs involved in aggregate planning-)-strategies of aggregate planning-methods to handle aggregate planning (graphical and Linear programming method).

UNIT – VI

Dispatching – Activities of dispatcher – Dispatching procedure – follow up – definition – Reason for existence of functions – types of follow up, applications of computer in production planning and control.

TEXT BOOKS:

1. Industrial Engineering and Management by DR. Ravi Shankar/Galgotia publications pvt. Ltd. 2000.
2. Industrial Engineering and Operations management by S.K. Sharma and Savita Sharma/ Kataria& sons. 2013.

REFERENCES:

1. Operations management by Russel/Taylar, 7/E, 2011.
2. Operations Management – S.N. Chary, 6/E, 2019.
3. Production and operations management by PannerSelvam, PHI, 3/E, 2012.
4. Elements of Production Planning and Control / Samuel Eilon, 2015.
5. Modern Production/ operation managements / Baffa&RakeshSarin, 1987.
6. Production Control A Quantitative Approach / John E. Biegel, 1963.
7. Production Control / Moore, 1959.
8. Operations Management / Joseph Monks, 1987.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/112102106
2. https://nptel.ac.in/courses/112107238
3. https://nptel.ac.in/courses/110107141

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AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

IV B.Tech, I-Sem. (M.E)

L	T	C
2	1	3

[A0335197] MODERN MANUFACTURING METHODS

[Professional Elective-IV]

COURSE OBJECTIVES:

- To familiarize the students with the principles and applications of different modern manufacturing processes.
- To familiarize the students with the modern machining processes used to remove the material from different types of metals and for different purposes.

COURSE OUTCOMES:

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

- Analyze applications of different modern manufacturing processes
- Understand the material remove process like AJM, WJM and AWJM.
- Understand different Electro chemical Process using modern technology.
- Analyze the thermal metal removal process using unconventional methods like EDM, EDG and EDWC.
- Understand thermal and Non-thermal processes using EBM and LBM.
- Familiarize the process of Plasma Arc machining and Chemical Machining.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1	3	2	-	3	-	-	-	-	1	2	2	2	1
CO2	2	3	1	2	1	2	-	2	2	-	1	1	2	2	2	-
CO3	2	2	1	2	2	-	1	-	1	-	-	1	2	2	1	-
CO4	3	2	1	2	2	-	1	-	-	-	-	1	2	2	2	1
CO5	2	3	2	1	1	-	-	-	-	-	-	1	2	1	-	1
CO6	2	3	2	1	2	-	1	-	-	-	-	1	2	2	2	-

UNIT I

Need for non-traditional machining Processes -Classification of modern machining processes. Ultrasonic Machining– Elements of the process, mechanics of metal removal process parameters, economic considerations, applications and limitations, recent development.

UNIT II

Abrasive jet machining, Water jet machining and abrasive water jet machine: Basic principles, equipments, process variables, mechanics of metal removal, MRR, application and limitations.

UNIT – III

Electro – Chemical Processes: Fundamentals of electro chemical machining, electrochemical grinding, electro chemical honing and deburring process, metal removal rate in ECM, Tools, Surface finish and accuracy economic aspects of ECM.

UNIT – IV

Thermal Metal Removal Processes: General Principle and applications of Electric Discharge Machining, Electric Discharge Grinding and electric discharge wire cutting processes – Power circuits for EDM, Process parameters, selection of tool electrode and dielectric fluids, methods of surface finish and machining accuracy, characteristics of spark eroded surface and machine tool selection. Wire EDM, principle, applications.

UNIT – V

Electron Beam Machining: Generation and control of electron beam for machining, theory of electron beam machining, comparison of thermal and non-thermal processes.

Laser Beam Machining: General Principle and application of laser beam machining – thermal features, cutting speed and accuracy of cut.

UNIT-VI

Plasma Machining: Principle, metal removal mechanism, process parameters, accuracy and surface finish, applications.

Chemical Machining: Fundamentals of chemical machining- Principle- maskants –etchants- advantages and applications.

TEXT BOOKS:

1. Advanced Machining Processes, VK Jain, Allied publishers, 2009.
2. Modern Machining Process, Pandey, P.C. and Shah H.S., TMH, 1981.

REFERENCES:

1. New Technology, Bhattacharya A, the Institution of Engineers, India 1984.
2. Manufacturing Technology, Kalpakjian, Pearson, 2009.
3. Fundamentals of Machining & Machine Tools, D G Booth Roy & WA, 2005.

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AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

IV B.Tech, I-Sem. (M.E)

L	T	C
2	1	3

[A0336197] INTERNAL COMBUSTION ENGINES

[Professional Elective-IV]

COURSE OBJECTIVES:

- Modern industry requires Mechanical Engineers, who are capable of design & implementing Internal Combustion Engines specific tasks. To do this engineer must exercise creative ability, sound judgment and technical knowledge.
- The student should able to know the power cycles used in Internal Combustion Engines.
- The student should able to know the different systems used in Internal Combustion Engines.
- The student should able to know the combustion processes in CI & SI Engines.
- The student should able to know the knowledge of testing & performance of Engines.

COURSE OUTCOMES:

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

- Understand working and performance of IC Engines through thermodynamic cycles
- Understand Various engines systems used in I.C engines
- Understand combustion phenomena in SI and CI engines.
- Classify combustion chambers of IC engines and understand combustion phenomena in IC engines
- Evaluate methods for test and estimating the IC engine performance
- Outline emission formation mechanism of IC engines, its effects and the legislation standards.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	1	1	2	1	-	-	1	-	3	2	1	-	1
CO2	3	3	2	-	1	1	1	-	-	1	-	3	2	1	1	1
CO3	3	3	2	2	1	2	2	-	-	1	-	3	2	1	1	1
CO4	3	3	2	2	2	2	2	-	-	1	-	3	2	1	1	1
CO5	3	3	2	-	2	2	2	-	-	1	-	3	2	1	1	1
CO6	3	3	1	1	1	2	2	-	-	1	-	3	2	1	1	1

UNIT – I

Power Cycles: Carnot cycle, Air standard cycles -Description and representation of Otto cycle, Diesel cycle & Dual cycles on P–V and T-S diagram -Thermal Efficiency – Comparison of Otto, Diesel and Dual cycles. Simple problems on Otto, Diesel and Dual cycles

UNIT-II

I.C. Engines: Energy conversion – basic engine components –Classification of I.C. Engines, Working principle of two stroke and four stroke engines - comparison of two stoke and four stroke, SI and CI engines –Valve and port timing diagrams, application of I.C Engines.

UNIT – III

Engine Systems: Working principle of, Magneto & Battery Ignition System **-** Simple Carburetor - Common rail fuel Injection System - Air & Thermostat cooling system - Petrol & Pressure Lubrication system.

Super Charging: Introduction, types of superchargers, methods of supercharging, advantages and limitations of supercharging.

UNIT - IV

Combustion in S.I. Engines: Homogeneous Mixture - Stages of combustion - Importance of flame speed and factors influencing the flame speed –Abnormal Combustion - Phenomenon

of Knocking, Summary of Engine variables affecting the knocking, pre-ignition– Combustion Chambers, requirements, types - Rating of S.I Engine fuels.

UNIT - V

Combustion in C.I. Engines: Heterogeneous Mixture - Stages of combustion – Delay period and its importance – factors affecting the Delay Period – Phenomenon of Knock – Comparison of knock in SI & CI Engines - Combustion chambers (DI & IDI), requirements, types- Rating of C.I Engine fuels.

UNIT – VI

Testing and Performance: Engine Performance Parameters - Determination of brake power, friction power and indicated power – Performance test – Heat balance sheet and chart- Emissions from Diesel & Petrol Engines, Euro Norms - Simple problems on performance and heat balance sheet.

TEXT BOOKS:

1. I.C. Engines, V. GANESAN- McGraw Hill, 4/E, 2017.
2. I.C. Engines, Heywood, McGraw Hill, 2/E, 2018.

REFERENCES:

1. Thermal Engineering / R.K Rajput / Lakshmi Publications, 8/E, 2010.
2. I.C Engines – Mathur & Sharma – DhanpathRai & Sons, 2016.
3. Engineering fundamentals of I.C Engines – Pulkrabek / Pearson /PHI, 2003.
4. Thermal Engineering / Rudramoorthy – McGraw Hill, 2017.
5. Thermodynamics & Heat Engines / B. Yadav/ Central Book Depot., Allahabad, 2002.
6. Thermal Engineering – R.S. Khurmi & J.K.Gupta – S. Chand, 2008.

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IV B.Tech, I-Sem. (M.E)

L	T	C
2	1	3

[A0325197] OPERATIONS RESEARCH

[Open Elective-II]

COURSE OBJECTIVES:

Upon completion of this course, the student should be able to,

- Formulate a real-world problem as a mathematical programming model,
- Understand the theoretical workings of the simplex method for linear programming and perform iterations of it by hand,
- Understand the relationship between a linear program and its dual, including strong duality and complementary slackness,
- Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change,
- Solve specialized linear programming problems like the transportation and assignment problems,
- Solve network models like the shortest path and scheduling, replacement and queuing problems.

COURSE OUTCOMES:

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

- Understand the concepts of operations research modelling approaches
- Formulate and solve engineering and managerial situations as linear programming model.
- Formulate and solve engineering and managerial situations as Transportation and Assignment problems
- Apply the concept of Replacement models.
- Apply Queuing theory model and scheduling techniques to real life problems.

MAPPING WITH COs & POS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	-	-	-	-	1	-	1	1	2	1	2	2	-	1
CO2	3	2	2	1	2	-	1	-	1	1	1	1	2	2	1	1
CO3	2	2	2	1	2	-	1	-	1	1	-	1	2	1	1	2
CO4	3	2	2	1	1	-	1	-	1	1	2	1	2	1	1	2
CO5	2	3	2	1	1	-	1	-	1	1	1	1	2	2	1	1

UNIT – I

Linear Programming: Introduction-structure of linear programming model- Formulation– Graphical solution – Simplex method, Big-M method, two phase method, Special cases-Duality, dual simplex method.

UNIT-II

Transportation: Introduction-methods of finding initial basic feasible solution (North-west corner rule, least cost method and Vogel‟s Approximation method), optimal solution (Modi Method), variations in transportation problem-maximization.

UNIT-III

Assignment problems: Hungarian method of Assignment problem- variations of the assignment problem-Traveling salesman problem.

Job sequencing: n jobs - two machines, n jobs - three machines, two jobs - n machines.

UNIT-IV

Replacement and maintenance models: Introduction-types of failure-replacement of items whose efficiency deteriorates with time- replacement of items that fail completely-staffing problem.

UNIT-V

Queuing theory: Introduction-characteristics of queuing system-probability distributions in queuing system-single server queuing models, multi-server queuing models.

UNIT-VI

Inventory: Introduction-functional role of inventory-reasons for carrying inventory, inventory control models without shortages and with shortages-EOQ models with quantity discounts-instantaneous probabilistic demand without set-up cost, P-system and Q-system.

TEXT BOOKS:

1. Operations Research- theory and applications, second edition, J.K. Sharma/MacMillian publications, 2020.
2. Introduction to operations research, Hamdy A. Taha/PHI publications, 2006.

Online resources:

1. https://nptel.ac.in/courses/110106062
2. https://archive.nptel.ac.in/courses/112/106/112106134/
3. https://nptel.ac.in/courses/111107128

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IV B.Tech, I-Sem. (M.E) L T C
2 1 3

[A0330197] INDUSTRIAL WASTE MANAGEMENT

[Open Elective-II]

COURSE OBJECTIVES:

- To understand the wastewater treatment process.
- To gain knowledge on waste disposal in various ways.
- To know about advances in wastewater treatment.

COURSE OUTCOMES:

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

- Understand wastewater treatment methods
- Understand and analyze the waste disposal methods
- Analyze technologies used for chemical and biological methods of effluent treatment
- Analyze advanced wastewater treatment to specific industries.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	2	1	1	1	-	1	1	1	1	1	2	1	1	1
CO2	3	2	2	2	1	1	-	1	1	1	1	1	2	1	2	1
CO3	1	2	2	1	1	1	-	1	1	1	1	1	2	1	1	1
CO4	3	2	2	2	1	1	-	1	1	1	1	1	2	1	2	1

UNIT I

Wastewater Treatment an Overview: Terminology – Regulations – Health and Environment Concerns in waste water management – Constituents in waste water inorganic – Organic and metallic constituents. Process Analysis and Selection: Components of waste water flows – Analysis of Data – Reactors used in waste water treatment – Mass Balance Analysis – Modeling of ideal and non ideal flow in Reactors – Process Selection

UNIT II

Waste disposal methods – Physical, Chemical & Biological; Economical aspects of waste treatment and disposal. Treatment methods of solid wastes: Biological composting, drying and incineration; Design of Solid Waste Management System: Landfill Digester, Vermicomposting Pit.

UNIT III

Introduction: Classification and characterization of food industrial wastes from Fruit and Vegetable processing industry, Beverage industry; Fish, Meat & Poultry industry, Sugar industry and Dairy industry.

UNIT IV

Chemical Unit Processes: Role of unit processes in waste water treatment chemical coagulation – Chemical precipitation for improved plant performance chemical oxidation – Neutralization – Chemical Storage

UNIT V

Biological Treatment: Overview of biological Treatment – Microbial metabolism – Bacterial growth and energetics – Aerobic biological oxidation – Anaerobic fermentation and oxidation – Trickling filters – Rotating biological contractors – Combined aerobic processes – Activated sludge film packing.

UNIT VI

Advanced Wastewater Treatment: Technologies used in advanced treatment – Classification of technologies. Removal of Colloids and suspended particles – Depth Filtration – Surface Filtration – Membrane Filtration- Absorption – Ion Exchange – Advanced oxidation process.

TEXT BOOKS:

1. Food Industry Wastes: Disposal and Recovery, Herzka A & Booth RG; Applied Science Pub Ltd. 1981.
2. Water & Wastewater Engineering, Fair GM, Geyer JC &Okun DA, John Wiley & Sons, Inc. 1986.

REFERENCES:

1. GE; "Symposium: Processing Agricultural & Municipal Wastes"; AVI. 1973,
2. Food Processing Waste Management, Inglett Green JH & Kramer A, AVI. 1979,
3. Environmental Biotechnology: Principles and Applications, Rittmann BE & McCarty PL, Mc-Grow-Hill International editions, 2001.
4. Environmental Biotechnology, Bhattacharyya B C & Banerjee R, Oxford University Press.
5. Wastewater Treatment; Applied Science, Bartlett RE, Pub Ltd.
6. Waste water Engineering Treatment and Reuse, G. Tchobanoglous, FI Biston, McGraw Hill, 2002.
7. Industrial Waste Water Management Treatment and Disposal by Waste Water, 3rd Edition McGraw Hill 2008.

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IV B.Tech, I-Sem. (M.E)

L	T	C
2	1	3

[A0327197] ENTREPRENEURSHIP

[Open Elective-II]

COURSE OBJECTIVES:

- To make the student understand about Entrepreneurship
- To enable the student in knowing various sources of generating new ideas in setting up of New enterprise
- To impart knowledge about various government sources which provide financial assistance to entrepreneurs/ women entrepreneurs
- To encourage the student in creating and designing business plans

COURSE OUTCOMES:

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

- Understand the concept and recent trends in Entrepreneurship across the globe
- Analyze the sources of new methods in generating business idea for design plans in project preparation
- Analyze various sources of finance and subsidies to entrepreneurs
- Analyze the role of banks and other financial institutions in promoting small scale enterprises in India
- Understanding the government of India labours acts. for successful running of start-ups.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	1	1	1	1	2	2	2	2	2	2	1	1	2
CO2	2	1	1	1	1	1	1	2	2	2	2	2	2	1	1	1
C03	2	2	2	1	1	1	1	2	2	2	2	2	2	1	1	1
C04	2	2	1	1	1	1	1	2	2	2	2	2	2	1	1	2
CO5	2	2	1	1	1	1	1	2	2	2	2	2	2	1	1	1

UNIT 1: Introduction to Entrepreneurship Definition of Entrepreneur, Entrepreneurial Traits, Entrepreneur vs. Manager, Entrepreneur vs Intrapreneur. The Entrepreneurial decision process. Role of Entrepreneurship in Economic Development, Ethics and Social responsibility of Entrepreneurs. Opportunities for Entrepreneurs in India and abroad. Woman as Entrepreneur.

UNIT II: Creating and Starting the Venture, Sources of new Ideas, Methods of generating ideas, creating problem solving, product planning and development process, channels of distribution, marketing functions.

UNIT III: Financing and managing the new venture, Sources of capital, venture capital, Record keeping, recruitment, motivating and leading teams, and financial controls. Marketing and sales controls. E-commerce and Entrepreneurship, Internet advertising.

UNIT IV: small scale enterprises. Characteristics of small scale industry, role and importance of small business, problems of small business enterprises, sickness in small scale enterprises, Institutional support to entrepreneurship

UNIT V: Choosing location and layout, Issues related to Selection of layout.

UNIT VI: Labour legislation, Salient Provision under Indian Factories Act, Industrial Disputes Act, Employees State Insurance Act, Workmen's Compensation Act and payment of Bonus Act.

TEXT BOOKS:

1. Entrepreneurship, Robert Hisrich, & Michael Peters, McGraw-Hill, 11/e, 2020
2. Entrepreneurship, Dollinger, Pearson, 4/e, 2004.

REFERENCES:

1. Dynamics of Entrepreneurial Development and Management, Vasant Desai, Himalaya

Publ. House, 2004.
2. Entrepreneurship management Bolanath Dutta
3. Harvard Business Review on Entrepreneurship. HBR Paper Back, 1999.
4. Entrepreneurial Management, Robert J. Calvin, McGraw-Hill, 2004.
5. The Entrepreneurial Connection, Gurmeet Naroola, McGraw-Hill, 2001.
6. Indian Economy, Dutt & Sundaram S. Chand, 2005.
7. Essential of Entrepreneurship and small business management, Thomas W. Zimmerer & Norman M. Scarborough, PHI, 4/e, 2005.
8. Industrial Relations & Labour Laws, Srivastava, Vikas, 2005.
9. Industrial Law, ND Kapoor, Sultan Chand & Sons, 2005

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DEPARTMENT OF MECHANICAL ENGINEERING

IV B.Tech, I-Sem. (M.E) L T C
2 1 3

[A0337197] PARAMETRIC MODELLING-III

[Skill Development Course]

COURSE OBJECTIVES:

- To know the basic properties of Solid Edge.
- To know the Solid Edge environments.
- To understand the important terms and definitions of Solid Edge.
- To know about the user interface of Solid Edge.
- To save the Solid Edge designs automatically after regular intervals.

COURSE OUTCOMES:

At the end of the lab the students will be able to:

- Draw the 2D and 3D drawings using Solid Edge Software package.
- Create 3D assemble drawings for useful to increase the productivity of an industry.
- Understand the national and international standards pertaining to machine drawing.
- Useful to increase the productivity of an industry.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	2	1	-	-	-	-	3	-	2	1	1	2	1
CO2	3	2	1	1	3	-	-	-	-	2	-	-	1	1	2	2
CO3	3	2	1	-	3	1	-	-	-	2	2	2	1	1	1	2
CO4	3	2	1	1	2	-	-	-	-	3	-	2	1	1	2	1

UNIT-I:

Induction to SOLID EDGE: Solid Edge Environment-Assembly Environment-Drafting environment-Interface basics-The solid application window-Quick Access tool bar-Command bars

UNIT – II:

Sketches for solid model: Induction to SOLID EDGE-drawing 2D elements-drawing command and tools-sketching tools-lines, tangents and normal's, circles, Ellipses, Arc etc.

Adding Relationships to the sketches: Geometric Relationship-Displaying parents for relationship-working with grids-dimensioning of sketches-3D pictorial drawing views of dimensions

UNIT – III:

Profile based features: Profile-based ordered feature work flow-Profile validation-creating cutout features-using the edge of existing features-Projecting edges

UNIT – IV:

Modeling Tools:

Creating holes-round work flow-Blend work flow-Chamfer command-Pattern features-circular patterns command-mirror copy paste command

UNIT –V:

Advance modeling tools: Adding drafts to model-Adding a lip to the model-creating web networks-creating vents-constructing swept features-comparing swept, lofted and blue surf feature.

UNIT –VI:

Assembly: Top down and bottom up design in solid edge-Placing additional parts in an assembly-using part reference planes to position parts-Maintaining assembly relationships

Generating Orthographic view from 3D models: Thedraft environment-Generating drawing views-Generating the principal view-Generating the section views.

TEXT BOOKS:

1. Engineering and Technical Drawing Using Solid Edge Version 20, 2008.
2. Solid Edge 2020 Black Book By Gaurav Verma and Matt Weber, 2020.

LIST OFEXERCISES:

1. To draw the sketch with given dimensions by using circles
2. To draw the sketch with given dimensions.
3. To model the given object using the Extrude and cut features as per the given dimensions.
4. To model the given object using the Revolve and Hole features as per the given dimensions.
5. To model the given object using the Fillet, Chamfer and Rib features as per the given dimensions.
6. To model the given object by using Pattern feature as per the given dimensions.
7. To model the given object using the Extrude and Cut features as per the given dimensions.
8. To model the given parts as per the given dimensions.
9. To model the all parts of machine component and complete the assembly.
10. To create Views and Bill of Materials for specified assembly modelling.

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DEPARTMENT OF MECHANICAL ENGINEERING

IV B.Tech, I-Sem. (M.E) P C
3 1.5

[A0384197] COMPUTER AIDED MACHINING LAB

COURSE OBJECTIVES:

- To create awareness among the students about the use of computer technology in manufacturing
- Imparting programming skills to write a part program and simulation &machining for CNC –Turn and CNC- Milling machine.

COURSE OUTCOMES:

At the end of the lab the students will be able to:

- Use knowledge of computer-aided machining" for practical applications.
- Understand the simulation process for lathe operations by cam software
- Understand the working and machining process by CNC lathes
- Understand the simulation process for milling operations by cam software
- Understand the working and machining process by CNC milling.
- Understand the generation of codes for Turn and Milling machines by edge cam software

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2	1	2	2	2	1	1	1	2	2	1	1	2
CO2	2	3	2	1	2	3	1	1	1	1	2	2	1	1	1	1
CO3	3	2	2	3	2	2	2	2	2	2	1	2	1	1	1	1
CO4	2	2	2	2	3	1	2	1	1	1	1	2	1	1	2	1
CO5	1	3	2	3	3	2	1	1	1	1	1	2	2	1	1	2
CO6	3	3	2	3	3	1	2	2	1	1	2	2	1	1	1	1

LIST OF EXPERIMENTS:

1. Facing Operation
2. Plane Turning Operation
3. Taper Turning Operation
4. Thread Cutting operation
5. Step Turning Operation
6. 6.Face Milling Operation
7. Profile Milling Operation
8. Circular Spigot
9. Square Spigot
10. Create 2D model using poly line with Cartesian & Polar Coordinate system with Edge CAM

Software package.

11. Generate CNC codes to Turn the component using Edge CAM Software package
12. Generate CNC codes to Mill the component using Edge CAM software package

Experiments beyond the Curriculum:

1. Plane Turning operation
2. Step Turning operation
3. Taper Turning operation
4. Profile Milling (Model-I)
5. Profile Milling (Model-II)

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DEPARTMENT OF MECHANICAL ENGINEERING

IV B.Tech, I-Sem. (M.E) P C
3 1.5

[A0385197] PARAMETRIC MODELING - II LAB

COURSE OBJECTIVES:

- Use of computer for drafting purpose.
- To train the student to make use of CATIA software package
- To improve the quality of the engineering drawing

COURSE OUTCOMES:

At the end of the lab the students will be able to:

- Able to understand 2Ddrawings and 3D drawings and can be drawn using CATIA Software package.
- Understand and apply the importance of the linking functional and visualization aspects in the preparation of the part drawings.
- Able to create 3D assemble drawings.
- Understand the national and international standards pertaining to machine drawing.
- Useful to increase the productivity of an industry.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	2	2	-	-	-	-	2	-	1	2	2	2	2
CO2	3	2	1	1	3	-	-	-	-	2	-	1	2	2	2	2
CO3	3	3	1	-	2	1	-	-	-	2	2	1	2	2	1	2
CO4	3	2	1	1	2	-	-	-	-	3	-	2	2	2	2	2
CO5	3	2	1	2	2	-	-	-	-	2	-	1	2	2	2	2

UNIT – I:

Drawing the sketches in sketcher: Introduction to CATIA – understanding the sketch terms – using sketch tools – editing and modifying sketches – applying constraints and dimensions.

UNIT – II:

Modeling in CATIA: Transformation features – generating solid – combine – protrusion – creating and removing – multi section solid – creating fillets – chamfers – shell.

UNIT – III:

Assembly modeling: Creating bottom-up and top-down assembly – applying constraints – moving components

UNIT – IV:

Working with drafting: Types of views – generating drawing views – exploded views – modifying the views – insertion of frame and title block – generating dimensions – applying symbols – bill of materials.

UNIT –V:

Working with wireframe and surface design: Need of surface modeling – creating wireframe elements – creating surfaces – cylindrical surfaces – offset surfaces – spherical surfaces – fill option – editing and modifying surfaces.

UNIT – VI:

Working with sheet metal: Setting sheet metal parameters – sheet metal walls – swept walls – creating bend – folding – unfolding sheet metal parts – different types of stampings.

TEXT BOOKS:

1. CATIA for Designers, Sham Tickoo, CAD/ CIM Technologies.

LIST OF EXERCISES:

1. Draw the sketch with given dimensions.
2. Draw the sketch and specify dimensions.
3. Create a part using extrude and revolve features.
4. Create a part using chamfer and fillets features.
5. Create a part using sweep, blend tools & pattern features.

6. Complete the part using revolve and rib tools features.
7. Modify the dimensions and regenerate the existing part.
8. Draw the simple parts and assemble.
9. Draw all parts of machine component and complete the assembly.
10. Generate views for specified part.
11. Create views, dimensions and bill of materials for specified assembly modeling.
12. Draw the surface and convert it into solid.

Software Required: CATIA software Package.

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DEPARTMENT OF MECHANICAL ENGINEERING

IV B.Tech, I-Sem. (M.E)

L	T	C
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[A0084197] MINI PROJECT –II [EPICS]

COURSE OBJECTIVE:

- To develop competency of applying engineering knowledge to real life problems

COURSE OUTCOMES:

At the end of the project work the students will be able to:

- Identify an open-ended problem, in the area of mechanical engineering/applied mechanical engineering, which requires further investigation.
- Identify the methods and materials required for the project work.
- Manage the work with team members.
- Formulate and implement innovative ideas for social and environmental benefits
- Analyze the results to come out with concrete solutions
- Write technical report of the project apart from developing a presentation

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	2	1	1	3	3	3	3	3	2	2	2	2	2
CO2	3	2	1	1	3	1	3	3	3	2	3	3	2	2	2	2
CO3	3	2	1	1	3	1	3	3	3	2	2	2	2	2	2	2
CO4	3	2	1	1	2	1	3	3	3	3	3	2	2	2	2	2
CO5	3	2	1	2	1	1	3	3	3	3	3	2	2	2	2	2
CO6	3	2	1	1	3	1	3	3	3	2	3	3	2	2	2	2

There shall be two Mini-Projects, in collaboration with an industry/EPICS (Engineering Projects In Community Services) (wherever is possible) of their specialization, to be taken up during the vacation (data collection, components etc.) after II year II and III Year II Semester examination and implementation/simulation shall be carried out in III year I semester and IV Year I Semester during lab classes. Implementation or fabrication/simulation of mini projects will be treated as laboratory. However, the mini project and its report shall be evaluated in III year I Semester and IV Year I semester. The mini project shall be submitted in the report form and should be presented before the committee, which shall be evaluated for 50 marks. The committee consists of an external Examiner, Head of the Department and the supervisor of mini project. There shall be 25 internal marks for mini project which will be awarded based on the performance and involvement of the student during mini project period.

R G M COLLEGE OF ENGINEERING AND TECHNOLOGY
AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

IV B.Tech, I-Sem. (M.E)

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[A0085197] COMPREHENSIVE VIVA-VII

There shall be comprehensive Viva-Voce examination at the end of each semester. Comprehensive Viva Examination shall be conducted by the committee consisting of senior faculty (based on the recommendation of HOD), an external Examiner from other institutions and HOD and evaluated for 50 marks.

R G M COLLEGE OF ENGINEERING AND TECHNOLOGY
AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

IV B.Tech, I-Sem. (M.E)

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[A0083197] PROJECT PHASE-I

COURSE OBJECTIVE:

- To develop competency of applying engineering knowledge to real life problems

COURSE OUTCOMES:

At the end of the project work the students will be able to:

- Identify an open-ended problem, in the area of mechanical engineering/applied mechanical engineering, which requires further investigation.
- Review literature to identify gaps and define objectives & as well as methodology of work.
- Plan financial activities and team work.
- Generate and implement innovative ideas for social benefit

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	2	1	1	3	3	3	3	3	2	2	2	2	2
CO2	3	2	1	1	3	1	3	3	3	2	3	3	2	2	2	2
CO3	3	2	1	1	3	1	3	3	3	2	2	2	2	2	2	2
CO4	3	2	1	1	2	1	3	3	3	3	3	2	2	2	2	2

The project topic should be approved by Internal Department Committee (IDC). Out of total 150 marks for the project work, 50 marks shall be for Internal Evaluation (25 marks for Phase-I and 25 marks for Phase-II) and 100 marks for the End Semester Examination.

The evaluation of project work phase-I shall be conducted at the end of the IV year I semester and Phase-II shall be conducted at the end of the IV year II semester.

The project viva voce examination will be conducted by the committee consisting of an external Examiner from other institute, Head of the Department and the supervisor of the project. The Internal evaluation for 50 marks shall be on the basis of two seminars (25 marks for Phase-I and 25 marks for Phase-II) given by each student on the topic of the project. The Internal evaluation of the project work for 50 marks shall be conducted by the committee consisting of head of the Department or his nominee, senior faculty member and the supervisor of project.

R G M COLLEGE OF ENGINEERING AND TECHNOLOGY
AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

IV B.Tech, II-Sem. (M.E)

L	T	C
2	1	3

[A0338198] INDUSTRIAL AUTOMATION AND ROBOTICS

[Professional Elective-V]

COURSE OBJECTIVES:

- The objective of this subject is to impart basic knowledge on automation in Industries.
- To know about anatomy, different configuration and motion of robots.
- To learn about basic component of robots such as sensor, actuators, and feedback devices

COURSE OUTCOMES:

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

- Understand fundamental aspects of automation in industries.
- Understand the basics of Numerical Control machines and part programming of simple geometries
- Understand fundamental of automatic assembly line and production line
- Learn robot anatomy of robot, configuration of different robots, and Describe construction and working of different types robots
- Represent Position and orientation of body, transformation of rigid body, Homogenous Transformation, The Manipulator Kinematics, D-H parameters, forward and inverse kinematics.
- Understand Robot actuator and feedback components such as stepper motor, encoder, resolver.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2	2	-	1	-	-	1	1	3	2	1	1	1
CO2	2	2	1	2	3	1	-	-	-	-	-	2	2	3	1	1
CO3	3	2	2	2	3	-	-	-	-	-	1	2	3	1	1	1
CO4	3	2	3	2	3	1	-	-	-	-	-	2	3	2	1	1
CO5	3	2	2	2	3	1	1	-	-	1	1	1	3	1	1	1
CO6	3	3	2	2	3	1	1	-	-	1	1	2	3	1	1	1

UNIT – I

INTRODUCTION TO AUTOMATION: Automation - need-types, Basic elements of an automated system, levels of automation- computer process control, Forms of computer process control, input/output devices for discrete data, overview of material handling equipment.

UNIT – II

NUMERICAL CONTROL: Introduction-NC Procedure, NC Coordinate systems, elements of NC Systems, classification of NC Systems, Advantages and dis-advantages of NC Systems, Applications of NC, NC Manual Part programming, APT Language.

UNIT – III

MANUAL ASSEMBLY LINES AND TRANSFER LINES: Fundamentals of Manual Assembly lines and automated production lines, Alternative assembly systems, Design for Assembly, Applications of Automated production lines, Analysis of Transfer lines with NO Internal storage, Analysis of Transfer lines with storage Buffers.

UNIT – IV

INTRODUCTION TO INDUSTRIAL ROBOTS: Robotics Definition - robot configurations, Robot Anatomy, joint system, types of joints, Work volume, Robot Drive systems, Precision of Movement, Robotic sensors and actuators, End effectors, Grippers, different types of grippers.

UNIT – V

MANIPULATOR KINEMATICS: Representation of Position and orientation of body, transformation of rigid body, Homogenous Transformation, The Manipulator Kinematics, D-H parameters, 2R and 3R Mechanism D-H analysis, forward and inverse kinematics.

UNIT – VI

ROBOT ACTUATORS AND FEED BACK COMPONENTS: Actuators- pneumatic-hydraulic actuators, Electric & stepper motors, comparison, Position sensors – potentiometers- resolvers- encoders – velocity sensors-tactile sensors-proximity sensors, Robot applications in Manufacturing.

TEXT BOOKS:

1. Automation, Production Systems and CIM, Mikell P. Groover, Prentice-Hall of India Pvt. Ltd, 2016.
2. Industrial Robotics -Technology, Programming and Applications (SIE), Nicholas Odrey, Mitchell Weiss, Mikell Groover, Roger Nagel, Ashish Dutta, McGraw-Hill 2nd Edition, 2017.
3. Introduction to robotics: analysis, control, applications. Niku, S. B, John Wiley & Sons, 2020.

REFERENCE BOOKS:

1. Robotics: Control Sensing, K.S.Fu., R.C.Gonzalez, C.S.G. Lee, Vision and Intelligence Indian Edition, McGraw Hill Book Co., 2008.
2. An introduction to robot technology. Coiffet, P., & Chirouze, M., Springer Science & Business Media, 2012.
4. Robotics: fundamental concepts and analysis, Ghosal, A, Oxford university press, 2006 .
5. Robotics and Control, Mittal R.K & Nagrath IJ, McGraw-Hill, 2017.
6. Introduction to Robotics, Craig, John J, 2005.

R G M COLLEGE OF ENGINEERING AND TECHNOLOGY
AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

IV B.Tech, II-Sem. (M.E)

L	T	C
2	1	3

[A0329197] AUTOMOBILE ENGINEERING

[Professional Elective-V]

COURSE OBJECTIVES:

- The student should get the knowledge about components of automobile fuel supply system cooling systems ignition system and power transmission systems
- The student should understand some fundamental aspects of an internal combustion engines, including important mechanisms used in automobile braking systems, steering system and also clutch mechanism. Emphasis is placed on understanding how the combustion takes place inside the engine cylinder. Supply of air fuel mixture to the engine considered in some detail.
- The student should able to apply the knowledge to solve the trouble shootings at various areas like steering mechanisms, fuel supply pumps and lubricating oil supply pumps etc.

COURSE OUTCOMES:

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

- Understand the basic parts of an automobile
- Understand the operation of engine, transmission, clutch, brakes
- Understand the operation of steering, suspension and braking systems operate.
- Understand the environmental implications of automobile emissions.
- Develop a strong base for understanding future developments in the automobile industry.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2	2	2	2	2	-	1	2	2	1	2	1	2	2
CO2	2	3	2	2	2	2	2	1	1	-	2	2	1	1	2	1
CO3	2	2	2	1	2	2	1	1	2	-	1	2	1	1	2	2
CO4	2	2	2	2	2	-	2	-	2	1	1	1	1	2	2	1
CO5	2	2	2	1	2	2	2	-	2	-	1	2	2	1	2	1

UNIT – I

Introduction: Components of an automobile – chassis and body – power unit – rear wheel drive, front wheel drive, 4 wheel drive – types of automobile engines, engine construction, oil filters, oil pumps – crank case ventilation-Fuel gauge – oil pressure gauge, Engine température indicator.

UNIT – II

Fuel Supply Systems: S.I. Engine: Types of Fuel Supply system, Mechanical and electrical fuel pump – filters– Carburetors (Simple & Zenith) – air filters – petrol injection systems-types, Mechanical, MPFI and electronic injection system.

C.I. Engines: Requirements of diesel injection systems, types of injection systems, CRDE, fuel pumps, testing of fuel pumps.

UNIT – III

Cooling System: Cooling Requirements, Air Cooling, Thermostat Liquid cooling, Radiators – Types, Cooling Fan, water pump, thermostat, antifreeze solutions.

Ignition System: Function of an ignition system, Principle of Electronic Ignition System, Distributer less Electronic Ignition System.

UNIT – IV

Emission Control: Introduction, Emission Norms – Pollution standards – types of emissions-Reduction of formation of pollutants, closed crankcase ventilation, fuel tank and carburetor ventilation, redesigning the combustion chamber, changes in fuel supply system,

modifications in ignition system, treating the exhaust gasses to reduce pollutants – use of alternative fuel.

Starting system: Introduction, Starting Motor, Starting drives, Bendix drive mechanism-starting motor switches –Accessories, Horn, Speedometer, Wind screen wiper.

UNIT – V

Transmission System: Clutches – Principle- types, single plate, multi plate, and centrifugal clutches – gear box – types, constant mesh, synchromesh, epi-cyclic, over drive, torque converter- Propeller shaft – Hotch Kiss drive, Torque tube drive, universal joint, differential, rear axles.

UNIT – VI

Steering System: Introduction, Types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism, Steering geometry – camber, castor, king pin rake, combined angle toe-in, toe-out- - Steering gears – types, steering linkages.

Suspension System: Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system.

Braking System: Introduction, Classification, Mechanical brake system, Hydraulic brake system, air and vacuum brake systems.

TEXT BOOKS:

1. Automobile Engineering, – Vol.1 & Vol.2, Kirpal Singh, 2020.
2. Automotive Mechanics, William Crouse. Hanna Publishers, 1993.

REFERENCE BOOKS:

1. Automobile Engineering, G.B.S.Narangkhanna publishers, 1995.
2. Automobile Engineering, R.B.Gupta, 2006.
3. Automobile Engineering, T.R.Bangakhanna publishers, 2005.
4. Automobile Engineering, K.K. Jain TMH, 2012.
5. Automobile Engineering, K.K.Ramalingam, Scitech Publishers, 2011.

R G M COLLEGE OF ENGINEERING AND TECHNOLOGY
AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

IV B.Tech, II-Sem. (M.E)

L	T	C
2	1	3

[A0340198] MECHANICS OF COMPOSITE MATERIALS

[Professional Elective-V]

COURSE OBJECTIVES:

The course should enable the students to learn:

- To enlighten the students about modern lightweight composite materials which are being used extensively in this modern senior.
- To understand about the matrix and reinforcing materials used in processing the composite materials.
- To understand the macro & Micro mechanics of composite materials.

COURSE OUTCOMES:

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

- Understand the various types of composite materials used for different engineering applications.
- Understand and analyse the different types of reinforcing materials used in making of composite materials.
- Understand different types of manufacturing processes used for making of composite materials.
- Analyse stress-strain tensors of isotropic and orthotropic materials through macro-scopic analysis.
- Determine the stress-strains of 2-D Uni-directional lamina and angle lamina and also apply failure theories.
- Apply the concepts of Micro-mechanical analysis to determine the physical and mechanical properties of the composite material based on matrix and reinforcing material properties.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	1	3	3	3	3	-	1	-		2	1	1	-	-
CO2	1	1	1	3	3	3	3	-	3	-	-	2	3	3	1	2
CO3	1	2	3	3	3	2	2	2	3	-	-	2	3	3	2	3
CO4	3	3	3	3	3	2	-	-	3	3	2	2	3	3	2	2
CO5	3	3	3	3	3	2	-	-	3	3	2	2	3	3	2	2
CO6	3	3	3	3	3	2	-	-	3	3	2	2	3	3	2	2

UNIT-I

Introduction to Composite Materials: Introduction, Classification: Polymer Matrix Composites. Metal Matrix Composites, Ceramic Matrix Composites, Carbon–Carbon Composites, Fiber. Reinforced Composites and nature-made composites, and applications.

UNIT-II

Reinforcements: Fibres- Glass, Silica, Kevlar, carbon, boron, silicon carbide, and boron carbide. fibres. Particulate composites, Polymer composites, Thermoplastics, Thermosets, Metal matrix and ceramic composites.

UNIT-III

Manufacturing Processes: Hand lay-up, Spray lay-up, Vacuum bagging, Pultrusion, Resin Transfer Molding (RTM), Filament winding.

UNIT-IV

Macro-Mechanical Analysis of a Lamina: Introduction, Definitions: Stress, Strain, Elastic Moduli, Strain Energy. Hooke's Law for Different Types of Materials – Anisotropic material, monoclinic material and orthotropic material, Hooke's Law for a Two Dimensional Unidirectional Lamina - Plane Stress Assumption, Reduction of Hooke's Law in Three Dimensions to Two Dimensions, Relationship of Compliance and Stiffness Matrix to

Engineering Elastic Constants of a Lamina, Angle Lamina.

UNIT-V

Hooke's Law for a Two-Dimensional Angle Lamina, Engineering Constants of an Angle Lamina, Invariant Form of Stiffness and Compliance Matrices for an Angle Lamina, Strength Failure theories of an angle lamina- Maximum stress Failure Theory, Tsai–Hill Failure Theory, Tsai–Wu Failure Theory.

UNIT-VI

Micro-Mechanical Analysis of a Lamina: Introduction, Volume and Mass Fractions, Density, and Void Content, Evaluation of the Four Elastic Moduli – Longitudinal young's modulus, Transverse young's modulus, Major Poisson's ratio and In-plane shear modulus by Strength of Materials Approach, Semi Empirical Models, Ultimate Strengths of a Unidirectional Lamina- Longitudinal tensile strength, Transverse tensile strength, Longitudinal compressive strength, Transverse compressive strength. In-Plane shear strength.

TEXT BOOKS:

1. Mechanics of Composite Materials- Autar K. Kaw, 2/e, CRC Pubi., 1997.
2. Analysis and performance of fibre Composites, B. D. Agarwal and L.J. Broutman Wiley- Inter science, 4/E, 2017.

REFERENCE BOOKS:

1. Engineering Mechanics of Composite Materials- Isaac and M Daniel, Oxford Univ. Press. 2/E, 2005.
2. Mechanics of Composite Materials, R. M. Jones, McGraw Hill Company, New York, 2/E, 1999.
3. Composite Materials Science and Engineering, Kishan K. Chawla, Springer, 2015.
4. Analysis of Laminated Composite Structures, L.R. Calcote, Van Nostrand Rain fold, New York, 1968.
5. Mechanics of Composite Materials and Structures, Madhujit Mukhopadhyay, New York, 2004.

R G M COLLEGE OF ENGINEERING AND TECHNOLOGY
AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

IV B.Tech, II-Sem. (M.E)

L	T	C
2	1	3

[A0341198] NON-CONVENTIONAL ENERGY SOURCES

[Open Elective-III]

COURSE OBJECTIVES:

Upon successful completion of this course, the student will understand

- The potential of the different renewable energy resources
- The methodologies for energy conversion processes and utilization
- The economics of energy production and consumption.

COURSE OUTCOMES:

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

- Understanding different types of renewable energy sources and their utilization.
- Ensures the effective employment of energy sources for their corresponding applications
- Identify problems and develop data-driven solutions related to energy systems from an economic point of view.
- Applying knowledge to assess alternative methods for minimizing waste without affecting production & quality

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	-	-	1	3	1	-	-	-	1	2	1	1	1
CO2	2	2	-	2	2	1	2	2	2	2	2	1	2	2	2	2
CO3	2	2	-	1	1	1	3	2	-	-	-	1	2	2	2	1
CO4	2	1	3	1	-	2	3	1	1	1	1	1	2	1	2	1

UNIT – I

PRINCIPLES OF SOLAR RADIATION: Introduction - solar constant - Role and potential of new and renewable source, instruments for measuring solar radiation, Introduction – type - Flat plate, ETC and concentrating (Parabolic) collectors - Merits & Demerits.

UNIT-II

SOLAR ENERGY STORAGE AND APPLICATIONS: Introduction - Different methods - Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion- photovoltaic Cells.

UNIT III

WIND ENERGY: Introduction – Potential in India - Basic Principle of wind energy conversion - Basic components – classification – Horizontal & Vertical Axis wind mill – Merit & demerits.

UNIT IV

BIO-MASS: Principles of Bio-Conversion – Bio gas generation-Anaerobic/Aerobic Digestion – Factors affecting Biogas generation-classification of biomass gasifiers -thermal gasification of Bio mass- up draught, down draught & cross draught gasifies- advantages and disadvantages- utilization for cooking and IC Engine operation.

UNIT V

Energy Economics: Financial Analysis Techniques – Simple payback, Time value of money, Net Present Value (NPV), Return on Investment (ROI), Internal Rate of Return (IRR), Risk and Sensitivity analysis.

UNIT-VI

Cogeneration and Waste Heat Recovery: Cogeneration- Need, applications, advantages, classification, the cogeneration design process. Waste heat recovery- Classification and application, Potential for waste-heat recovery in Industry, Commercial WHR devices, saving potential.

TEXT BOOKS:

1. Renewable energy resources/ Tiwari and Ghosal/ Narosa,2005.
2. Energy Management: W. R. Murphy, G. McKay (Butterworth), 2016.
3. Non-Conventional Energy Sources /G.D. Rai,2017.

REFERENCE BOOKS:

1. Solar Energy /Sukhame,2017.
2. Renewable Energy Sources /Twidell& Weir,2015.
3. Handbook of Energy Audit, Albert Thumann P.E. CEM, William J. Younger CEM, The Fairmont Press Inc., 7th Edition, 2003.
4. Energy management Handbook, Wayne C. Turner, The Fairmont Press Inc., 5th Edition, Georgia, 2013.
5. Energy Performance assessment for equipment and Utility Systems, Vol. 2, 3, 4, BEE, Govt. of India, 2006.
6. Boiler Operator's Guide Fourth Edition, Anthony L Kohan, McGraw Hill, 2016.
7. Efficient Use of Energy: I. G. C. Dryden (Butterworth Scientific),2015.
8. www.energymanagertraining.com
9. www.bee-india.nic.in

R G M COLLEGE OF ENGINEERING AND TECHNOLOGY
AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

IV B.Tech, II-Sem. (M.E)

L	T	C
2	1	3

[A0339198] MECHATRONICS

[Open Elective-III]

COURSE OBJECTIVES:

The course should enable the students to learn:

- The application of mechanical, electronics, control systems and software in Modern technologies.
- To formulate, design, analyze, and test "intelligent" products and processes that incorporate appropriate computing tools, sensors, and actuators.
- Work efficiently in multidisciplinary teams.
- Practice professional and ethical responsibility, and, be aware of the impact of their designs on human-kind and the environment.

COURSE OUTCOMES:

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

- Understand the different elements of the mechatronics systems and their benefits in manufacturing.
- Understand and analyse the different types of sensors with respect to specifications.
- Understanding and analyse the different types of actuators and able to model/develop 1D or 2D systems.
- Understand the basic concepts of digital electronics.
- Understand the operational principles of amplifiers, inverters, data acquisition and control system etc.
- Understanding the principles of PLC programming for different industrial applications.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	1	2	2	2	-	-	2	1	-	1	1	1	1	1
CO2	3	3	3	3	3	1	-	-	2	1	-	1	3	3	2	1
CO3	3	3	3	3	3	1	-	-	2	1	-	1	3	3	2	1
CO4	1	1	1	2	2	2	-	-	2	1	-	1	1	1	1	1
CO5	2	3	3	3	3	-	-	-	2	1	-	2	3	3	2	1
CO6	2	3	3	3	3	-	-	-	2	1	-	2	3	3	2	1

UNIT-I

Introduction: Overview of the course, Examination and Evaluation patterns, History of Mechatronics, Scope and Significance of Mechatronics systems, elements of mechatronic systems, needs and benefits of mechatronics in manufacturing

UNIT-II

Sensors: classification of sensors basic working principles, Displacement Sensor - Linear and rotary potentiometers, LVDT and RVDT, incremental and absolute encoders. Strain gauges. Force/Torque – Load cells. Temperature – Thermocouple, Bimetallic Strips, Thermistor, RTD

Accelerometers, Velocity sensors – Tachometers, Proximity and Range sensors – Eddy current sensor, ultrasonic sensor, laser interferometer transducer, Hall Effect sensor, inductive proximity switch. Light sensors – Photodiodes, phototransistors, Flow sensors – Ultrasonic sensor, laser Doppler anemometer tactile sensors – PVDF tactile sensor, micro-switch and reed switch Piezoelectric sensors, vision sensor

UNIT-III

Actuators: Electrical Actuators: Solenoids, relays, diodes, thyristors, triacs, BJT, FET, DC motor, Servo motor, BLDC Motor, AC Motor, stepper motors. Hydraulic & Pneumatic

devices – Power supplies, valves, cylinder sequencing. Design of Hydraulic & Pneumatic circuits. Piezoelectric actuators, Shape memory alloys.

Basic System Models & Analysis: Modeling of one and two degrees of freedom Mechanical, Electrical, Fluid and thermal systems, Block diagram representations for these systems. Dynamic **Responses of System:** Transfer function, Modeling Dynamic systems, first order systems, second order systems.

UNIT-IV

Digital Electronics: Number systems, BCD codes and arithmetic, Gray codes, self-complimenting codes, Error detection and correction principles. Boolean functions using Karnaugh map, Design of combinational circuits, Design of arithmetic circuits. Design of Code converters, Encoders and decoders.

UNIT-V

Signal Conditioning: Operational amplifiers, inverting amplifier, differential amplifier, Protection, comparator, filters, Multiplexer, Pulse width Modulation Counters, decoders. Data acquisition – Quantizing theory, Analog to digital conversion, digital to analog conversion.

Controllers: Classification of control systems, Feedback, closed loop and open loop systems, Continuous and discrete processes, control modes, Two step Proportional, Derivative, Integral, PID controllers.

UNIT-VI

PLC Programming: PLC Principles of operation PLC sizes PLC hardware components I/O section Analog I/O section Analog I/O modules, digital I/O modules CPU Processor memory module Programming. Ladder Programming, ladder diagrams, timers, internal relays and counters, data handling, analogue input and output. Application on real time industrial automation systems.

Case studies of Mechatronics systems: Pick and place robot, Bar code, Engine Management system, Washing machine etc.

TEXT BOOKS:

1. Mechatronics, W. Bolton, Addison Wesley Longman Ltd, , 5th edition, 2010 .
2. Introduction to Mechatronics and Measurement systems, Alciatore David G & Histand Michael B, McGraw Hill, 4th edition, 2006.

REFERENCE BOOKS/VIDEO:

1. Mechatronics System Design, DevdasShetty& Richard Kolk, PWS Publishing, 3rd edition, 2009.
2. http://video_demos.colostate.edu/mechatronics
3. http:// mechatronics.me.wisc.edu.

R G M COLLEGE OF ENGINEERING AND TECHNOLOGY
AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

IV B.Tech, II-Sem. (M.E)

L	T	C
2	1	3

(A0345198) INDUSTRIAL IOT

[Open Elective-III]

COURSE OBJECTIVES:

- Acquire theoretical knowledge on Industrial Internet of Things.
- Apply suitable machine learning techniques for data handling and to gain knowledge from it.
- Evaluate the performance of algorithms for sensors and data transmission.

COURSE OUTCOMES:

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

- Understand the characteristics of Internet of Things and its industry strategies.
- Apply various Internet of Things models to appropriate problems.
- Identify and integrate more than one technology to enhance the performance.
- Understand the sensors and data transmission used in Internet of Things.
- Analyze the co-occurrence of data to find interesting frequent patterns.
- Pre-process the data before applying to any real-world problem and can evaluate its performance.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	1	2	2	2	-	-	2	1	-	1	1	1	1	1
CO2	3	3	3	3	3	1	-	-	2	1	-	1	3	3	2	1
CO3	3	3	3	3	3	1	1	-	2	1	1	1	3	3	2	1
CO4	1	1	1	2	2	2	-	-	2	1	-	1	1	1	1	1
CO5	2	3	3	3	3	1	-	1	2	1	-	2	3	3	2	1
CO6	2	3	3	3	3	1	-	-	2	1	-	2	3	3	2	1

UNIT I

Overview of Internet of Things

Introduction, IOT Architecture, Application –based IOT protocols, Cloud Computing, Fog Computing, Sensor Cloud, Big Data.

Overview of Industry 4.0 and Industrial Internet of Things: IIoT- Prerequisites of IIOT, Basics of CPS, CPS and IIOT, Applications of IIoT.

UNIT II

Industrial Internet of Things;

Introduction, Industrial Internet Systems, Industrial sensing, Industrial sensing, Industrial Processes.

Business Models and Reference Architecture of IIoT: Definition of a business model, Business models of IOT, Business models of IIOT.

UNIT III

Key and on-site Technologies

Key Technologies: Off-site Technologies- Introduction, Cloud Computing- Necessity, Cloud Computing and IIot, Industrial Cloud Platform Providers, SLA, Requirements of Industry 4.0, Fog Computing.

On-site Technologies- Introduction, Augmented Reality- History, Categorization, Applications, Virtual Reality- History, Categorization, Applications.

UNIT IV

Sensors and Data Transmission

Sensors: Introduction to Sensors, Characteristics-Sensor calibration, Sensor profile, Operating voltage, Sensor Categories.

Actuators: Introduction, Thermal Actuators, Hydraulic Actuators, Pneumatic Actuators, Electromechanical Actuators.

Industrial Data Transmission: Foundation fieldbus, Profibus, HART, Interbus, Bitbus.

UNIT V

Machine learning and Data science,

Machine Learning and Data Science in Industries: Introduction, Machine Learning, Categorization on ML, Applications and Data Science of ML in industries, Deep Learning, Applications of Deep Learning in industries.

Unit-VI

Applications in Healthcare Applications of Healthcare in Industries: Smart Devices, Advanced Technologies using in Healthcare, Open Research Issues to be Addressed.

Textbooks:

1. Introduction to Industrial Internet of Things and Industry 4.0., S. Misra, C. Roy, and A. Mukherjee, CRC Press, 2020.

Reference Books:

1. Industrial IoT. Available online: https://medium.com/iotforall/whatproduct-managers-need-to-know-about-industrial-iot-8c92eec1d9d2
2. IIoT Cloud Platforms. Available online: https://fr.farnell.com/willthere-be-a-dominant-iiot-cloud-platform.
3. Development of a high-speed solenoid valve: Investigation of solenoids. Kajima, T. and Kawamura, Y., 1995. IEEE Transactions on industrial electronics, 42(1), pp.1-8.

Online Learning Resources:

1. https://www.coursera.org/learn/industrial-internet-of-things
2. https://www.coursera.org/specializations/developing-industrial-iot

R G M COLLEGE OF ENGINEERING AND TECHNOLOGY
AUTONOMOUS
DEPARTMENT OF MECHANICAL ENGINEERING

IV B.Tech, II-Sem. (M.E) L T C
2 1 3

[A0344198] MODELLING AND ANALYSIS

[Skill Development Course]

COURSE OBJECTIVES:

- To train the student to make use of ANSYS software package.
- To make students understand and learn about the analysis and simulation of simple mechanical parts through software and the solving techniques of various engineering problems.

COURSE OUTCOMES:

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

- Structural, thermal, Model and Dynamic analysis can be done using ANSYS
- Software package
- Have a good grip on simulations of the models any of the analysis software
- Make use of ANSYS software/Any open-source analysis software for solving various problems
- Able to create geometry using ANSYS modeler.
- Able to know various fields of engineering where these tools can be effectively used to improve the output of a product.
- Able to know how these tools are used in Industries by solving some real time problems using these tools.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	-	-	2	1	-	-	-	2	2	-	1	-	1	-
CO2	3	2	-	2	2	-	-	-	-	2	-	-	1	-	2	1
CO3	3	3	-	-	2	1	-	-	-	2	2	-	1	-	1	-
CO4	2	2	-	2	-	-	-	-	-	3	-	1	-	-	2	1
CO5	3	2	-	2	2	-	-	-	-	2	-	-	1	-	2	1
CO6	3	3	-	-	2	1	-	-	-	2	2	-	1	-	1	-

UNIT – I

FEA and ANSYS: What is FEA? Introduction about ANSYS – ANSYS basics & environment.

UNIT – II

General analysis procedure: Overview – pre-processing – applying element type – material properties – solution – applying loads – boundary conditions.

UNIT – III

Introduction to modelling in ANSYS: Direct generation – solid modelling – creating nodes – elements – fill between nodes – setting element attributes.

UNIT - IV

Advanced solid modelling: Using key points – lines – splines – arcs – using areas and volumes – concepts of line fillets – and area fillets – Boolean option.

UNIT –V

Meshing in ANSYS: Introduction to elements – 1D, 2D & 3D, quadrilateral elements – brick elements –tetrahedral elements – introduction to meshing – mapped and free mesh – control the mesh size.

UNIT – VI

Post processing – results – graphs – deflection – deformation – animation.

TEXT BOOKS:

1. Finite Element Analysis, SDC Publications, 2010.
2. A first course in the Finite element method by Daryl L Logan, Thomason, Third Edition,2015
3. Fundaments of FEM by Hutton- McGraw Hill, 2004

4. Finite Element Analysis by George R. Buchanan, Schaum Series,2008

LIST OF EXERCISES TO BE CARRIED OUT USING ANSYS SOFTWARE:

1. Uniform cross section bar subjected to axial load.
2. Variable cross section bar subjected to axial load.
3. Exercise on 2D truss – configuration 1.
4. Exercise on 2D truss – configuration 2.
5. Exercise on 2D truss – configuration 3.
6. Analysis of simply supported beam.
7. Analysis of cantilever beam.
8. One dimensional heat transfer through slab.
9. Heat transfer of hallow pipe with internal heat generation.
10. Analysis of composite wall.
11. Problems on model analysis.
12. Problems on buckling analysis.

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IV B.Tech, II-Sem. (M.E)

L	T	C
0	0	0.5

[A0088198] COMPREHENSIVE VIVA-VIII

There shall be comprehensive Viva-Voce examination at the end of each semester. comprehensive Viva Examination shall be conducted by the committee consisting of Senior faculty (based on the recommendation of HOD), an external Examiner from other institutions and HOD and evaluated for 50 marks.

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IV B.Tech, II-Sem. (M.E)

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[A0086198] SEMINAR

COURSE OBJECTIVES:

- To understand the basic concepts of technical and practical issues of course specialization
- To import a well organized report writing skill of technical writing

COURSE OUTCOMES:

At the end of the Seminar the students will be able to:

- Identify and compare technical and practical issues related to the area of course specialization
- Outline annotated bibliography of research demonstrating scholarly skills
- Prepare a well-organized report employing elements of technical writing and critical thinking.
- Demonstrate the ability to describe, interpret and analyze technical issues and develop competence in presenting.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	-	2	2	1	2	2	2	1	2	2	2	1	-
CO2	1	2	-	2	-	2	1	1	2	1	1	2	2	2	-	1
CO3	1	2	-	-	-	1	1	2	2	2	1	2	1	2	-	-
CO4	1	2	1	2	-	1	1	1	2	1	1	1	1	1	2	1

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DEPARTMENT OF MECHANICAL ENGINEERING

IV B.Tech, II-Sem. (M.E)

L	T	C
0	0	8

[A0087198] PROJECT PHASE-II / INTERNSHIP

COURSE OBJECTIVE:

- To develop competency of applying engineering knowledge to real life problems

COURSE OUTCOMES:

At the end of the project work the students will be able to:

- Formulate prototype/models and/or experimental set-up and/or simulation and other systems capable of meeting the objectives.
- Identify methods and materials to carry out experiments/develop code
- Analyse the results to come out with concrete solutions.
- Write a technical report citing relevant information of the project apart from developing a presentation.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	-	-	2	1	-	-	-	2	2	-	1	-	1	-
CO2	3	2	-	2	2	-	-	-	-	2	-	-	1	-	2	1
CO3	3	3	-	-	2	1	-	-	-	2	2	-	1	-	1	-
CO4	2	2	-	2	-	-	-	-	-	3	-	1	-	-	2	1

PROJECT WORK PHASE-II

The project topic should be approved by Internal Department Committee (IDC). Out of total 150 marks for the project work, 50 marks shall be for Internal Evaluation (25 marks for Phase-I and 25 marks for Phase-II) and 100 marks for the End Semester Examination.

The evaluation of project work phase-I shall be conducted at the end of the IV year I semester and Phase-II shall be conducted at the end of the IV year II semester.

The project viva voce examination will be conducted by the committee consisting of an external Examiner from other institute, Head of the Department and the supervisor of the project. The Internal evaluation for 50 marks shall be on the basis of two seminars (25 marks for Phase-I and 25 marks for Phase-II) given by each student on the topic of the project. The Internal evaluation of the project work for 50 marks shall be conducted by the committee consisting of head of the Department or his nominee, senior faculty member and the supervisor of project.

INTERNSHIP

The student has an option of going for internship in IV year –II Sem in a reputed organization (The finalization of the internship organization will be as per college guidelines (HOD, two Senior faculty members of the department and same will be recommended to the Principal for approval). In case any student opted for internship he/she need not attend the classes however he has to write internal and external examination of subjects when ever conducted in that semester and acquire the required credits. The project work in the final semester may be carried out during the internship and same may be submitted for evaluation. Student has to acquire 01 credit by going for internship (minimum of Two weeks) / carrying out internal project work/ study project report on any industry/ attending work shop in reputed institutions for two weeks. Certificate from the organization has to be submitted to this effect attested by Head of the Department and Internship in charge to the academic section before the commencement of 3-2 semester. Student is expected to carry out the activities mentioned here during the summer break before the commencement of 3-1 semester.