B. TECH. FOUR YEAR DEGREE COURSE

DEPARTMENT OF MECHANICAL ENGINEERING

R18 – REGULATIONS, COURSE STRUCTURE & SYLLABUS

(Applicable for the batches admitted from 2018-19)

SHRI VISHNU ENGINEERING COLLEGE FOR WOMEN :: BHIMAVARAM

(Autonomous)

Approved by AICTE & Affiliated to JNTU-K, Kakinada
Accredited with 'A' grade by NAAC & NBA
Vishnupur, Bhimavaram -534202
West Godavari Dist., Andhra Pradesh, India
Email: info@svecw.edu.in, website: www.svecw.edu.in

SHRI VISHNU ENGINEERING COLLEGE FOR WOMEN:: BHIMAVARAM (AUTONOMOUS)

VISION

Transform the society through excellence in Education, Community empowerment and sustained Environmental protection.

MISSION

- To achieve Academic excellence through innovative learning practices
- To instill self confidence among rural students by supplementing with co-curricular and extra-curricular activities
- To inculcate discipline and values among students
- To establish centers for Institute Industry partnership
- To extend financial assistance for the economically weaker sections
- To create self-employment opportunities and skill up gradation
- To support environment friendly Green Practices
- Creating innovation hubs

SHRI VISHNU ENGINEERING COLLEGE FOR WOMEN :: BHIMAVARAM
(Autonomous)

Department of Mechanical Engineering

Vision

To be recognized globally for quality education and research leading to well-qualified, innovative, entrepreneurial and successful mechanical engineer.

Mission

- To Impart quality education to enhance skills and make graduates globally competitive.
- To Prepare students to pursue lifelong learning, serve the profession and meet intellectual, ethical and work place challenges.
- To Provide Research facilities and opportunities to faculty & students to create, interpret, apply and disseminate knowledge.

ACADEMIC REGULATIONS

B.Tech. FOUR YEAR DEGREE COURSE

R18 Regulations

(Applicable for the batches admitted from 2018-2019)

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REGULATIONS

THE DEGREE OF BACHELOR OF TECHNOLOGY - REGULAR

(With effect from 2018-19)

RB 0.0	**TITLE AND DURATION OF THE COURSE**
	The course shall be called the degree course in Bachelor of Technology, abbreviated as B.Tech.
	The course shall be of four academic years duration divided into eight semesters, each semester having duration of minimum 16 weeks.
	The calendar of events in respect of the course shall be fixed by the Institute from time to time.
	The external examination in all the subjects shall be conducted at the end of each semester for all the eight semesters.
	Students joining the B. Tech. programme shall have to complete the programme in a stipulated time frame of 8 years from the date of joining and students joining the B.Tech. Programme in the third semester directly through Lateral Entry Scheme (LES) shall have to complete the programme in a stipulated time frame of 6 years from the date of joining otherwise; they shall forfeit their seat in B.Tech. Programme and their admission shall stand cancelled. The students who availed GAP years facility can complete the programme in 10 years.
	When a student is detained for lack of credits / shortage of attendance, she may be re-admitted into the same semester / year in which she has been detained. However, the academic regulations under which she was first admitted shall continue to be applicable to her.
RB 1.0	**ELIGIBILITY FOR ADMISSION**
RB 1.1	Admissions are done as per the norms prescribed by Government. The Government orders issued from time to time in this regard shall prevail.
RB 1.2	The Candidate shall be an Indian National.
RB 1.3	The Candidate should have passed the qualifying examination, Intermediate or equivalent on the date of admission.
RB 1.4	Seats in each programme in the college are classified into CATEGORY-A (70% of intake) and CATEGORY – B (30% of intake) besides lateral entry.
RB 1.5	Category 'A' Seats shall be filled by the Convener, EAMCET Admissions. Category 'B' Seats shall be filled by the College as per the guidelines of Andhra Pradesh State Council of Higher Education. 'Lateral Entry' candidates (20% of the intake) shall be admitted into the Third semester directly based on the rank secured by the candidate in Engineering Common Entrance Test (ECET) in accordance with the instructions received from the Convener, ECET and Government of Andhra Pradesh.
RB 2.0	**AWARD OF B.TECH. DEGREE**
RB 2.1	A Student shall be declared eligible for the award of the B.Tech. Degree, if she pursues a course of study in not less than four and not more than eight academic years (plus maximum of 2 years of GAP years). A Student admitted into III semester shall be declared eligible for the award of the B.Tech. Degree, if she pursues a course of study in not less than three and not more than six academic years (plus maximum of 2 years of GAP years).

RB 2.2	Each discipline of the B.Tech. programme is designed to have a total of 160 credits and the student shall have to complete the courses and earn all credits as per the requirements for award of the degree. Students joining the B.Tech. programme in the third semester directly through Lateral Entry Scheme (LES) shall have to complete the courses, excluding first year courses and earn 124 credits as per the requirements for award of the degree.
RB 2.3	The B.Tech. Degree shall be conferred on a candidate who has satisfied the following requirements. A Regular student (four year programme) should register herself for 160 credits. In order to become eligible for the award of B.Tech. Degree, the student must obtain 160 credits. A Lateral Entry student should register herself for 124 credits and should obtain all the credits. However, it is mandatory for the students to complete the noncredit courses
RB 3.0	**MINIMUM INSTRUCTION DAYS**
RB 3.1	The minimum instruction days for each semester shall be 90 working days.
RB 4.0	**COURSES OF STUDY**
	Branch Code- Branch Abbreviation 01-CE (Civil Engineering) 02-EEE (Electrical and Electronics Engineering) 03-ME (Mechanical Engineering) 04-ECE (Electronics and Communication Engineering) 05-CSE (Computer Science & Engineering) 12-IT (Information Technology)
RB 4.1	**Groups of Courses:** The Courses in the B.Tech. Programme is of five kinds: Core, Professiona Elective, Open Elective, Free Elective and Mandatory Audit Course. **Core Course:** These are courses which are to be compulsorily studied by a student and it is the core requirement to complete the programme in a said branch. **Professional Elective Course:** A student can choose a course (subject) from a pool of courses of branch concerned, which add proficiency to the students. **Open Elective Course:** These are the courses offered by other branches. These courses are designed to lead to knowledge enhancement in multi disciplinary domains. **Free Elective Course:** A student can choose a course (subject) from a pool of courses of branch concerned, which add proficiency to the students. **Mandatory Audit Course**: These courses allow a student to attend classes without the benefit of a grade for a course. An undergraduate student who audits a course does so, for the purpose of self-enrichment and academic exploration.
RB 5.0	**DISTRIBUTION AND WEIGHTAGE OF MARKS**
RB 5.1	The performance of a student in each semester shall be evaluated subject wise with a maximum of 100 marks for theory and 75 marks for practical subject. The main project work shall be evaluated for 200 marks, Mini Project 1 and Mini Project 2 are evaluated each for 50 marks and seminar is evaluated for 50 marks.
RB 5.2	For theory subjects, the distribution shall be 40 marks for Internal Evaluation and 60 marks for the End Examinations.

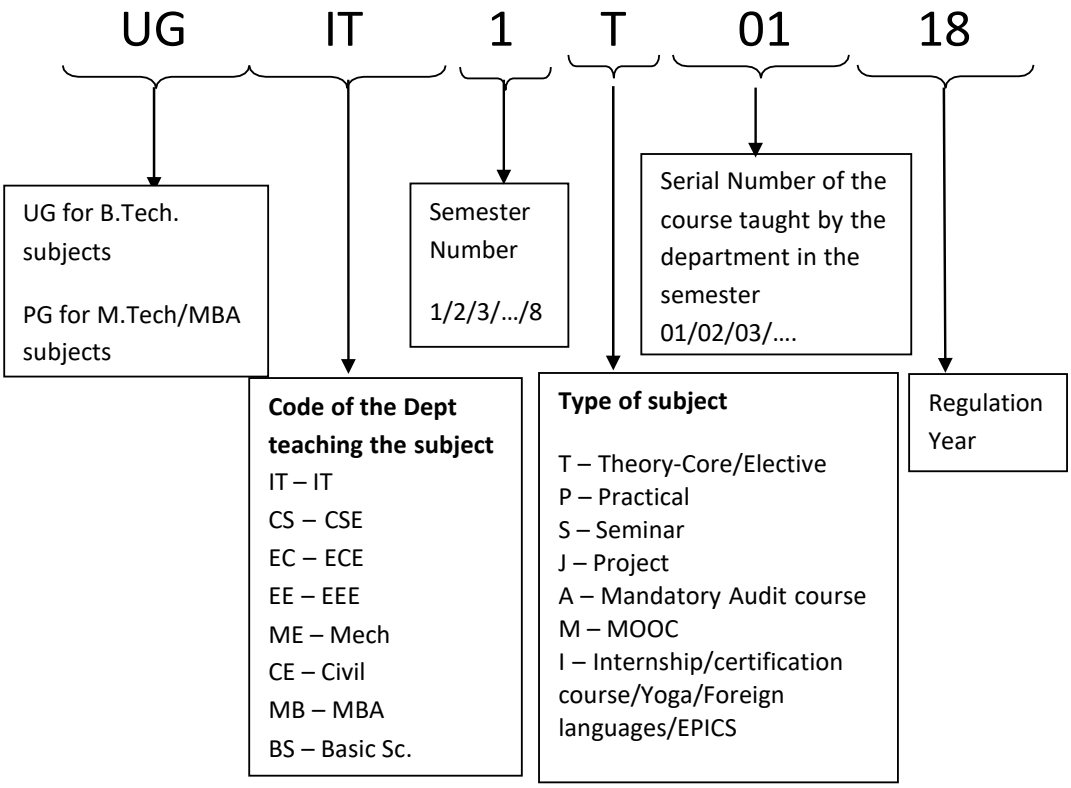
RB 5.3	Internal evaluation 40 marks shall be awarded as follows: 20 marks for Descriptive, 10 marks for Quiz and 10 marks for Assignment. The descriptive examination is for 90 minutes duration conducted for 30 marks. Each descriptive examination question paper consists of three questions (either - or type) from three units. Three questions to be answered, one from each unit. The descriptive examination conducted for 30 Marks is to be brought down to total marks of 20. The quiz examination is for 20 minutes duration (Conducted with 20 multiple choice questions with a weightage of ½ Mark each). Thought provoking questions shall be covered in Quiz examination. After every two Units, one Assignment/Tutorial shall be conducted. Two questions from each Unit and maximum of 4 questions must be set in Assignment. Assignment/Tutorial consists of Theory, Design, Analysis, Simulation, Algorithms, Drawing, etc. as the case may be. Out of the 3 Assignments / tutorials, average of best of the 2 Assignments shall be considered for awarding of marks. For theory subjects, during the semester there shall be 2 MID tests. As the syllabus is framed for 6 units, the First MID examination (both descriptive and quiz) is conducted from first three units and Second MID examination (both descriptive and quiz) is considered from last three units of each subject. Average of two Mid tests (both descriptive and quiz) shall be considered as final marks of the MID. Eg: A student got 18 marks out of 20 marks in Descriptive-1, 8 marks out of 10 marks in Quiz-1 and 8 marks out of 20 marks in Descriptive-2 and 2 marks out of 10 marks in Quiz-2. Assignment-1 = 9 out of 10, Assignment-2 = 4 out of 10 and Assignment-3 = 10 out of 10. The student Internal marks are = ((26+10)/2 + ((9+10)/2) = 27.5 is rounded to 28 marks out of 40 marks. If a student is absent for any one MID examination, she can appear for a Grand Test after MID-2. The Grand Test will be conducted with questions covering the entire syllabus. The marks in the grand test is reduced to 30 marks and to be considered for respective mid.
RB 5.4	The end semester examination is conducted for 60 marks by covering the topics of all units. The end examination paper contains 12 questions (two from each unit with either - or choice) of 10 marks each. 1 question has to be answered from each unit. (6 x 10 = 60 marks)
RB 5.5	For practical subjects, there shall be continuous evaluation during the semester for 25 internal marks. Out of the 25 marks for internal, day-to-day work 10 marks, Record 5 marks and 10 marks to be awarded by conducting an internal laboratory test. The end examination shall be conducted for 50 marks by the internal examiner and external examiner.
RB 5.6	For the subject having design and/or drawing (such as Engineering Graphics, Engineering Drawing, Machine Drawing) and estimation, the distribution shall be 40 marks for interna evaluation (20 marks for day–to–day work, and 20 marks for MID tests) and 60 marks for end examination. The average of 2 MIDs shall be considered as final marks of the MID.
RB 5.7	For the seminar, the student shall collect the information on a specialized topic and prepare a technical report showing her understanding over the topic, and submit to the department, which shall be evaluated by the Departmental Committee consisting of Head of the Department, seminar supervisor and senior faculty member. The seminar report shall be evaluated for 50 marks. There shall be no external examination for seminar.

RB 5.8	Out of a total of 200 marks for the main project work, 100 marks shall be for Internal Evaluation and 100 marks for the End Semester Examination. The End Semester Examination (Viva – Voce) shall be conducted by the Committee. The Committee consists of an external examiner, Head of the Department and Supervisor of the Project. The evaluation of project work shall be conducted at the end of the Eighth semester. The Internal Evaluation marks shall be on the basis of Two seminars given by each student on the topic of her project and evaluated by an Internal Committee, consisting of Head of the department, supervisor of the project and a senior faculty member.	
RB 5.9	For the mini project works, 50 marks shall be for Internal Evaluation. Viva- Voce shall be conducted by the Committee. The Committee consists of Head of the Department and Supervisor of the Project. The Viva–Voce may be conducted along with respective semester lab external examinations. There shall be no external examination for mini projects.	
RB 5.10	Laboratory marks and the internal marks awarded by the department are not final. The marks are subjected to be scrutinized and scaled by the Institute wherever it felt desirable. The internal and laboratory marks awarded by the department shall be referred to a Committee if required. The Committee shall arrive at a scaling factor and the marks shall be scaled as per the scaling factor. The recommendations of the Committee are final and binding. The laboratory records and internal test papers shall be preserved for two years after the final examinations of that semester in the respective departments as per the norms of the Institute and shall be produced to the Committees as and when they ask for.	
RB 6.0	**PROGRAMME STRUCTURE**	
	Basic Science Courses	10-12%
	Engineering Science Courses	9-10%
	Humanities and Social Science Courses	6-8%
	Professional Core Courses	55-65%
	Professional Elective Courses	10-12%
	Project	5-7%
	Open Elective Courses	5-7%
	Internships / Certification Courses/ Seminar	3-4%
	Mandatory Audit Courses – 6 courses without credits	-
RB 7.0	**SCHEME OF INSTRUCTION FOR I, II, III AND IV YEARS**	
RB 7.1	The Schemes of Instruction and syllabi of all B.Tech. programmes are given separately, which are approved by the BOS concerned and the Academic Council.	
RB 8.0	**CONTACT HOURS AND CREDITS**	
RB 8.1	One hour of lecture/Tutorial is equivalent to one credit and one hour of practical work/field work is equivalent to 0.5 credit**.**	
RB 8.2	**THEORY / TUTORIAL CLASSES** Each course is prescribed with fixed number of lecture periods per week. During lecture periods, the course instructor shall deal with the concepts of the course. For certain courses, tutorial periods are prescribed in order to give exercises to the students and to closely monitor their learning abilities and achievements.	
RB 8.3	**LABORATORY / DRAWING COURSES** A minimum prescribed number of experiments/drawings/jobs/programmes have to be performed by students, who shall complete these in all aspects and get each experiment evaluated by teacher concerned and certified by the Head of the Department concerned at the end of the semester.	
RB 9.0	**MEDIUM OF INSTRUCTION**	
	The Medium of Instruction and examination is in English.	

RB 10	ATTENDANCE REQUIREMENTS
RB 10.1	In each semester the candidate has to put in a minimum attendance of 75% with a provision of condonation of 10% of the attendance by the Principal on the specific recommendation of the HOD, showing some reasonable cause such as medical grounds, participation in University level sports, cultural activities, seminars, workshops, paper presentation etc.
RB 10.2	Shortage of attendance below 65% in aggregate shall not be condoned.
RB 10.3	Students, having shortage of attendance and got condonation for attendance, shall have to pay requisite fee towards condonation.
RB 10.4	Students whose shortage of attendance is not condoned will be detained and the student has to re-register for that semester when it is offered by the department.

RB 10.5	Rules for calculation of attendance for the re-admitted candidates who were detained for want of attendance or who had break – in study for various reasons: a) No. of classes conducted shall be counted from the day one of the semester concerned, irrespective of the date of payment of tuition fee. b) They should submit a written request to the Principal, along with a challan paid towards tuition and other fee, for re-admission before the commencement of class-work. c) Student should come to know about the date of commencement of class-work of the semester into which she wishes to get re-admission. The information regarding date of commencement of class-work for each semester is available in the college notice boards/ website.
RB 11.0	**CONDITIONS FOR PASS AND AWARD OF CREDITS FOR A COURSE**
RB 11.1	A candidate shall be declared to have passed in individual theory/drawing course if she secures a minimum of 40% aggregate marks (40 marks out of 100, Internal and semester end examination marks put together), subject to a minimum of 35% marks (21 marks out of 60) in semester end examination. For successful completion of mandatory audit course the student must get a satisfactory grade from the department offering the course. If fails, she has to reappear whenever the course is offered.
RB 11.2	A candidate shall be declared to have passed in individual lab/project course if she secures a minimum of 40% aggregate marks (Internal and semester end examination marks put together), subject to minimum of 35% marks in semester end examination.
RB 11.3	The student has to pass the failed course by appearing the supplementary examination as per the requirement for the award of degree.
RB 11.4	On passing a course of a programme, the student shall earn assigned credits in that course.
RB 12.0	**TRANSITORY REGULATIONS**
RB 12.1	A candidate, who is detained or discontinued in the semester, on readmission shall be required to pass all the courses in the curriculum prescribed for such batch of students in which she joins subsequently. However, exemption shall be given to those candidates who have already passed in such courses in the earlier semester(s) and substitute subject may be offered as approved by College Academic Committee and ratified by Academic
RB 12.2	A student shall be eligible for promotion to next semester of B.Tech. programme, if she satisfies the conditions as stipulated in Regulation RB10.
RB 12.3	Further, a student shall be eligible for promotion to V / VII Semesters of B.Tech. programme, if she acquires the minimum number of credits as given below: A student shall be promoted from Semester - IV to Semester - V or from Semester - VI to Semester - VII only if she fulfills the academic requirements of 50% of the credits from the exams for which results are declared. **For Lateral Entry Candidates** A student shall be promoted from Semester - VI to Semester - VII only if she fulfills the academic requirements of 50% credits from the exams for which results are declared.

RB 13.0	**COURSE CODE AND COURSE NUMBERING SCHEME:** The subject codes shall be given by the Department teaching the subject. Each subject code contains 10 characters. The 10 Characters for each subject shall be coded as per the following guidelines.



	While giving the subject codes the Departments can follow the following steps. i. Collect the requirements from various Departments.(subjects which they have to teach for other Departments) ii. Prepare a list of all the subjects the Departments have to teach in that semester (for their Department as well as other Departments based on the requirements they have collected in point i.) iii. Give subject codes to all these subjects following the guidelines given. iv. Communicate these subject codes(identified in point i) to various Departments. v. Use the subject codes identified in point iii to the subjects in their course structure.
RB 14.0	**CONSOLIDATED GRADE CARD**
	A consolidated grade card containing credits and grades obtained by the candidate shall be issued after completion of the four years B.Tech. Programme.

<table>
<tr><td>RB 15.0</td><td colspan="5">METHOD OF AWARDING LETTER GRADES AND GRADE POINTS FOR A COURSE</td></tr>
<tr><td rowspan="10">RB 15.1</td><td colspan="5">A letter grade and grade point shall be awarded to the student in each course based on her performance as per the grading system given below</td></tr>
<tr><td>Marks Range Theory (Max – 100)</td><td>Marks Range Lab (Max – 75)</td><td>Letter Grade</td><td>Level</td><td>Grade Point</td></tr>
<tr><td>≥ 90</td><td>≥ 67</td><td>O</td><td>Outstanding</td><td>10</td></tr>
<tr><td>≥ 80 < 90</td><td>≥ 60 < 67</td><td>S</td><td>Excellent</td><td>9</td></tr>
<tr><td>≥ 70 < 80</td><td>≥ 52 < 60</td><td>A</td><td>Very Good</td><td>8</td></tr>
<tr><td>≥ 60 < 70</td><td>≥ 45 < 52</td><td>B</td><td>Good</td><td>7</td></tr>
<tr><td>≥ 50 < 60</td><td>≥ 37 < 45</td><td>C</td><td>Fair</td><td>6</td></tr>
<tr><td>≥ 40 < 50</td><td>≥ 30 < 37</td><td>D</td><td>Satisfactory</td><td>5</td></tr>
<tr><td>< 40</td><td>< 30</td><td>F</td><td>Fail</td><td>0</td></tr>
<tr><td></td><td></td><td></td><td>Absent</td><td>0</td></tr>
<tr><td>RB 15.2</td><td colspan="5">Calculation of Semester Grade Points Average(SGPA)* for semester:
The Performance of each student at the end of each semester is indicated in terms of SGPA.
The SGPA is calculated as below:
$SGPA\ (S_i) = \sum(C_i \times G_i) / \sum C_i$ (for all courses passed in that semester)
Where C_i is the number of credits of the i^{th} course and G_i is the grade point scored by the student in the i^{th} course.
* SGPA is calculated for the candidates who passed all the courses in that semester</td></tr>
<tr><td rowspan="2">RB 15.3</td><td colspan="5">Calculation of Cumulative Grade Points Average (CGPA)</td></tr>
<tr><td colspan="5">The CGPA is calculated as below:
$CGPA = \sum(C_i \times S_i) / \sum C_i$ (for entire programme)
Where S_i is the SGPA of the i^{th} semester and C_i is the total number of credits in that semester.
The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts</td></tr>
<tr><td>RB 15.4</td><td colspan="5">Equivalent Percentage for CGPA is = (CGPA-0.75) x 10</td></tr>
<tr><td>RB 16.0</td><td colspan="5">REVALUATION
As per the notification issued by the Controller of Examination, the student can submit the application for revaluation, along with the fee receipt for revaluation of her answer script(s) of theory course(s), if she is not satisfied with the Grade obtained. The Controller of Examination shall arrange for revaluation of those answer script(s).</td></tr>
<tr><td>RB 16.1</td><td colspan="5">For Revaluation a new external examiner, other than the first examiner, shall re-evaluate the answer script(s). If there is any change in marks (below 15% of the maximum External marks) the highest of the two marks will be considered and if there is any change in marks (Equal or above 15% of the maximum External marks), the script will be evaluated by the third valuator. The marks of all the three valuators are compared and the average of two nearer marks will be awarded to the student.</td></tr>
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<table>
<tr><td rowspan="2">RB 17.0</td><td>SUPPLEMENTARY EXAMINATIONS.</td></tr>
<tr><td>Supplementary examinations shall be conducted twice in an academic year, along with regular semester end examinations.</td></tr>
<tr><td rowspan="2">RB 18.0</td><td>READMISSION CRITERIA.</td></tr>
<tr><td>A candidate, who is detained in a semester due to lack of attendance/ credits, has to obtain written permission from the Principal for readmission in the same semester after duly fulfilling all the required norms stipulated by the college in addition to paying an administrative fee of Rs.1,000/-</td></tr>
<tr><td rowspan="2">RB 19.0</td><td>BREAK IN STUDY.</td></tr>
<tr><td>Student, who discontinues her studies for whatsoever may be the reason, can get readmission into appropriate semester of B.Tech. programme after break-in study only with the prior permission of the Principal of the College provided, such candidate shall follow the transitory regulations applicable to such batch in which she joins. An administrative fee of Rs.1000/- per year of break in study in addition to the prescribed tuition fee and special fee has to be paid by the candidate to condone her break in study if this break in study is not covered under GAP year facility.</td></tr>
<tr><td rowspan="6">RB 20.0</td><td>AWARD OF DIVISION.</td></tr>
<tr><td>The award of division for the candidates who admitted into respective B.Tech. programmes in the year 2018-2019 and onwards, is as shown in the following table.</td></tr>
<tr><td><table>
<tr><th>CGPA secured from 160 credits</th><th>DIVISION</th></tr>
<tr><td>≥ 7.75 without any supplementary passing</td><td>First Class with Distinction</td></tr>
<tr><td>≥ 6.75 with supplementary exams passing</td><td>First Class</td></tr>
<tr><td>≥ 5.75 to < 6.75</td><td>Second Class</td></tr>
<tr><td>≥ 4.75 to < 5.75</td><td>Pass Class</td></tr>
</table></td></tr>
<tr><td>For the purpose of awarding First Class with Distinction, the student must get CGPA within 4 years in case of candidates admitted through EAMCET & Management Quota or within 3 years in case of Lateral Entry candidates admitted through ECET, 6 or 5 years for the students who availed the facility of GAP year, without appearing for any supplementary examinations.
Detained candidates are not eligible for the award of First Class with Distinction.
For the purpose of awarding First, Second and Pass Class, CGPA obtained in the examinations appeared within the maximum period allowed for the completion of course shall be considered.</td></tr>
<tr><td>RB 21.0</td><td>BETTERMENT /IMPROVEMENT OF CUMULATIVE GRADE POINT AVERAGE</td></tr>
<tr><td>RB 21.1</td><td>A candidate, after becoming eligible for the award of the Degree, may reappear for the external Examination in any of the theory courses as and when conducted, for the purpose of improving the CGPA. But this reappearance shall be within a period of two academic years after becoming eligible for the award of the Degree, subject to fulfillment of Regulation RB 2.0.</td></tr>
<tr><td>RB 21.2</td><td>However, this facility shall not be availed by a candidate to reappear either for Internal Examination or for Semester End Examinations in Practical courses (including Project Viva-voce) and also for Semester End Examinations evaluated internally for the purpose of improvement.</td></tr>
</table>

RB 21.3	Modified Grade Card and New Consolidated Grade Card shall be issued after incorporating new Grades and Credits.
RB 22.0	**ADVANCED SUPPLEMENTARY EXAMINATIONS**
	Candidate(s), who fails in Theory or Lab courses of 4th year second semester, can appear for advanced supplementary examinations conducted within one month after declaration of the revaluation results. However, those candidates who fail in this advanced supplementary examinations of IV year second semester shall appear for subsequent examination along with regular candidates in the examinations conducted at the end of the respective academic year.
RB 23.0	**MALPRACTICES** The Principal/chief superintendent shall refer the cases of malpractices in internal assessment tests and Semester End Examinations to a Malpractice Enquiry Committee, constituted by him/her for the purpose. The Principal shall take necessary action, against the erring students based on the recommendations of the Committee as per JNTUK Malpractice regulations.
RB 24.0	The physically challenged candidates who have availed additional examination time and a scribe during their Intermediate/EAMCET examinations shall be given similar concessions on production of relevant proof/documents.
RB 25.0	The students who are suffering from contagious diseases are not allowed to appear either internal or Semester end examinations with other students. A separate room will be allotted for such type of students.
RB 26.0	The students who participate in coaching/tournaments held at State/National/International levels through University / Indian Olympic Association during Semester end external examination period shall be promoted to subsequent semesters till the entire course is completed as per the guidelines of University Grants Commission Letter No. F. 1-5/88 (SPE/PES), dated 18-08-1994.
RB 27.0	The Principal shall deal with any academic problem, which is not covered under these rules and regulations, in consultation with the Heads of the Departments in an appropriate manner, and subsequently such actions shall be placed before the Academic Council for ratification. Any emergency modification of Regulation, approved in the Heads of the Departments meetings, shall be reported to the Academic Council for ratification.
RB 28.0	The Academic Council, from time to time, may revise or amend or change the Regulations, schemes of examination and/or syllabi.
RB 29.0	**GAP YEAR**: Shri Vishnu Engineering College for Women encourages admitted students to defer enrollment for one year to travel, pursue a special project or activity, work or spend time in another meaningful way provided they do not enroll in a degree-granting programme at another college. Deferral for two-year obligatory military service is also granted. The student who wants to avail GAP year must take prior approval from the Principal. The Principal shall grant this facility to students on case -to -case basis, by considering the genuinely of the case.
RB 29.1	The GAP years can be availed only between II Year and III year.
RB 29.2	The students who have backlogs are not eligible for availing GAP year facility.

RB 30.0	**FREE ELECTIVES** In IV year II semester, Free Electives are offered to students which shall enable interested students to pass these free electives during III year and IV year I semester, and make themselves free in IV year for six months and can attend 6 months Internship/Project Work in Industry /Institute and after proper evaluation and recommendations of the Department, the work done can be submitted as Project work. Prior permission and registration of Free Electives is compulsory. The students who register for free elective should not have any standing backlogs. The students shall not be allowed to register in 3/2 or 4/1 without registering in 3/1. If any student would like to discontinue for the free elective in 3/2 or 4/1 after registering in 3/1, she can be permitted to do so.
RB 30.1	Minimum 20% of intake of students is compulsory for offering regular electives, whereas for Free Electives, the minimum students to register is 10% of total intake of students in that branch
RB 30.2	After announcement of the revaluation results, the students can also register for Free Elective in respect of R-18 regulations.
RB 31.0	As per the demand of the industry, a specific elective can be offered in the department with the permission of the Principal and that can be ratified in the college academic committee.
RB 32.0	For internship, minimum period shall be one month. However it can be completed in 3 to 4 slots /intervals which shall be a minimum of five days slot.

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MALPRACTICES GUIDELINES

Disciplinary Action for / Improper Conduct in Examinations

	Nature of Malpractices/Improper conduct	Punishment
	If the candidate:	
1.(a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of. (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the examination hall in respect of any matter.	Expulsion of all the candidates involved from the examination hall and cancellation of the performance in that subject only. In case of an outsider, he will be handed over to the police and a case will be registered against him
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket of the candidate will be seized and cancelled.
3.	Impersonates any other candidate in connection with the examination.	The candidate/Person who has impersonated shall be expelled from examination hall. The candidate will also be debarred and forfeits the course. The performance of the original candidate, who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester end examinations. The continuation of the course of such candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question	Expulsion from the examination hall and cancellation of performance in that subject

	paper during the examination or answer book or additional sheet, during or after the examination.	and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6.	Refuses to obey the orders of the Chief Superintendent / Asst. Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which results in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In Case of students, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester / year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the examination hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate will also be debarred for two consecutive semesters from class work and all semester end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate

		has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate will also forfeit his/her course.
9.	If the student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the college expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate will also forfeit the course. Person(s) who do not belong to the College will be handed over to police and a police case will be registered against them.
10.	Comes in a drunken/intoxicated condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations.
12.	If any malpractice is detected which is not covered in the above clauses1 to 11	Reported to the Principal for further action to award suitable punishment.

Malpractices identified by squad or special invigilators

Punishments to the candidates as per the guidelines.

* * * * *

SHRI VISHNU ENGINEERING COLLEGE FOR WOMEN:: BHIMAVARAM (AUTONOMOUS)

DEPARTMENT OF MECHANICAL ENGINEERING

Program Educational Objectives – PEOs:

PEO 1. Graduates will have foundation in engineering and science to apply technical knowledge and skills in various areas of Mechanical Engineering.

PEO 2. Graduates will become effective engineers to meet society needs with their research capabilities in inter disciplinary subjects.

PEO 3. Acquire skills for life-long learning and practice of professional ethics

Program Outcomes –POs:

PO 1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

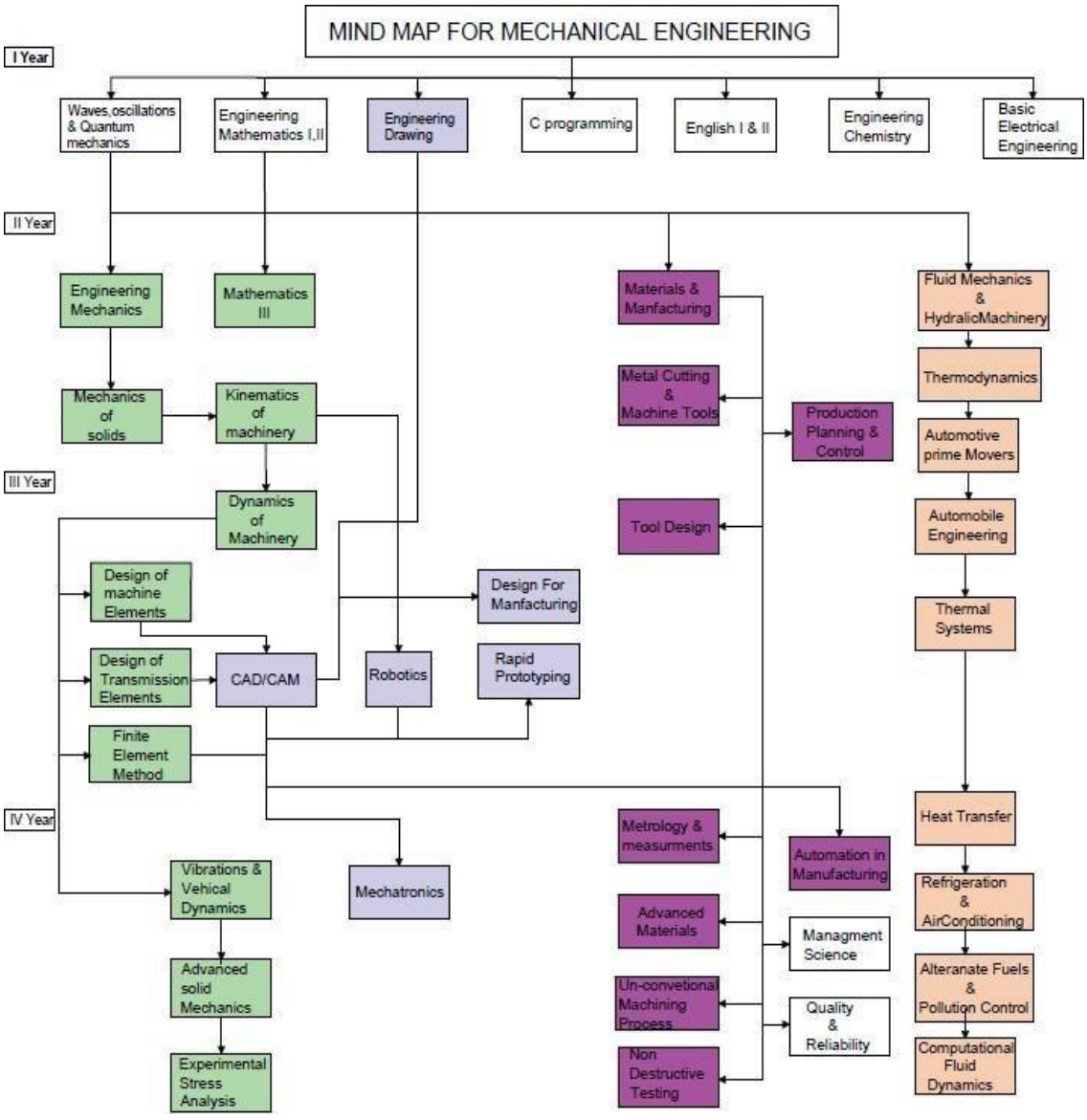
PO 11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projectsand in multidisciplinary environments.

PO 12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest contextof technological change.

Program Specific Outcomes - PSOs:

PSO1. Ability to design, develop and test an automobile using industry practices.

PSO2. Gain practical knowledge from Mechanical Engineering to serve the community and industry.


MIND MAP FOR MECHANICAL ENGINEERING
I Year
Waves, oscillations & Quantum mechanics
Engineering Mathematics I,II
Engineering Drawing
C programming
English I & II
Engineering Chemistry
Basic Electrical Engineering
II Year
Engineering Mechanics
Mathematics III
Materials & Manfacturing
Fluid Mechanics & HydralicMachinery
Thermodynamics
Mechanics of solids
Kinematics of machinery
Metal Cutting & Machine Tools
Production Planning & Control
Automotive prime Movers
III Year
Dynamics of Machinery
Tool Design
Automobile Engineering
Design of machine Elements
Design For Manfacturing
Thermal Systems
Design of Transmission Elements
CAD/CAM
Robotics
Rapid Prototyping
Finite Element Method
IV Year
Heat Transfer
Metrology & measurments
Automation in Manufacturing
Vibrations & Vehical Dynamics
Mechatronics
Refrigeration & AirConditioning
Advanced Materials
Managment Science
Advanced solid Mechanics
Alteranate Fuels & Pollution Control
Un-conventional Machining Process
Quality & Reliability
Experimental Stress Analysis
Non Destructive Testing
Computational Fluid Dynamics

SHRI VISHNU ENGINEERING COLLEGE FOR WOMEN::BHIMAVARAM
(AUTONOMOUS)
DEPARTMENT OF MECHANICAL ENGINEERING

COURSE STRUCTURE :: With Effect from 2018-19

I Year - First Semester

S.No	Sub. Code	Subject Title	L	T	P	C	I	E	TM
1.	UGBS1T0118	English – I	3	-	-	3	40	60	100
2.	UGBS1T0218	Mathematics – I	2	1	-	3	40	60	100
3.	UGBS1T0518	Engineering Chemistry	3	-	-	3	40	60	100
4.	UGCS1T0118	Programming for Problem Solving	3	-	-	3	40	60	100
5.	UGBS1P0618	English communication skills lab	-	-	3	1.5	25	50	75
6.	UGBS1P0918	Engineering Chemistry Lab	-	-	3	1.5	25	50	75
7.	UGCS1P0218	Programming for Problem Solving Lab	-	-	3	1.5	25	50	75
8.	UGBS1A1118	Indian Constitution	2	-	-	-	-	-	-
		Total	**13**	**01**	**9**	**16.5**	**235**	**390**	**625**

I Year - Second Semester

S.No.	Sub. Code	Subject Title	L	T	P	C	I	E	TM
1.	UGBS2T0118	English – II	3	-	-	3	40	60	100
2.	UGBS2T0218	Mathematics – II	2	1	-	3	40	60	100
3.	UGBS2T0318	Waves, Oscillationsand Quantum Mechanics	3	-	-	3	40	60	100
4.	UGME2T0118	Engineering Drawing	2	-	2	3	40	60	100
5.	UGEE2T0118	Basic Electrical Engineering	3	-	-	3	40	60	100
6.	UGBS2P0618	Business communication lab	-	-	3	1.5	25	50	75
7.	UGBS2P0718	Waves, Oscillationsand Quantum Mechanics Lab	-	-	3	1.5	25	50	75
8.	UGME2P0218	Workshop Practice / Innovation Lab	-	-	3	1.5	25	50	75
9.	UGBS2A1018	Environmental Science	2	-	-	-	-	-	-
		Total	**15**	**01**	**11**	**19.5**	**275**	**450**	**725**

II YEAR – FIRST SEMESTER

S.No.	Sub. Code	Subject Title	L	T	P	C	I	E	T
1	UGBS3T0118	Mathematics- III : PDE & Numerical Methods	3	-	-	3	40	60	100
2	UGME3T0218	Engineering Mechanics	2	2	-	4	40	60	100
3	UGME3T0318	Fluid Mechanics & Hydraulic Machinery	2	2	-	4	40	60	100
4	UGME3T0418	Thermodynamics	3	-	-	3	40	60	100
5	UGME3T0518	Materials and Manufacturing	3	-	-	3	40	60	100
6	UGME3P0618	Computer Aided Machine Drawing	-	-	3	1.5	25	50	75
7	UGME3P0718	Fluid Mechanics & Hydraulic Machinery Lab	-	-	3	1.5	25	50	75
8	UGME3P0818	Production Technology Lab	-	-	3	1.5	25	50	75
9	UGBS3A018	Effective Technical Communication	2	-	-	-	-	-	-
		Total	**15**	**4**	**09**	**21.5**	**275**	**450**	**725**

II YEAR – SECOND SEMESTER

S.No.	Sub. Code	Subject Title	L	T	P	C	I	E	T
1	UGME4T0118	Mechanics of Solids	2	2	-	4	40	60	100
2	UGME4T0218	Kinematics of Machinery	2	2	-	4	40	60	100
3	UGME4T0318	Automotive Prime Movers	3		-	3	40	60	100
4	UGME4T0418	Metal cutting and Machine Tools	3	-	-	3	40	60	100
5		**Open Elective-I**	3	-	-	3	40	60	100
6	UGME4P0618	Mechanics of Solids and Metallurgy lab	-	-	3	1.5	25	50	75
7	UGME4P0718	Thermal Engineering Lab	-	-	3	1.5	25	50	75
8	UGME4J0818	Minor project-1	-	1	2	2	50	-	50
9	UGBS4A0418	Essence of Indian Traditional Knowledge	2	-	-	-	-	-	-
		Total	**13**	**5**	**8**	**22**	**300**	**400**	**700**

III YEAR – FIRST SEMESTER

S.No.	Sub. Code	Subject Title	L	T	P	C	I	E	T
1	UGME5T0118	CAD/CAM	3	-	-	3	40	60	100
2	UGME5T0218	Dynamics of Machinery	3	-	-	3	40	60	100
3	UGME5T0318	Design of Machine Elements	2	2	-	4	40	60	100
4		**Open Elective-II**	3	-	-	3	40	60	100
5	**Professional Elective – I**		3	-	-	3	40	60	100
	UGME5T0518	Automobile Engineering							
	UGME5T0618	Design for Manufacturing							
	UGME5T0718	Tool Design							
6	UGME5P0818	Computer Aided Design laboratory	-	-	3	1.5	25	50	75
7	UGME5P0918	Machine Tools laboratory	-	-	3	1.5	25	50	75
8	UGME5P1018	Computer aided manufacturing and 3D Printing laboratory	-	-	3	1.5	25	50	75
9	UGBS5A0118	Quantitative ability	2	-	-	-	-	-	-
		Total	**16**	**2**	**9**	**20.5**	**275**	**450**	**725**

III YEAR – SECOND SEMESTER

S.No.	Sub. Code	Subject Title	L	T	P	C	I	E	T
1	UGME6T0118	Thermal Systems	3	-	-	3	40	60	100
2	UGME6T0218	Design of Transmission Elements	2	2	-	4	40	60	100
3	UGME6T0318	Finite Element Method	2	2	-	4	40	60	100
4		**Open Elective-III**	3		-	3	40	60	100
5	**Professional Elective – II**		3	-	-	3	40	60	100
	UGME6T0518	Production Planning and Control							
	UGME6T0618	Robotics							
	UGME6T0718	Rapid prototyping							
6	UGME6P0818	Mechanics of Machines Laboratory	-	-	3	1.5	25	50	75
7	UGME6P0918	Finite Element Analysis Laboratory	-	-	3	1.5	25	50	75
8	UGME6J1018	Minor Project-2	-	1	2	2	50	-	50
9	UGBS5A0218	Logical reasoning	2	-	-	-	-	-	-
		Total	**15**	**5**	**8**	**22**	**300**	**400**	**700**

IV YEAR – FIRST SEMESTER

S.No.	Sub. Code	Subject Title	L	T	P	C	I	E	T
1	UGME7T0118	Heat transfer	2	2	-	4	40	60	100
2	UGME7T0218	Metrology & Measurements	3	-	-	3	40	60	100
3	UGMB7T0118	Management Science	3	-	-	3	40	60	100
4		**Open Elective-IV**	3	-	-	3	40	60	100
5	**Professional Elective – III**		3	-	-	3	40	60	100
	UGME7T0518	Advanced Materials							
	UGME7T0618	Refrigeration and Air Conditioning							
	UGME7T0718	Vibrations and Vehicle dynamics							
6	UGME7P0818	Metrology & Instrumentation laboratory	-	-	3	1.5	25	50	75
7	UGME7P0918	Heat transfer laboratory	-	-	3	1.5	25	50	75
		Total	**14**	**2**	**6**	**19**	**250**	**400**	**650**

IV YEAR – SECOND SEMESTER

S.No	Sub. Code	Subject Title	L	T	P	C	I	E	T
	Free Electives (For each course)		3	-	-	3	40	60	100
			Cumulative of any 3 courses						
1	UGME8T0118	Non Destructive Evaluation	9			9	120	180	300
2	UGME8T0218	Mechatronics							
3	UGME8T0318	Quality and Reliability Engineering							
4	UGME8T0418	Alternate fuels and pollution control							
5	UGME8T0518	Advanced Solid Mechanics							
6	UGME8T0618	Unconventional Machining Processes							
7	UGME8T0718	Experimental Stress Analysis							
8	UGME8T0818	Computational Fluid Dynamics							
9	UGME8T0918	Automation in Manufacturing							
10	UGME8S1018	**Seminar**	-	2	-	2	50	-	50
11	UGME8J1118	Project Work	-	-	10	5	100	100	200
12	UGME8I1118	Foreign language/Internship / Certification course/Industry oriented course	-	-	-	3	-	-	-
Total			**9**	**2**	**10**	**19**	**270**	**280**	**550**

Note: Elective IV, Elective V and Elective VI can be chosen from the above list.

SHRI VISHNU ENGINEERING COLLEGE FOR WOMEN::BHIMAVARAM
(AUTONOMOUS)

OPEN ELECTIVES OFFERED BY DEPARTMENT OF CIVIL ENGINEERING

S. No.	Subject Code	Subject Name	L	T	P	C	I	E	TM
1	UGCE0T0118	RS & GIS and its Applications	3	-	-	3	40	60	100
2	UGCE0T0218	Elements of Transportation Engineering	3	-	-	3	40	60	100
3	UGCE0T0318	Water Supply Engineering.	3	-	-	3	40	60	100
4	UGCE0T0418	Sanitary Engineering	3	-	-	3	40	60	100
5	UGCE0T0518	Environment Pollution.	3	-	-	3	40	60	100
6	UGCE0T0618	Elements of Dam & Irrigation Engineering.	3	-	-	3	40	60	100
7	UGCE0T0718	Disaster Management	3	-	-	3	40	60	100
8	UGCE0T0818	Basic Elements of Earthquake Engineering	3	-	-	3	40	60	100

SHRI VISHNU ENGINEERING COLLEGE FOR WOMEN::BHIMAVARAM
(AUTONOMOUS)

OPEN ELECTIVES OFFERED BY DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

S. No.	Subject Code	Subject Title	L	T	P	C	I	E	TM
1	UGEE0T0118	Energy Studies	3	-	-	3	40	60	100
2	UGEE0T0218	Energy Audit and Conservation	3	-	-	3	40	60	100
3	UGEE0T0318	Sensors & Applications	3	-	-	3	40	60	100
4	UGEE0T0418	Industrial Electronics	3	-	-	3	40	60	100
5	UGEE0T0518	Electrical Machines for EV's	3	-	-	3	40	60	100
6	UGEE0T0618	PLC & Applications	3	-	-	3	40	60	100
7	UGEE0T0718	Solar Energy Appliances	3	-	-	3	40	60	100
8	UGEE0T0818	Energy Storage Technologies	3	-	-	3	40	60	100
9	UGEE0T0918	MATLAB	3	-	-	3	40	60	100
10	UGEE0T1018	AI Techniques	3	-	-	3	40	60	100

SHRI VISHNU ENGINEERING COLLEGE FOR WOMEN::BHIMAVARAM
(AUTONOMOUS)

OPEN ELECTIVES OFFERED BY DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

S. No.	Subject Code	Name of the Course	L	T	P	C	I	E	T
1	UGEC0T0118	Basic Electronics Engineering	3	0	0	3	40	60	100
2	UGEC0T0218	Applications of Electronic Devices	3	0	0	3	40	60	100
3	UGEC0T0318	Analog & Digital Communication	3	0	0	4	40	60	100
4	UGEC0T0418	Data Communication	3	0	0	3	40	60	100
5	UGEC0T0518	Microprocessors and Multicore Systems	3	0	0	3	40	60	100
6	UGEC0T0618	VLSI Design	3	0	0	3	40	60	100
7	UGEC0T0718	Image Processing	3	0	0	3	40	60	100
8	UGEC0T0818	Wavelet Transforms	3	0	0	3	40	60	100
9	UGEC0T0918	Embedded systems	3	0	0	3	40	60	100
10	UGEC0T1018	MEMS	3	0	0	3	40	60	100
11	UGEC0T1118	Electronic Instrumentation	3	0	0	3	40	60	100

SHRI VISHNU ENGINEERING COLLEGE FOR WOMEN::BHIMAVARAM
(AUTONOMOUS)

OPEN ELECTIVES OFFERED BY DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

S. No.	Subject Code	Course Title	L	T	P	C	IM	EM	TM
1	UGCS0T0118	Computer Networks	3	-	-	3	40	60	100
2	UGCS0T0218	Computer Organization and Architecture	3	-	-	3	40	60	100
3	UGCS0T0318	Database Management Systems	3	-	-	3	40	60	100
4	UGCS0T0418	Data Science	3	-	-	3	40	60	100
5	UGCS0T0518	Design and Analysis of Algorithms	3	-	-	3	40	60	100
6	UGCS0T0618	Internet of Things	3	-	-	3	40	60	100
7	UGCS0T0718	Linux Programming	3	-	-	3	40	60	100
8	UGCS0T0818	Object Oriented Programming through C++	3	-	-	3	40	60	100
9	UGCS0T0918	Object Oriented Programming through Java	3	-	-	3	40	60	100
10	UGCS0T1018	Operating Systems	3	-	-	3	40	60	100
11	UGCS0T1118	Python Programming	3	-	-	3	40	60	100
		Total	**33**	**-**	**-**	**33**	**440**	**660**	**1100**

SHRI VISHNU ENGINEERING COLLEGE FOR WOMEN::BHIMAVARAM
(AUTONOMOUS)

OPEN ELECTIVES OFFERED BY DEPARTMENT OF INFORMATION TECHNOLOGY

S. No.	Subject Code	List of Open Electives	L	T	P	C	IM	EM	TM
1	UGIT0T0118	Data Structures	3	-	-	3	40	60	100
2	UGIT0T0218	Software Engineering	3	-	-	3	40	60	100
3	UGIT0T0318	Web Technologies	3	-	-	3	40	60	100
4	UGIT0T0418	Unix Programming	3	-	-	3	40	60	100
5	UGIT0T0518	E-Commerce	3	-	-	3	40	60	100
6	UGIT0T0618	Artificial Intelligence	3	-	-	3	40	60	100
7	UGIT0T0718	Computer Graphics	3	-	-	3	40	60	100
8	UGIT0T0818	Cloud computing	3	-	-	3	40	60	100
9	UGIT0T0918	Machine Learning	3	-	-	3	40	60	100
10	UGIT0T1018	Advanced Data Structures	3	-	-	3	40	60	100
11	UGIT0T1118	Design and Analysis of Algorithms	3	-	-	3	40	60	100
12	UGIT0T1218	Parallel Computing	3	-	-	3	40	60	100
13	UGIT0T1318	Bioinformatics	3	-	-	3	40	60	100
14	UGIT0T1418	Advanced Java	3	-	-	3	40	60	100

SHRI VISHNU ENGINEERING COLLEGE FOR WOMEN::BHIMAVARAM
(AUTONOMOUS)

OPEN ELECTIVES OFFERED BY DEPARTMENT OF BASIC SCIENCE

S. No.	Subject Code	List of Open Electives	L	T	P	C	IM	EM	TM
1	UGBS0T0118	Probability and Statistics	3	-	-	3	40	60	100
2	UGBS0T0218	Operations Research	3	-	-	3	40	60	100
3	UGBS0T0318	Numerical Methods & Complex Variables	3	-	-	3	40	60	100
4	UGBS0T0418	Optimization Techniques (Open Elective—I)	3	-	-	3	40	60	100
5	UGBS0T0518	Optimization Techniques (Open Elective—II)	3	-	-	3	40	60	100

I YEAR
I SEMESTER

ENGLISH – I
(Common to All Branches)

Subject Code: UGBS1T0118	**L**	**T**	**P**	**C**
I Year / I Semester	**3**	**0**	**0**	**3**

SYLLABUS:

UNIT-I **4hrs**

Lesson: STEVE JOB'S SPEECH AT STANFORD GRADUATION CEREMONY

Grammar and Vocabulary: Concord forms: Subject-verb agreement ; Kinds of Verbs and Tenses; Describing oneself and others, objects, places, processes and narrating events and stories; Listening to narratives, talks and conversations and answering questions on them.

UNIT-II: **4hrs**

Lesson: THE MEANING OF LIFE By VIKTOR E.FRANKL (from the book 'Man's Search for Meaning')

Grammar and Vocabulary: Articles and prepositions; Framing appropriate questions and giving answers: exercises

UNIT-III: **3hrs**

Lesson: THE DAILY FIVE BY ROBIN SHARMA (from the book 'THE LEADER WHO HAD NO TITLE');

Grammar and Vocabulary: Selected Etymological roots and word formation; prefixes and suffixes derived from foreign languages to form derivatives in English

UNIT-IV: **3hrs**

Lesson: THE FESTIVAL OF THE SACRED TOOTH RELIC IN SRI LANKA based on the travelogues of Fa Hien

Grammar and Vocabulary: Synonyms and antonyms; Transformation of sentences: Direct and Indirect Speech; Active Voice and Passive Voice

UNIT-V: **3hrs**

Lesson: SATYA NADELLA'S LETTER TO HIS EMPLOYEES IN JUNE 2015

Grammar and Vocabulary: Simple, Compound and Complex Sentences; Uses of Phrases and Clauses in Sentences

UNIT-VI: **3hrs**

Lesson: A REVIEW ON THE MOVIE ' THE MAN FROM THE EARTH' (2007 release);

Grammar and Vocabulary: Paragraph writing, e-mail writing; Reading Comprehension

COURSE OUTCOMES:

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

CO1. Infer major events from the writer's perspective about the value of life appreciate it and create a sense of self responsibility to improve life.

CO2. Demonstrate the kinds and functions of verbs and their tenses and the use of Articles, Prepositions and different types of sentences.

CO3. Make use of acronyms so as to improve life and leadership skills.

CO4. Explain the variety in cultures, civilizations and modes of language and outline software business strategies to apply in professional contexts.

CO5. Identify plot and characterization of the movie and summarize different phases in the movie.

CO6. Select appropriate words and sentences for roots and affixes and develop a paragraph on the given topic.

Mapping of COs to POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO2	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO4	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO5	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO6	-	-	-	-	-	-	-	-	-	3	-	3	-	-

Text Books:

1. Man's Search for Meaning by Viktor E.Frankl
2. The Leader who had no Title by Robin Sharma
3. Life, Language and Culture – Explorations –I .
4. Internet sources for:
5. Steve Job's speech at Stanford Graduation Ceremony
6. Satya Nadella's letter to his employees in June 2015
7. The Movie ' The Man from the Earth' (2007 release)

Reference books

1. The Oxford guide to Writing & Speaking – John Seely
2. A Practical English Grammar Exercises 2 (Thrid Edition) – A.J. Thomson and A.V. Martinet, Oxford University Press, New Delhi, 2007.
3. The Students' Companion – Wilfred D. Best (New Edition) – Harper, Collins Publishers, 2012.
4. Col-Locate Your World, A store house of words & word-relations, their similarities & dissimilarities – Ajay Singh, Arihant Publications (I) Pvt. Ltd., Meerut.

MATHEMATICS - I
(Common to All Branches)

Subject Code: UGBS1T0218	**L**	**T**	**P**	**C**
I Year / I Semester	**2**	**1**	**0**	**3**

SYLLABUS:

UNIT-I: MATRICES **13hrs**

Types of Matrices: Symmetric, skew-symmetric, orthogonal, Hermitian, Skew-Hermitian, Unitary. Rank of a matrix by Echelon form and Normal form, Inverse of Non-singular matrices by Gauss-Jordan method, System of linear equations - solving system of Homogeneous and Non-Homogeneous equations by Gauss elimination method.

UNIT-II: EIGEN VALUES AND EIGEN VECTORS **11hrs**

Linear Transformation and Orthogonal Transformations, Eigen values and Eigen vectors and their properties, Diagonalization of matrices; Cayley-Hamilton Theorem (without proof).

UNIT -III: **11hrs**

ORDINARY DIFFERENTIAL EQUATIONS OF FIRST ORDER ANDFIRST DEGREE

Exact, Reducible to exact equations, Linear and Bernoulli's equations.

UNIT –IV: ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDER 13hrs

Second and Higher order linear differential equations with constant coefficients, Non-Homogeneous terms of the type $\sin ax, \cos ax, e^{ax}$, polynomials in x, $e^{ax}V(x)$ and $x\ V(x)$, Equations reducible to linear ODE with constant Coefficients, Legendre's equation and Cauchy-Euler equation.

UNIT-V: **MEAN VALUE THEOREMS** **11hrs**

Rolle's theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders

UNIT-VI: APPLICATIONS **9hrs**

Finding the current in an Electrical Circuit by Gauss elimination method, Finding inverse and powers of a matrix by Cayley-Hamilton Theorem, Orthogonal Trajectories, Newton's Law of Cooling, Law of Natural Growth and Decay, LCR Circuits.

Course Outcomes:

Upon the completion of the course, the students will able to:

CO1: Determine the Rank, inverse and Powers of a Matrix.

CO2: Apply matrix techniques to model and solve a system of linear equations.

CO3: Illustrate Eigen values, Eigen vectors, properties and diagonalization of a given Matrix.

CO4: Apply Appropriate Analytical technique to model and solve given Differential equation.

CO5: Justify Mean Value theorems and construct infinite series with the help of Mean value theorems.

Mapping of COs to POs

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

TEXT BOOKS:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 43rd Edition.
2. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th
3. Reprint, 2010.
4. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

REFERENCE BOOKS:

1. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.
2. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
3. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi,2008.
4. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson,
5. Reprint, 2002.
6. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006.

ENGINEERING CHEMISTRY
(For MECHANICAL ENGINEERING)

Subject Code: UGBS1T0518	**L**	**T**	**P**	**C**
I Year / I Semester	**3**	**0**	**0**	**3**

SYLLABUS:

UNIT-I: ATOMIC AND MOLECULAR STRUCTURE 12hrs.

Molecular orbitals of diatomic molecules and plots of the multicenter orbitals. Energy level diagrams of diatomic molecules (O_2, Cl_2, H_2 and N_2). Pi-molecular orbitals of butadiene. Crystal field theory and the energy level diagrams for transition metal ions (Octahedral-$Mo(CO)_6$, $[Co(NH_3)_6]^{+3}$) and their magnetic properties.

UNIT-II:ELECTRO CHEMISTRY AND CORROSION 10hrs.

EMF, Cell reactions, cell representation, cell potentials, Nernst equation and applications. Conductance- specific, equivalent and molar conductance. Reference electrode-SHE, calomel and glass electrode. Batteries-Primary cell, secondary cell (Li ion and Pb-acid battery. Fuel cells- H_2-O_2, methanol-oxygen cell

Dry and wet corrosion and their mechanisms. Pilling - Bedworth Rule. Types of Corrosion – galvanic corrosion, concentration cell corrosion, pitting corrosion and stress corrosion. Factors influencing corrosion. Corrosion Prevention methods – Cathodic protection – Sacrificial anodic method and Impressed current method. Metallic coatings –galvanization, tinning and electroplating.

UNIT-III: ENGINEERING MATERIALS 8hrs.

Lubricants – Classification, mechanism and properties (Oilyness, Flash and Fire point, Cloud and Pour point.

Building Materials – Cement, Classification, setting and hardening decay of cement and special cements.

Nano Composites – Classification, Matrix face and dispersed phase and applications

UNIT-IV : ORGANIC REACTIONS AND SPECTROSCOPY 5hrs.

Introduction to addition reactions, substitution reactions (SN^1, SN^2) and elimination reactions (E^1,E^2) aliphatic only, Oxidation-Reduction reactions($K_2Cr_2O_7$, $KMnO_4$, hydrogenation, $NaBH_4$ and $LiAlH_4$).

Principles of UV, IR, NMR, Mass – selection rules and applications.

Preparation of Drugs-Definition, Classification, Structure and uses of Asprin and Ibuprofen.

UNIT-V:WATER TECHNOLOGY 8hrs.

Hardness of water – Types, Units and Numerical problems on hardness- EDTA method, potable water treatment, steps involved in treatment. RO method, Ion-exchange method. Boiler troubles-Sludge, scale, Priming, foaming, caustic embrittlement and boiler corrosion their prevention.

UNIT-VI :STEREOCHEMISTRY **12hrs.**

Representations of three-dimensional structures-Newmann-Sawhorse Representations, Structural Isomers-Chain-position-functional, Stereo Isomers- Conformational isomerism (Ethane)-Configurations (Geometrical and Optical), Elements of Symmetry-Plane of symmetry and centre of symmetry and Chirality, Enantiomers, Diastereomers and Optical Activity of lactic acid.

COURSE OUTCOMES:

CO1: Understand the Chemistry in terms of atomic and molecular orbitals and intermolecular forces.

CO2. Explain the working principles of Batteries, Fuel cells, understanding of corrosion and its prevention methods.

CO3. Illustrate the types, properties of fuels and their applications using thermodynamic considerations.

CO4. Distinguish the various spectroscopic techniques to solve the complex engineering problems.

CO5. Identify the suitable water treatment methods for domestic and industry purposes.

CO6. Explain the structure of organic compounds and their applications.

Mapping of COs to PO

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

TEXT BOOKS:

1. Text book of Engineering Chemistry by Jain & Jain. Dhanpat Rai Publishing Company, 16th Edn., 2015.
2. A Text book of Engineering Chemistry by Shashi Chawla. Dhanpat Rai Publications, 3rd Edn., 2013.
3. A text book of Organic Reactions Stereochemistry and Mechanism by P.S. Kalsi, 9th Edition, 2016.
4. A text book of Organic chemistry by Bahl and bahl, S. Chand Publications, 21st Edition, 2017.
5. A text book of Inorganic chemistry by J.D.Lee, Wiley india edition.

REFERENCE BOOKS:

1. A Text book of Engineering Chemistry by S.S.Dara. S.Chand & Company Ltd., 12th Edn.,2010.
2. A Text book of Engineering Chemistry Shika Agarwal, Cambridge, 2015 Edition
3. A text book of Engineering Chemistry by Rath, Rama Devi, Reddy, Cengage Learning Indian pvt Ltd., 2016
4. A Text book of Chemistry, principles and applications by M.J.sienko and R.A.Plane.
5. Fundamentals of molecular spectroscopy by C.N.Banwell
6. A Text book of Physical chemistry by P.W. Atkins
7. A Text book of Organic chemistry: structure and function by K.P.C.Volhardt and N.E. Schore,5th edition
8. A text book of Inorganic chemistry by Dr.Wahid U.Malik, S.Chand publication, revised edition.

PROGRAMMING FOR PROBLEM SOLVING

Subject Code: UGCS1T0118	**L**	**T**	**P**	**C**
I Year / I Semester	**3**	**0**	**0**	**3**

SYLLABUS:

UNIT 1: **8 hrs**.

Problem Solving: Basic Computer Organization, Algorithm, pseudo code, flowchart, program development steps, Computer Languages: machine, symbolic, and high-level languages.

UNIT 2: **8 hrs.**

Basics of C: History of C, Structure of a C program, C tokens, Identifiers, Data Types, Constants, Variables, Input/ Output Statements, Creating and running programs, operators, precedence and order of evaluation, type conversion.

Selection Statements: Simple If, If-else, Nested if else, else-if, switch-statement and Examples.

UNIT 3: **8 hrs.**

Loop Statements: while, do-while, for, continue, break and goto statements.

Arrays: Arrays declaration, definition, accessing elements, storing elements, 1-D arrays, 2-D arrays and Multidimensional Arrays. Searching and sorting: Linear and Binary Search, Bubble sort, Selection sort.

UNIT 4: **8 hrs.**

Functions: Basics, categories of functions, parameter passing mechanism, Passing an Array to a Function, scope rules, Storage Classes, C pre-processor directives.

Recursion: Recursion versus Iterations, Recursive solutions for factorial, Fibonacci series, GCD.

UNIT 5: **8 hrs.**

Pointers: Introduction, Pointer Arithmetic, Array of Pointers, Pointers to Pointers, Pointers to Functions, Dynamic Memory Allocation Functions, Command-line Arguments.

Strings: Concepts,String Input/Output Functions, Arrays of Strings, String Manipulation Functions.

UNIT 6: **10 hrs.**

Structures: Declaration, definition and initialization of Structures, Accessing Structures, Nested Structures, Arrays of Structures, Structures and Functions, Pointers to Structures, Bit fields, Unions, Type Definition (typedef), Enumerated Types.

Files: Introduction to Files, Types of Files, Modes of Files, Accessing Files, File Input/output Functions, File handling functions, Applications of Files.

Course Outcomes:

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

CO1: Design efficient algorithms for arithmetic and logical problems using appropriate data structures and programming techniques.

CO2: Apply programming skills to effectively implement algorithms in C Programming Language.

CO3: Analyze complex problems and create solutions using modularization techniques.

CO4: Design and implement programs that effectively utilize pointers, strings, structures, and files for data manipulation and management.

Mapping of COs to POs :

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	3	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	3	-	-	-	-	-	-	-
CO3	3	3	3	3	3	-	-	-	-	-	-	3
CO4	3	3	3	3	3	-	-	-	-	-	-	3

TEXT BOOKS :

1. Programming in C, Reema Thareja, OXFORD.
2. The C programming Language by Dennis Richie and Brian Kernighan.

REFERENCE BOOKS:

1. C: The Complete Reference, Herbert Schildt (2000), 4th Edition, New Delhi, Osborne Mc Graw Hill.
2. Computer Science: A Structured Programming Approach using C, B. A. Fouruzan and R. F. Gilberg (2006), 3rd Edition, Thomson Publications, New Delhi.
3. Let us C, Yashawanth Kanethkar (2008), 8th Edition, Jones & Bartlett Publishers, India.
4. The C Programming Language, B. W. Kerninghan and Dennis M. Ritche (1988), 2nd Edition, Prentice Hall Software Series, India.
5. Programming in C, Stephen G.Kochan (2004), 3rd Edition, Pearson Education Private Limited.
6. C Programming and Data Structures –E. Balagurusamy, TMH

ENGLISH COMMUNICATION SKILLS LAB
(Common to All Branches)

Subject Code: UGBS1P0618	**L**	**T**	**P**	**C**
I Year / I Semester	**0**	**0**	**3**	**1.5**

English Lab Activities:

UNIT-I: Introduction to sounds of English – Phonetic Transcription (2 sessions)

UNIT-II: Introduction to Stress and Intonation

UNIT-III: English for Social Purposes- Role play/ Situational Dialogues & Just a minute (4 sessions)

UNIT-IV: Body Language (2 sessions)

UNIT-V: PPT Presentation (General topics) (3 sessions)Practice Work

UNIT-VI: Debate (2 sessions)

Laboratory Outcomes:

Upon the completion of the course, the students will be able to:
C01: Classify the sounds of English.
CO2: Demonstrate the appropriate stress, intonation of English Language.
CO3: Develop Situational Dialogues/ Role-plays and demonstrate students language skills
CO4: Show appropriate body language to the situations and settings.
CO5: Interpret a given topic.
CO6: Summarize opinion on an argumentative topic.

Mapping of COs to POs

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

TEXT BOOKS:

1. Cambridge English for Job Hunting – Colin Downes, CUP, 2009
2. English for Presentations, Oxford University Press
3. Body Language – Allan & Barbara Pease
4. Strengthen Your Communication Skills – Maruthi Publications

ENGINEERING CHEMISTRY LAB
(For Mechanical Engineering)

Subject Code: UGBS1P0918	**L**	**T**	**P**	**C**
I Year / I Semester	**0**	**0**	**3**	**1.5**

EXPERIMENTS:

Exp1: Introduction to chemistry laboratory – Quantitative analysis, Qualitativeanalysis Molarity, Normality, Primary, Secondary standard solutions, Volumetric titrations
Exp2: Estimation of iron in cement by colorimetry
Exp3: Determination of total hardness of given water sample by EDTA method
Exp4: Conductometric Titrations between strong acid and strong base
Exp5: Potentiometric Titrations between strong acid and strong base
Exp6: Determination of viscosity of polymer/organic liquid
Exp7: Determination of Rate Constant of a reaction
Exp8: Determination of chloride content of water sample
Exp9: Thin Layer Chromatography
Exp10: Synthesis of Aspirin
Exp11: Synthesis of Urea-Formaldehyde

COURSE OUTCOMES:

CO 1: Apply the basic knowledge on volumetric and quantitative analysis.
CO 2: Analyse the parameters to measure the quality of water samples.
CO 3: Identify the physical and chemical properties of organic solvents and solutions used in Engineering.
CO 4: Synthesize a drug or a polymer.

Mapping of COs to POs

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

PROGRAMMING FOR PROBLEM SOLVING LAB

Subject Code: UGCS1P0218	**L**	**T**	**P**	**C**
I Year / I Semester	**0**	**0**	**3**	**1.5**

Experiments:

EXP1:

a. Write a program that will output your name and address using a separate printf() statement for each line of output.
b. Modify your solution for the previous program so that it produces all the output using only one printf() statement.
c. Write a program to output the following text exactly as it appears here: " C is just like sea……" she said.
d. Write a program that prompts the user to enter a distance in inches and then outputs that distance in yards and feet.
e. Write a program to convert the temperature from degree centigrade to Fahrenheit and vice versa.

EXP2:

a. Write a C program to find the largest of three numbers using nested if-else.
b. Write a C Program to swap two numbers without using a temporary variable.
c. Write a simple program based on operators (pre, post increment , bitwise and , or , etc.).
d. Write a simple program based on type conversions (from int to float & float to int)

EXP3:

a. Write a program that displays all the numbers from X to Y, that are divisible by a and b.(X,Y,a and b should be read from the key board)
b. Write a program that reads an unspecified number of integers, determines how many positive and negative values have been read, and computes the total and average of the input values, not counting zeros. Your program ends with the input 0. Display the average as a floating-point number. (For example, if you entered 1, 2, and 0, the average should be 1.5.)
c. Write a C program for finding student Grade by reading marks as input.

EXP4:

a. The total distance travelled by vehicle in 't' seconds is given by distance s = ut+1/2at2 where 'u' and 'a' are the initial velocity (m/sec.) and acceleration (m/sec2). Write a C program to find the distance travelled at regular intervals of time given the values of 'u' and 'a'. The program should provide the

flexibility to the user to select his own time intervals and repeat the calculations for different values of 'u' and 'a'.

b. Write a C program, which takes two integer operands and one operator from the user, performs the operation and then prints the result. (Consider the operators +,-,*, /, % and use Switch Statement)
c. Write a C Program to enter a decimal number, and calculate and display the binary equivalent of that number

EXP5:

a. Write a C program to find the sum of individual digits of a positive integer and find the reverse of the given number.
b. 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. Write a C program to generate the first n terms of the sequence.
c. Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.

EXP6:

a. Write a C Program to check whether the given number is Armstrong number or not.

b. Write the programs for the following series:

$$1 + \frac{1}{2} + \frac{1}{3} + \cdots + \frac{1}{n}$$

$$\frac{1}{3} + \frac{3}{5} + \frac{5}{7} + \frac{7}{9} + \frac{9}{11} + \frac{11}{13} + \cdots + \frac{95}{97} + \frac{97}{99}$$

c. Write a C program to find the roots of a Quadratic equation.

EXP7:

a. Write C programs that use both recursive and non-recursive functions
   i. To find the factorial of a given integer.
   ii. To find the GCD (greatest common divisor) of two given integers.
b. Write C programs for implementing Storage classes: (Auto, register, static, extern)

EXP8:

a. Write a C program to find the minimum and maximum integer of an Array.
b. Write a C program that uses functions to perform the following:
   i. Addition of Two Matrices
   ii. Multiplication of Two Matrices

EXP9:

a. Write a C program to construct the following pyramid of numbers.

1 1 2 1 2 3	* * * * * *	1 2 3 4 5 6	A B B C C C D D D D E E E E E

EXP10:

a. Write a C program to swap two numbers using call by reference method.
b. Write a C program that uses a pointer to read and display Array elements.
c. Write a C program to create an array with calloc() , store the values into it and find their sum.

EXP11:

a. Write a C program to find length of the given string without using strlen().
b. 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 a given position.
    ii. To delete n Characters from a given position in a given string.
c. Write a C program to determine if the given string is a palindrome or not

EXP12:

a. Write a C program to implement Linear Search.
b. Write a C program to implement sorting of an array using bubble sort.

EXP13:

Examples which explore the use of structures, union and other derived data types.

EXP14:

a. Write a C program which copies the contents of one file to another.
b. Write a C program to count the number of characters and number of lines in a file.
c. Write a C Program to merge two files into a third file. The names of the files must be entered using command line arguments.
d. Write a C program that copies the characters from position X to position Y from one file to another file.

Course Outcomes:

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

CO1: Write and execute basic C programs, and debug syntax and logical errors.

CO2: Develop programs for the basic mathematical and general problems.

CO3: Analyze complex problems and break them into logical modules and interpret the results.

Mapping of COs to POs:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3		3	-	-	-	3	-	-	-	-	-
CO2	3	3	3		3	-	-	-	3	-	-	-	-	-
CO3	3	3	3	3	3	-	-	-	3	-	-	3	-	-

TEXT BOOKS:

1. Programming with C (Schaum's Outlines Series), Byron Gottfried, Jitender Chhabra, Mc Graw Hill Publishers.
2. Let us C, Yashawanth Kanethkar (2008), 8th Edition, Jones & Bartlett Publishers, India.

REFERENCE BOOKS:

1. C: The Complete Reference, Herbert Schildt, 4th Edition, Mc Graw Hill.
2. Computer Science: A Structured Programming Approach using C, B. A. Fouruzan and R. F. Gilberg (2006), 3rd Edition, Thomson Publications, New Delhi.

INDIAN CONSTITUTION

Subject Code: UGBS1A1118	**L**	**T**	**P**	**C**
I Year / I Semester	**2**	**0**	**0**	**0**

SYLLABUS:

UNIT-I: Introduction to Indian Constitution **2hrs**

Meaning of the term Indian Constitution –Preamble- Constituent Assembly- Salient Features of Indian Constitution

UNIT-II: Fundamental Rights **2hrs**

Fundamental Rights -Fundamental Duties -The Directive Principles of State Policy

UNIT-III: Union Government **2hrs**

Union Government -Union Legislature (Parliament) -Lok Sabha and Rajya Sabha (with Powers and Functions) -Union Excecutive -President of India (with Powers and Functions) -Prime Minister of India (with Powers and Functions) -Union Judiciary (Supreme Court) -Jurisdiction of the Supreme Court

UNIT-IV State Government **3hrs**

State Government -State Legislature (Legislative Assembly/ Vidhan Sabha, Legislative Council / Vidhan Parishad) -Powers and Functions of the State Legislature -State Executive-Governor of the State (with Powers and Functions) -The Chief Minister of the State (with Powers and Functions) -State Judiciary (High Courts)

UNIT-V: Local Self Governance **2hrs**

Powers and functions of Municipalities, Panchyats, ZP's and Co – Operative Societies

UNIT-VI: Sovereign Bodies **2hrs**

Election Commission of India (with Powers and Functions) -The Union Public Service Commission (with Powers and Functions)

COURSE OUTCOMES:

Upon the completion of the course, the student will be able to:

CO1: Examine salient features of Indian Constitution and live accordingly in society.

CO2: Interpret the meaning of Fundamental Rights and Directive Principles of State Policy and, develop an attitude which paves the way for better living conditions.

CO3: Discover various aspects of Union Government legislation and live up to the expectations of the rules.

CO4: Critically examine State Government legislation and improve your living standards by following the rules strictly

CO5: Examine powers and functions of local bodies such as Municipalities and Panchayats and, take advantage of available resources for better living

CO6: Analyze the powers and functions of Election Commission and The UnionPublic Service Commission and decide upon it for safe and secured life.

Mapping of COs to PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	-	-	3	-	3	-	3	-	3	-	3	-	-
CO2	-	-	-	3	-	3	-	3	-	3	-	3	-	-
CO3	-	-	-	3	-	3	-	3	-	3	-	3	-	-
CO4	-	-	-	3	-	3	-	3	-	3	-	3	-	-
CO5		-	-	3	-	3	-	3	-	3	-	3	-	-
CO6	-	-	-	3	-	3	-	3	-	3	-	3	-	-

TEXT BOOKS:

1. Introduction to constitution of India, Durga Das Basu, Lexis Nexis Publications
2. Constitution of India by PRFESSIONAL BOOK PUBLISHERS
3. The Constitution of India by Arun K Tiru vengadam, Blooms bury publishers.
4. The constitution of India by PM Bakshi, Universal law publishing co
5. The Constitution of India by S.R. Bhansali, Universal law publishing co

I YEAR
II SEMESTER

ENGLISH – II
(Common to All Branches)

Subject Code: UGBS2T0118	**L**	**T**	**P**	**C**
I Year / II Semester	**3**	**0**	**0**	**3**

SYLLABUS:

UNIT-I: **8hrs.**

The Rule of Law by **Stephen Hawking** (from Stephen Hawking's '**The Grand Design')**

Letter writing: Official and Business lettersPhrasal verbs and idiomatic expressions

UNIT-II: **14hrs.**

Malala Yousafzai's Speech at the U N General Assembly

One word substitutes, Précis writingExtempore speaking

Assignment-I : Each Student is required to present a report on a problem faced by individuals or the society with an analysis and possible solutions. She has to make an oral presentation of it in the class after the completion of UNIT-II Examination. It is mandatory for all the students. It is for Internal Assessment.

UNIT-III: **8hrs.**

Next Sunday by R**.K.Narayana** from his book '**NEXT SUNDAY'** Essay writing Descriptive, Expository, analytical and Narrative Providing examples or evidence in writing

UNIT-IV: **13hrs.**

'**Give Us A Role Model**' from **'Ignited Minds'** by **A P J Adbul Kalam**

Preparing a Resume/ C.V.

Redundancies and clichés in writing

Assignment-II : Each Student is required to present a report on a problem faced by individuals or the society with an analysis and possible solutions. She has to make an oral presentation of it in the class after the completion of Unit-IV Examination. It is mandatory for all the students. It is for Internal Assessment.

UNIT-V: **7hrs.**

Sudha Murthy's Letter to JRD TATA

Common errors in English

UNIT-VI: **14 hrs.**

A Review on the Movie ' Cast Away'

Report Writing Information Transfer

Assignment-III : Each Student is required to submit a critical review of the prescribed movie in the syllabus

COURSE OUTCOMES:

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

CO1: Classify the laws governing nature, discuss the scientific determinism and create a sense of empowerment of women through education.

CO2: Relate the day-to-day hassles in life, maintain mental equilibrium, and realize the importance of time and to derive inspiration to strive for success.

CO3: Outline different essays & letters as well as phrases and idioms in writing, speaking efficiently and make use of one-word substitutes in written communication

CO4: Explain the need for equal power and privilege to women in work place as well as in the society.

CO5: Identify psychological aspects and the struggle for survival of an individual.

CO6: Summarize CV, short reports and explain redundancies, common errors in English.

Mapping of COs to Pos

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO2	-	-	-	-	-	-	-	-	3	3	-	3	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO4	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO5	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO6	-	-	-	-	-	-	-	-	-	3	-	3	-	-

SOURCE BOOKS FOR ENGLISH-II

1. The Grand Design- Stephen Hawking
2. Next Sunday – R K Narayana
3. Ignited Minds – A P J Abdul Kalam

Internet sources for:

- Malala Yousafzai's speech at the UN General Assembly
- Sudha Murthy's letter to JRD TATA
- The Movie 'Cast Away"

BOOKS FOR FURTHER REFERENCE

1. The Oxford guide to Writing & Speaking – John Seely
2. A Practical English Grammar Exercises 2 (Thrid Edition) – A.J. Thomson and A.V.Martinet, Oxford University Press, New Delhi, 2007.
3. The Students' Companion – Wilfred D. Best (New Edition) – Harper, CollinsPublishers, 2012.
4. Col-Locate Your World, A store house of words & word-relations, their similarities& dissimilarities – Ajay Singh, Arihant Publications (I) Pvt. Ltd., Meerut.
5. English Conversation Practice – Grant Taylor, Tata Mc Graw-Hill PublishingCompany Limited, New Delhi, 2007.
6. Verbal Workout – Intensive practice to boost your English Vocabulary,Educational Software Technologies
7. The Official Cambridge Guide to IELTS, For Academic & General Training, (WithDVD-ROM), Student Book with Answers, 2015.
8. Immortal Speeches, Complied by Harshvardhan Dutta, Unicorn Books Pvt. Ltd.,Distributors – Pustak Mahal, Delhi.

MATHEMATICS-II
(Common to All Branches)

Subject Code: UGBS2T0218	**L**	**T**	**P**	**C**
I Year / II Semester	**2**	**1**	**0**	**3**

SYLLABUS:

Unit -I: Partial Differentiation **11hrs.**

Partial Differentiation, Total derivative; Jacobian, Functional dependence, Maxima, minima of functions of two and three variables, Lagrange method of undetermined multipliers.

Unit -II: Special Functions **8hrs.**

Definition of Improper integrals, Beta and Gamma functions and their properties.

Unit-III: Multiple Integrals **12hrs.**

Evaluation of Double Integrals (Cartesian and polar coordinates), change of order of integration (only Cartesian form). Evaluation of Triple Integrals: Change of variables (Cartesian to polar) for double and triple integrals.

Unit-IV: Vector Differentiation **12hrs.**

Vector point functions and scalar point functions. Gradient, Divergence and Curl, Solenoidal and Irrotational Vectors. Directional derivative, Vector Identities.

Unit-V: Vector Integration **13 hrs.**

Line, Surface and Volume Integrals. Green's, Gauss and Stoke's Theorems (without proofs) and their applications involving cubes, sphere and rectangular parallelepipeds.

Unit-VI: Applications **10hrs.**

Areas (by double integrals) and volumes by (by double integrals, by triple integrals), Centre of mass and Gravity (constant and variable densities) by double and triple integrals, Scalar potential function. Work done by force as a line integral.

COURSE OUTCOMES:

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

CO1: Apply the concepts of Partial differentiation to Jacobians and Extrema of several variable functions.

CO2: Evaluate various kinds of improper integrals using Beta and Gamma functions.

CO3: Evaluate and use multiple integrals for Engineering Applications.

CO4: Determine the Gradient, Divergence and Curl of a Vector field and their Applications using Vector Differentiation.

CO5: Evaluate Vector Integrals and justify the relation between them by integral Theorems.

Mapping of COs to PO's

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	3	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	3	-	-	-	-	-	-	-	-	-	3	-	-

TEXT BOOKS:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers
2. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

REFERENCE BOOKS:

1. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.
2. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
3. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi,2008.
4. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson,Reprint, 2002.
5. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

WAVES, OSCILLATIONS AND QUANTUM MECHANICS

Subject Code: UGBS2T0318	**L**	**T**	**P**	**C**
I Year / II Semester	**3**	**0**	**0**	**3**

SYLLABUS:

UNIT-I WAVES AND VIBRATIONS 12hrs.

Simple harmonic motion, Characteristics of SHM, Energy of simple harmonic oscillators, Damped harmonic oscillator damping, energy decay in a damped harmonic oscillator, Logarithmic decrement, relaxation time and quality factor, Forced harmonic oscillators, Resonance, Amplitude Resonance, Sharpness ofResonance

UNIT-II TRANSVERSE VIBRATIONS OF STRECHED STRINGS 8hrs.

Velocity of a transverse wave along a stretched string, Frequency of a vibrating string, Harmonics and overtones, Experimental verification of laws of vibrating strings, Melde's experiment

UNIT-III ULTRASONICS 7hrs.

Ultrasonics- Properties of Ultrasonics ,Production by Piezo electric and magnetostriction-Detection of ultrasonics-; Applications of ultrasonics, NDT

UNIT-IV INTRODUCTION TO QUANTUM MECHANICS 10hrs

Dual nature of radiation; concept of de Broglie hypothesis; concept of matter waves-properties; Davisson-Germer's Experiment- Heisenberg Uncertainty principle, physical significance of wave function; Schrodinger time-independent wave equation; Particle in one dimensional potential well

UNIT-V CRYSTALLOGRAPHY AND CRYSTAL STRUCTURES 10hrs

Crystal systems-Bravais lattices, Packing fraction-SC, FCC, BCC, NaCl Structure, Diamond Structure-lattice planes-Miller indices-Inter planar spacing for orthogonal crystal system.

UNIT-VI DEFECTS IN CRYSTALS AND X-RAY DIFFRACTION 8hrs

Crystal Defects–Point Defects (Schottky and Frenkel Defects), Line defects-Edge and Screw Dislocations, Burgers Vector X-Ray Diffraction–Braggs Law, Laue and Powder diffraction methods

COURSE OUTCOMES:

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

CO 1: Study the basics and applications of simple, damped and forced harmonic oscillations

CO 2: Learn the fundamentals of periodic oscillations, modes and overtones in stretched string

CO 3: Know the concepts of production, detection and applications of ultrasonic waves.

CO 4: Understand the concept of dual nature of matter waves and wave equation.

CO 5: Understand the basic concepts and formation of crystal structures

CO 6: Summarize the knowledge on various defects in crystals and their characterization using X-rays

Mapping of COs to PO

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

TEXT BOOKS:

1) Ian G. Main, Oscillations and waves in physics

(2) H.J. Pain, The physics of vibrations and waves

REFERENCE BOOKS:

(1) E. Hecht, Optics

(2) A. Ghatak, Optics

(3) solid state physics by S.O.Pillai.

(4) Physics volume II by Resnick, Halliday & Walker (John Wiley & sons)

ENGINEERING DRAWING

Subject Code: UGME2T0118	**L**	**T**	**P**	**C**
I Year / II Semester	**2**	**0**	**2**	**3**

SYLLABUS:

UNIT-I: 36 hrs

Objective: Acquire basic skills in technical graphic communication and also get thorough knowledge of various geometrical elements used in Engineering practice

INTRODUCTION TO THE ENGINEERING DRAWING, Polygons, Conic sections: construction of ellipse, parabola and hyperbola by general method, Introduction to scales.

INTRODUCTION TO ORTHOGRAPHIC PROJECTIONS: projections of points

UNIT-II: 9hrs

Objective: Impart and inculcate proper understanding of the theory of projection and projection of one dimensional objects on 2D planes.

PROJECTIONS OF STRAIGHT LINES perpendicular to one and parallel to other, parallel to both the planes, parallel to one plane and inclined to the other plane, inclined to both the planes, determination of true lengths, angle of inclinations and traces.

UNIT-III: 12hrs

Objective: To impart knowledge on projecting two dimensional figures and to visualize the different positions of planes.

PROJECTIONS OF PLANES: regular planes perpendicular/parallel to one plane and inclined to the other reference plane; inclined to both the reference planes

UNIT-IV: 15hrs

Objective: To visualize and represent the 3D objects in 2D planes with proper dimensioning, scaling.

PROJECTIONS OF SOLIDS – Prisms, Pyramids, Cones and Cylinders with the axis inclined to one of the reference plane**.**

UNIT-V: 12hrs

Objective: To visualize and represent the pictorial views of two & three dimensional objects with proper dimensioning and scaling.

ISOMETRIC PROJECTIONS

UNIT-VI 12 hrs

Objective: Interpret and represent both two & three dimensional of objects.

Conversion of isometric views to orthographic views

Conversion of orthographic views to isometric views

COURSE OUTCOMES:

CO1: Familiarize how industry communicates, practices for accuracy in presenting the technical information through drawing
CO2: Develop the engineering perspective essential for representing orthographic projections
CO3: Develop the engineering perspective essential for representing isometric projections
CO4: Improve their visualization skills to develop new designs

Mapping of COs to PO

COs		POs											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	-	-	-	-	-	-	-	-	3	-	-	-	-
CO2	3	-	3	-	-	-	-	-	-	3	-	-	-	-
CO3	3	-	3	-	-	-	-	-	-	3	-	2	2	-
CO4	3	-	3	-	-	-	-	-	-	3	-	2	2	-

TEXT BOOKS:

1. Engineering Drawing by N.D. Butt, Chariot Publications
2. Engineering Drawing by K.L.Narayana & P. Kannaiah, Scitech Publishers.
3. Engineering Graphics by PI Varghese, McGrawHill Publishers
4. Engineering Drawing + AutoCad – K Venugopal, V. Prabhu Raja, New Age

REFERENCES:

1. Engineering Graphics for Degree by K.C. John, PHI Publishers
2. Engineering Drawing by Agarwal & Agarwal, Tata McGraw Hill Publishers
3. Engineering Drawing by M.B.Shah&B.C.Rana,Pearson Publications

Basic Electrical & Electronics Engineering
(For Mechanical Engineering)

Subject Code: UGEE2T0218	**L**	**T**	**P**	**C**
I Year / II Semester	**3**	**0**	**0**	**3**

SYLLABUS:

UNIT I: DC Circuits **10 hrs**

Electrical circuit parameters (R, L and C), ohms law, Kirchhoff current and voltage laws, voltage and current sources, series and parallel circuits, voltage and current division rule, analysis of simple circuits with dc excitation (independent sources only), Star to delta transformation

UNIT II: DC Machines **11 hrs**

Construction, working of DC Generator, EMF Equation, types and characteristics of DC generators, Principle of DC motor Torque Equation of Motor, types of DC Motors, Torque-speed characteristic and speed control of DC motor.

UNIT III: Transformers **9 hrs**

Construction, Principle of operation, types, EMF Equation of a Transformer, OC and SC tests, efficiency and regulation, simple problems

UNIT IV: AC Machines **9 hrs**

Construction and working of three-phase Induction motor, types, slip-torque characteristics. Construction and working of Alternators, types, EMF equation, regulation by synchronous impedance method

UNIT V: Electronic Devices **10 hrs**

PN junction diodes, types, V-I characteristics. Transistors, types, characteristics. Principle of operation of Half wave, Full wave rectifiers and bridge rectifiers, Introduction to OP-AMPs

UNIT VI: Amplifiers and Oscillators **9 hrs**

Biasing Methods, Classification of Amplifiers, Feedback Amplifiers, Transistor as an Amplifier, frequency response of CE Amplifier, Principles of Oscillators – RC Phase Shift, Wien Bridge.

COURSE OUTCOMES:

CO1: To understand and analyze basic electric circuits with DC excitation
CO2: To study the working principles of DC machines
CO3: To study the working principles of Transformers
CO4: To study the working principles of AC machines
CO5: To study the working principles of Diodes and Transistors
CO6: To study the working principles of Oscillators & Amplifiers

Mapping of COs to Pos

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

TEXT BOOKS:

1. "Basic Electrical Engineering" by Nagsarkar,,Sukhija, 2nd edition, Oxford University Press, 2005
2. "Basic Electrical Engineering" by M. S. Naidu & S. Kamaksiah, TMH publications
3. "Basic Electrical Engineering" by S. N. SINGH, PHI learning, 2011.

REFERENCE BOOKS:

1. "Basic Electrical Engineering" by C. L. Wadhwa, 4th edition, New Age Publishers, 2007.
2. "Basic Electrical Engineering", by D. C. Kulshreshtha, 2nd edition, McGraw Hill, 2009.
3. "Basic Electrical Engineering", D. P. Kothari and I. J. Nagrath, 3rd edition, Tata McGraw Hill, 2010.

BUSINESS COMMUNICATION LAB
(Common to All Branches)

Subject Code: UGBS2P0618	**L**	**T**	**P**	**C**
I Year / II Semester	**0**	**0**	**3**	**1.5**

ENGLISH LAB ACTIVITIES:

UNIT – I: **(2 sessions)**

Listening: Listening to short conversations or monologues

Speaking: Giving information about oneself and their opinions and Giving a short talk on business related topics

Reading: Reading short and simple texts to understand the central idea/theme.

Writing: Writing a piece of internal business communication of 30-40 words (Email)

UNIT – II: **(2 sessions)**

Listening : Listening to a conversation/ monologue and taking notes

Speaking : Giving short talk on business related topics.

Reading: Matching descriptions of people to short texts. Matching statements to Information given in a graph or graphs.

Writing : Writing a piece of internal business communication of 30-40 words (Message)

UNIT – III **(2 sessions)**

Listening: Listening to longer conversations/interviews.

Speaking: Extempore

Reading : Reading a longer text and deciding whether the statements about the text are right or wrong or if the information is not given.

Writing : Write a business letter or e-mail of 60-80 words, based on an input text and some notes.

UNIT – IV **(2 sessions)**

Listening: Listening to TV news channels and taking notes.
Listening to songs and writing down the lyrics.

Speaking: Interview sessions

Reading: Read a longer text and answering questions. .

Writing: Writing a Business Report

UNIT – V: **(2 sessions)**

Listening: Watching short documentaries and making notes.
Speaking: Short plays, Presentations.
Reading : Read short texts and fill in a form using information from the texts.
Writing : Write a skit and enact.

UNIT – VI: **(2 sessions)**

Listening: Watching documentaries and making notes.
Speaking: Nail your point.
Reading : Critical Reading to know author's perspective.
Writing : Write a skit and enact.

COURSE OUTCOMES:

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

CO1: Develop listening skills through short or long conversations, monologues, interviews, TV news channels as well as watch documentaries and take notes.

CO2: Demonstrate speaking skills through talking about oneself, opinions, about business related topics and speak one's opinion.

CO3: Make use of speaking skills through giving extempore, participating in skits, short plays, presentations and mock interviews.

CO4: Build reading skills through general or critical reading of simple or longer texts to understand theme, to match statements correctly, to answer questions and to know author's perspective.

CO5: Apply writing skills with the practice of taking or making notes, emails or messages with maximum of 40 or 80 words.

CO6: Apply writing skills through reports or skits and identify four LSRW skills for learning communication for business purposes.

Mapping of COs to POs

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	3	3	-	3	-	-
CO2	-	-	-	-	-	-	-	-	3	3	-	3	-	-
CO3	-	-	-	-	-	-	-	-	3	3	-	3	-	-
CO4	-	-	-	-	-	-	-	-	3	3	-	3	-	-
CO5	-	-	-	-	-	-	-	-	3	3	-	3	-	-
CO6	-	-	-	-	-	-	-	-	3	3	-	3	-	-

REFERENCE BOOKS:

1. Cambridge English – Business English Certificate Preliminary
2. Suresh Kumar. E. & Sreehari P.A (2007), Handbook for English Language Laboratories,
3. Cambridge University Press India Pvt. Ltd, New Delhi.
4. Mandal S. K (2006),Effective Communication & Public Speaking , Jaico Publishing House, New Delhi.
5. Grant Taylor (2004), English Conversation Practice, Tata McGraw Hill, New Delhi.
6. Balasubramanian .T (2000), A text book of English Phonetics for Indian Student, MacMillan Publishers, India.
7. Kamalesh Sadanand, Susheela Punitha (2008), Spoken English: A foundation Course: Parts 1& 2, New Delhi, Orient Longman Pvt. Ltd

WEB REFERENCES: 1. www.cambridgeenglish.org. 2. www.esl-lab.com

WAVES, OSCILLATIONS & QUANTUM MECHANICS LAB

Subject Code: UGBS2P0718	**L**	**T**	**P**	**C**
I Year / II Semester	**0**	**0**	**3**	**1.5**

EXPERIMENTS:

(Any eight of the following to be done)

EXP1: Melde's Experiment- Transverse and Longitudinal modes
EXP2: Verification of laws of vibrations in stretched strings
EXP3: Newton's Rings- Radius of curvature of Plano-convex lens
EXP4: Determination of thickness of thin object using parallel interference fringes
EXP5: Determination of velocity of sound - Volume resonator
EXP6: Study the I/V characteristics of P-N junction diode
EXP7: Determine the rigidity modulus of a material – Torsional pendulum
EXP8: Determine the radius of gyration and acceleration due to gravity using compound pendulum
EXP9: LCR series resonance circuit
EXP10: Time constant of R-C circuit

COURSE OUTCOMES:

CO1: Examine the vibrational modes of a stretched string
CO2: Apply the optical phenomena in understanding the scientific applications
CO3: Determine the mechanical properties by studying various oscillatory motions
CO4: Experiment with basic electronic circuit to understand their functioning.

Mapping of Cos to PO

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	2	-	-	-	-	-	-	-	-	-	-

WORKSHOP PRACTICE AND INNOVATION LAB

Subject Code: UGME2P0218	**L**	**T**	**P**	**C**
I Year / II Semester	**0**	**0**	**3**	**1.5**

LIST OF EXPERIMENTS:

Part A
Workshop Practice

S.NO	**TITLE**
	CARPENTRY
1	T-Lap Joint
2	Cross Lap Joint
	FITTING
3	V—Fit
4	Square Fit
	TIN SMITHY
5	Taper Tray
6	Rectangular Box without lid
	HOUSE WIRING
7	a) Parallel / Series Connection of three bulbs
	b) Staircase Wiring/ Two Lamps controlled by two SPST Switches
8	Florescent Lamp
	Welding
9	To make Lap Joint by Gas Welding
10	To make Butt Joint by Arc Welding

Part B
Innovation Lab

During the due course, the students have to design/develop/manufacture any product and/or improve the process capabilities for better quality.

COURSE OUTCOMES:

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

CO1: Prepare basic joints used in carpentry

CO2: Prepare edges for better joint for fitting

CO3: Imparting skills to fabricate various objects by using sheet metal

CO4: Perform basic house wiring connections

CO5: Perform joining operations of materials

Mapping of COs to POs

COs		POs											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	-	3	-	-	-	-	-	-	-	-	3	-	3
CO2	3	-	3	-	-	-	-	-	-	-	-	3	-	3
CO3	3	-	3	-	-	-	-	-	-	-	-	3	-	3
CO4	3	-	3	-	-	-	-	-	-	-	-	3	-	3
CO5	3	-	3	-	-	-	-	-	-	-	-	3	-	3

ENVIRONMENTAL SCIENCE

Subject Code: UGBS2A1018	**L**	**T**	**P**	**C**
I Year / II Semester	**2**	**0**	**0**	**0**

SYLLABUS:

12 hrs

UNIT-I: MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES: Definition, Scope, Importance and sustainability - People, institutions in the environment.

ECOSYSTEMS & BIODIVERSITY

Introduction to Ecosystem, types of Ecosystems ,Bio diversity its conservation: Conservation of biodiversity: Insitu conservation, Exsitu conservation.

UNIT-II: ENERGY &WATER RESOURCES 6hrs

INTRODUCTION: Non-conventional energy resources (solar/wind/tidal) & controlling in use of electricity and conventional energy sources(fossil fuels & coal)Water management (rain water harvesting watershed management and water conservation) Urban problems related to energy.

UNIT-III: ENVIRONMENTAL POLLUTION: 11hrs

Definition, Cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution, nuclear hazards. Role of an individual in prevention of pollution. – Pollution case studies. Global Environmental Challenges: Stockholm and Rio Summit: Global warming and climate change, acid rains, ozone layer depletion

SOLID WASTE MANAGEMENT: Sources, classification, effects and control measures of urban and industrial solid wastes. Consumerism and waste products.

UNIT-IV: SOCIAL ISSUES AND THE ENVIRONMENT: 6hrs

Resettlement and rehabilitation of people, its problems and concerns. Environmental ethics: Environmental Protection Act –Air (Prevention and Control of Pollution) Act. –Water Prevention and control of Pollution) Act – Wildlife Protection Act –Forest Conservation Act-Issues involved in enforcement of environmental legislation. –Public awareness

4hrs

UNIT-V: ENVIRONMENTAL MANAGEMENT: Impact Assessment and its significance various stages of EIA, preparation of EMP and EIS, Environmental audit. Ecotourism.

GREEN CHEMISTRY: Introduction & Principles. The student should submit a report individually on any issues of Environmental Studies course and make a power point presentation.

UNIT-VI **12hrs**

I. Studying the nearest lake water/farm land/forest ecosystems and preparing document and creating awareness programs among public in mitigating pollution.

II. Conducting Mass level **cycling** for making aware of public in minimizing use of fossil fuels.(ECO CLUB ACTIVITY)

III. Mass level plantation programs and involving students in government Programs NEERU-CHETTU

IV. **Poster presentation**, involving the students in making aware of public Avoiding the use of Non-biodegradable polythene covers, glasses, bottles.

V. Involving the students in making aware of farmers use/preparing of natural manure and avoiding use of Insecticides/pesticides and chemical fertilizers.

COURSE OUTCOMES:

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

CO1. Demonstrate a general understanding of interdisciplinary &multi disciplinary nature of environmental issues.

CO2. Identify key natural resources that need to be conserved .

CO3. Illustrate types of ecosystems and to understand the importance of ecosystems.

CO4. Demonstrate depth of critical analysis and writing of environmental problems.

CO5. Formulating methods for meaningful sustainable development of environment.

CO6. Executing an action plan for environmental management.

Mapping of COs to POs

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

TEXT BOOKS:

1. Environmental Studies by R. Rajagopalan, 2nd Edition, 2011, Oxford University Press.
2. A Textbook of Environmental Studies by Shashi Chawla, TMH, New Delhi.
3. Environmental Studies by P.N. Palaniswamy, P. Manikandan, A. GeethEnviroa, and K. Manjula Rani; Pearson Education, Chennai.

REFERENCE BOOKS:

1. Text Book of Environmental Studies by Deeshita Dave & P. Udaya Bhaskar, Cengage Learning.
2. Environmental Studies by K.V.S.G. Murali Krishna, VGS Publishers,Vijayawada.
3. Environmental Studies by Benny Joseph, Tata McGraw Hill Co, New Delhi.
4. Environmental Studies by Piyush Malaviya, Pratibha Singh, Anoop singh: Acme Learning, New Delhi.

II YEAR
I SEMESTER

MATHEMATICS -III

Subject Code: UGBS3T0118	L	T	P	C
II B.Tech./I Sem.	3	-	0	3

SYLLABUS

Unit-I **5hrs**

Partial Differential Equations-I

Definition of Partial Differential Equations, Formation of partial differential equations, solutions of first order linear and non-linear PDEs.

Unit -II **5hrs**

Partial Differential Equations-II

Second and Higher order linear equations- Solution to homogenous and non-homogenous equations separation of Variables method, Solution of wave equation.

Unit -III **6hrs**

Numerical Methods-I: Root finding methods & Interpolation

Solution of polynomial and transcendental equations – Bisection method, Newton-Raphson method and Regula-Falsi method. Finite differences, Interpolation using Newton's forward and backward difference formulae.

Unit -IV **5hrs**

Numerical Methods-II: Numerical solution of First Order Differential Equations Taylor's series, Euler and modified Euler's methods. Runge-Kutta method of fourth order forsolving first and second order equations.

Unit V **3hrs**

Numerical Methods-III: Numerical integration:

Trapezoidal rule and Simpson's 1/3rd and 3/8 rules.

Unit –VI **5hrs**

Numerical Methods-IV: Numerical Solution of Partial Differential Equations

Partial differential equations: Classification, Finite difference solution, one dimensional heatequation and two-dimensional Laplace equation.

Course Outcomes:

CO1: Construct a partial differential equation of a given family of curves.

CO2: Determine the solution of linear and non-linear partial differential equations analytically

CO3: Solve a polynomial or transcendental equation using numerical methods.

CO4: Demonstrate the use of interpolation methods to find intermediate values in real time data

CO5: Determine approximate solution to ordinary and partial differential equations using numerical methods

CO6: Evaluate an approximate value of the integral of a function using numerical Methods

Mapping of COs to PO

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

Text books:

1.B.S.Grewal, Higher Engineering Mathematics, 42nd Edition, Khanna Publishers

2.B.V. Ramana, Higher Engineering Mathematics, , Tata McGrawhill

3. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, Wiley-India

Reference books:

1. R.K. Jain & S.R.K. Iyengar, Advanced Engineering Mathematics , 3rd ed., Narosa PublishingHouse, Delhi.
2. Dean G. Duffy, Advanced Engineering Mathematics with MATLAB, 3rd Ed., CRC PressTaylor & Francis Group.
3. Michael Greenberg, Advanced Engineering Mathematics, Second Edition. PearsonEducation.
4. Erwin Kreyszig, Advanced engineering Mathematics by John Wiley & Sons Publishers
5. T.K.V. Iyengar, B.Krishna Gandhi & Others, Mathematical Methods S. Chand

ENGINEERING MECHANICS

Subject Code: UGME3T0218	**L**	**T**	**P**	**C**
II Year / I Semester	**2**	**2**	**0**	**4**

SYLLABUS:

UNIT-I: **10hrs**

Introduction – Basic concepts System of Forces- Coplanar Concurrent Forces – Components in Space – Resultant- Moment of Forces and its Application – Couples and Resultant of Force System – Equilibrium of System of Forces- Free body diagrams- Equations of Equilibrium of Coplanar Systems and Spatial Systems.

UNIT-II: **10hrs**

FRICTION: Types of friction – Limiting friction – Laws of Friction –Motion of Bodies – Wedge

ANALYSIS OF TRUSSES: (Analytical Method) – Types of Trusses – Assumptions made in analysis of trusses, Method of joints, Method of sections, Force table, Cantilever Trusses, Structures with one end hinged and the other freely supported on rollers carrying horizontal or inclined loads.

UNIT-III: **08hrs**

CENTROID: Centroids of simple figures (from basic principles) – Centroids of Composite Figures

CENTRE OF GRAVITY: Centre of gravity of simple body (from basic principles), centre of gravity of composite bodies, Pappus theorem.

UNIT-IV: **07hrs**

AREA MOMENTS OF INERTIA: Definition – Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of Composite Figures.

MASS MOMENT OF INERTIA: Moment of Inertia of Masses, Transfer Formula for Mass Moments of Inertia, mass moment of inertia of composite bodies.

UNIT-V: **07hrs**

KINEMATICS: Rectilinear and Curve linear motion – Velocity and Acceleration – Motion of a Rigid Body – Types and their Analysis in Planar Motion.

KINETICS: Analysis as a particles and Analysis as a Rigid Body in Translation – Central Forces of motion – Equations of Plane Motion – Fixed Axis Rotation – Rolling Bodies.

UNIT-VI: **07hrs**

WORK – ENERGY METHOD: Equations for Translation, Work-Energy Applications to

Particle Motion, Connected System-Fixed Axis Rotation and Plane Motion. Impulse momentum method.

Course Outcomes:

Upon the completion of the course, the students will able to:

CO1: Apply static equilibrium equations for coplanar & non coplanar force systems.
CO2: Evaluate parameters associated with various types of friction.
CO3: Analyse the axial forces in the truss members using method of joints and method of sections.
CO4: Determine centroid, centre of gravity and moment of inertia.
CO5: Analyse rigid bodies for different types of motion

Mapping of COs to PO

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

TEXT BOOKS:

1. Engineering Mechanics, by Ferdinand L.Singer Published by Harper Collins Publishers, Singapore.
2. Engineering Mechanics by S.Timoshenko, D.H. Young and J.V. Rao

REFERENCE BOOKS:

1. Engineering Mechanics (Statics and Dynamics) by Arthur P.Boresi & Ridhard J.Schmidt – Thomson publications 2001.
2. Engineering Mechanics by A.K.Tayal, Umesh Publications
3. Engineering Mechanics – Schaum's series – Mc.Grawhill Publications.
4. Engineering Mechanics by R.C.Hibbeler; Pearson education
5. Engineering Mechanics by Basudeb bhattacharyya; Oxford publication

FLUID MECHANICS & HYDRAULIC MACHINERY

Subject Code: UGME3T0318	**L**	**T**	**P**	**C**
II Year / I Semester	**2**	**2**	**0**	**4**

SYLLABUS:

UNIT-I: FLUID STATICS: 12hrs

Dimensions and units: physical properties of fluids- density, specific gravity, viscosity, surface tension- vapor pressure and their influence on fluid motion- atmospheric gauge and vacuum pressure – measurement of pressure- Piezometer, U-tube and differential manometers. Pascal's law, hydrostatic law, Buoyancy and floatation: Meta center, stability of floating body, submerged bodies, Calculation of meta center height.

UNIT-II: FLUID KINEMATIC AND FLUID DYNAMICS: 12hrs

FLUID KINEMATICS: Stream line, path line and streak lines and stream tube, classification of flows-steady & unsteady, uniform, non-uniform, laminar, turbulent, rotational and irrotational flows-equation of continuity for one dimensional flow and three-dimensional flows. Stream and velocity potential functions.

FLUID DYNAMICS: Surface and body forces –Euler's and Bernoulli's equations for flow along a stream line, momentum equation and its application on force on pipe bend. Measurement of flow: pitot tube, venturimeter, and orifice meter.

UNIT- III: CLOSED CONDUIT FLOW AND BOUNDARY LAYER THEORY: 10hrs

CLOSED CONDUIT FLOW: Reynold's experiment- Darcy Weisbach equation- Minor losses in pipes- pipes in series and pipes in parallel- total energy line-hydraulic gradient line.

BOUNDARY LAYER THEORY: Introduction, momentum integral equation, displacement, momentum and energy thickness, separation of boundary layer, control of flow separation, stream lined body, Bluff body and its applications, Basic concepts of velocity profiles.

UNIT-IV: BASICS OF TURBO MACHINERY AND HYDROELECTRIC POWER STATIONS: 8hrs

BASICS OF TURBO MACHINERY: Hydrodynamic force of jets on stationary and moving flat, inclined and curved vanes, jet striking centrally and at tip, velocity diagrams, work don and efficiency, flow over radial vanes.

HYDROELECTRIC POWER STATIONS: Elements of hydroelectric power station, types, storage requirements, mass curve, heads and efficiencies.

UNIT-V: HYDRAULIC TURBINES: 11hrs

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

PERFORMANCE OF HYDRAULIC TURBINES: Geometric similarity, Unit and specific speed, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer.

UNIT-VI: CENTRIFUGAL PUMPS AND RECIPROCATING PUMPS 11hrs

CENTRIFUGAL PUMPS: Classification, working, workdone – manomertic head- losses and efficiencies –specific speed- pumps in series and parallel-performance characteristic curves, cavitations & NPSH.

RECIPROCATING PUMPS: Working, Discharge, slip, indicator diagrams.

COURSE OUTCOMES:

CO1: Explain various fluid properties and hydrostatic forces on different bodies.

CO2: Apply conservation laws to fluid flow problems in engineering applications.

CO3: Illustrate the concepts of boundary layer theories & fluid flow through pipes

CO4: Solve the problems involving velocity triangles and hydrodynamic forces.

CO5: Illustrate the working principles of various hydraulic machines.

CO6: Analyze the performance of various hydraulic machines under different working conditions.

Mapping of COs to PO

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

TEXT BOOKS:

1. Hydraulics, fluid mechanics and Hydraulic machinery MODI and SETH.
2. Yunus A.Cengel and John M.Cimbala, "Fluid Mechanics", Tata McGrawHill, 2006.

3. Fluid Mechanics and Hydraulic Machines by R K Bansal.

REFERENCES:

Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria & Sons.
1. Fluid Mechanics and Machinery by D. Rama Durgaiah, New Age International.
2. Hydraulic Machines by Banga & Sharma, Khanna Publishers.
3. Fluid Mechanics & Hydraulic Machines by Domkundwar & Domkundwar, Dhanpatrai & Co.
4. Fluid Mechanics and Hydraulic Machines by Rajput.

THERMODYNAMICS

Subject Code: UGME3T0418	L	T	P	C
II Year / I Semester	3	0	0	3

SYLLABUS

UNIT I: **8hrs**

Basic Concepts and Definitions:

Introduction, System, surrounding, boundaries, universe, types of systems, Macroscopic and Microscopic viewpoints, properties and state of a substance, Thermodynamic equilibrium and Quasi-static Process, thermodynamic path, reversible and irreversible processes, factors that render a process irreversible, cycle, Zeroth law of thermodynamics, concept of temperature, Principles of Thermometry, Reference Points, Constant Volume gas Thermometer, Scales of Temperature, Ideal Gas Scale.

Work and Heat: Definitions and units, Work done at the moving boundary of a system, work done in various non-flow processes, comparison of heat and work, point and path functions

UNIT II: **8hrs**

First law of Thermodynamics:

Joule's Experiments, First law applied to a Process , internal energy and enthalpy, specific heats and their relation to internal energy and enthalpy of ideal gases, PMM-I. First law applied to a flow system, Steady flow energy equation and its application to engineering equipment. Equation of state, specific and universal gas constants, Throttling and free expansion processes, Vanderwaals equation of state-compressibility charts, variable specific heats, gas tables. Limitations of the First Law.

UNIT III : **8hrs**

Second Law of Thermodynamics: Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance. Kelvin-Planck and Clausius Statements and their equivalence, PMM of second kind, Carnot's principle, Carnot cycle and its specialties, thermodynamic scale of temperature.

Entropy: Inequality of Clausius, entropy change in reversible process, entropy change of a system during an irreversible process, principle of increase of entropy, applications, entropy change of an ideal gas, availability, maximum work. Gibbs and Helmholtz Functions, Maxwell Relations –elementary treatment of the Third Law of thermodynamics.

UNIT IV: **7hrs**

Pure Substances: P-V, T-S and h-s diagrams, properties of saturated and superheated

steam, Mollier Charts, Phase Transformations, Triple point at critical state properties during change of phase, Dryness Fraction, Clausius – Clapeyron Equation, Property tables. Various Thermodynamic processes and energy Transfer, Steam Calorimetry

UNIT V: 9hrs

Mixtures of perfect Gases: Mole fraction, Mass fraction, gravimetric and volumetric analysis, Dalton's law of partial pressure, Avogadro's laws of additive volumes, volume fraction and partial pressure, equivalent gas constant and molecular weight internal energy, enthalpy, sp. heats and entropy of mixture of perfect gases and vapour, Atmospheric air - Psychrometric properties, Dry bulb temperature, Wet bulb temperature, Dew point temperature, thermodynamic wet bulb temperature, specific humidity, relative humidity, saturated air, vapour pressure, degree of saturation, adiabatic saturation, carrier's equation, Psychrometric chart.

UNIT VI: 8hrs

Basic Air standard cycles: Otto cycle, Diesel cycle, Dual cycle, Bell-Coleman, description and representation on P–V and T-S diagram, thermal efficiency, mean effective pressures on air standard basis – comparison of cycles.

Vapour Power Cycles - Rankine cycle - Schematic layout, Thermodynamic Analysis, Concept of Mean Temperature of Heat addition, Methods to improve cycle performance – Regeneration & reheating

COURSE OUTCOMES:

Upon the completion of the Course, the student will be able to

CO1: Explain the basic concepts of thermodynamics to a system with heat and work interactions.

CO2: Apply the laws of thermodynamics to various thermodynamic systems.

CO3: Evaluate the properties of pure substances during phase transformation.

CO4: Evaluate the properties of Perfect mixtures and Psychrometric properties of air.

CO5: Analyze the various Air standard cycles and Vapour Power cycles.

Mapping of COs to PO

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

TEXT BOOKS :

1. Engineering Thermodynamics / PK Nag/TMH
2. Thermodynamics – J.P.Holman / McGrawHill
3. Engineering Thermodynamics. D. S.Kumar
4. Thermal Engineering - Mahesh M. Rathore / Tata McGrawHill

REFERENCES :

1. Engineering Thermodynamics – Jones &Dugan
2. Thermodynamics – An Engineering Approach – YunusCengel& Boles/TMH
3. Thermal Engineering – P L Bellaney / Khannapublishers.
4. An introduction to Thermodynamics / YVC Rao / New Age Engineering Thermodynamics – K. Ramakrishna / Anuradha Publishers

MATERIALS AND MANUFACTURING

Subject Code:UGME3T0518	L	T	P	C
II Year/ I Semester	3	0	0	3

SYLLABUS

UNIT-I: CRYSTAL STRUCTURES **9hrs**

Bonds in Solids – crystal structure-simple cubic, BCC, FCC, HCP Space Lattice and unit Cells, crystallization of metals, grain and grain boundaries, determination of grain size. Necessity of alloying, types of solid solutions, Hume Rotherys rules, intermediate alloy phases and electron compounds. Study of Iron-Iron carbide (Fe-Fe_3C) phase diagram

UNIT- II **8hrs**

FERROUS METALS – STEELS

Classification of steels, structure and properties of plain carbon steels, Low alloy steels, Hadfield manganese steels, tool and die steels.

NON-FERROUS METALS AND ALLOYS: Structure and properties of copper and its alloys, Aluminum and its alloys, Titanium and its alloys.

CAST IRONS: Structure and properties of White Cast iron, grey cast iron, Spheroidal cast iron, Malleable Cast iron, Alloy cast irons.

UNIT -III **9 hrs**

MECHANICAL BEHAVIOR OF MATERIALS

Elastic deformation, plastic deformation- twinning, fracture.

HEAT TREATMENT OF STEELS: Importance of heat treatment, types-Annealing, normalizing, Hardening, tempering. Harden ability, TTT diagrams

UNIT –IV **9 hrs**

BULK FORMING PROCESSES

Hot working and Cold working of metals Forging and its types, Fundamental principle of Rolling, types of Rolling mills, Forward extrusion and backward extrusion processes, wire drawing and Tube drawing**.**

SHEET METAL FORMING: sheet metal operations, stretch forming, deep drawing, coining, spinning, bending, springback and remedies Types of presses and press tools.

UNIT-V: **CASTING** **8 hrs**

Steps involved in making a casting – Advantage of casting and its applications. –Types of Moulding sands and its properties, Patterns and Pattern making – Types of patterns – Materials used for patterns, pattern allowances and their construction, Principles of Gating and Gating system elements.

SPECIAL CASTING PROCESSES: Centrifugal, Die and Investment casting.

UNIT-VI: WELDING **9 hrs**

Classification of welding process

GAS WELDING: Operating principle, basic equipment, merits and applications of oxy acetylene welding and different types of flames and uses.

ARC WELDING: Operating principle, basic equipment, merits and applications of Manual metal arc welding and submerged arc welding. Operating principle, basic equipment, merits and applications of TIG and MIG weldings, Resistance welding process, Thermit welding, Laser beam welding, Electron beam welding, Soldering and Brazing, Welding defects causes and remedies.

COURSE OUTCOMES:

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

CO1: Identify the properties of metals with respect to crystal structure and grain size and interpret phase diagrams.

CO2: Classify different types of ferrous and non-ferrous metals with respect to their properties

CO3: Select appropriate process of heat treatment and examine the structure for shaping the metal using different forming techniques.

CO4: Identify the right casting process according to the application.

CO5: Apply the basic principles of welding different materials.

CO6: Illustrate and Communicate effectively the knowledge of the material science and manufacturing for science and engineering.

Mapping of COs to Pos

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

TEXT BOOKS:

1. Introduction to Physical Metallurgy / Sidney H. Avner.
2. Materials Science and Metallurgy/kodgire
3. Manufacturing Engineering and Technology/Kalpakjin S/ Pearson Edu.

4. Manufacturing Technology / P.N. Rao/TMH
5. Manufacturing Technology by Amitab Gosh & Mallik

REFERENCES:

1. Essential of Materials science and engineering/ Donald R.Askeland/Thomson.
2. Elements of materials science by V.Raghavan, Pearson Education
3. Engineering materials and metallurgy/R.K.Rajput/ S.Chand.
4. Engineering Material and Metallurgy – Er Amandeep Singh Wadhva
5. Analysis and performance of fiber composites by Bhagawan. D.Agarwal, 4th edition, John Wiley and Sons, Inc.
6. Production Technology, R.K. Jain
7. Process and materials of manufacturing – indberg, PE
8. 8.Principles of Metal Castings, Rosenthal.

COMPUTER AIDED MACHINE DRAWING LABORATORY

Subject Code: UGME3PT0618	**L**	**T**	**P**	**C**
II B.Tech./I Sem.	**0**	**0**	**3**	**1.5**

LIST OF EXERCISES

1. Study of capabilities of software for sketcher module - Drafting and Modeling – Usage of tools in sketcher module - Drafting of simple 2D machine components.
2. 2D drafting of Plummer block
3. 2D drafting of stuffing box
4. 2D drafting of simple eccentric
5. 2D drafting of petrol engine connecting rod
6. 2D representation of popular forms of Screw threads, bolts & nuts.
7. Study of capabilities of software for Part modeling & Assembly module - Drafting and Modeling – Usage of tools in part modeling module - Drafting of simple 3D machine components.
8. 3D Assembly of Oldham's coupling
9. 3D Assembly of flange coupling
10. 3D Assembly of Knuckle Joint
11. 3D Assembly of Socket and Spigot joint
12. 3D Assembly of gib and cotter joint
13. 3D Assembly of machine vice
14. 3D Assembly of tail stock
15. 3D Assembly of screw jack
16. Generative sheet metal design - Sheet Metal Walls - Bends and Unfold Mode - Flanges - Sheet Metal Features - Mapping Curves - Create an Unfolded View
17. Create Wall, User-defined Flange and Rectangular Pattern - Create Countersunk Hole and Corner - Generate the Unfolded View
18. Create basic Sheet Metal features - Create Wall on Edge and Corner Relief - Create Cutout and Louver - Mirror a feature - Create Surface Stamp, Bead, Flanged Hole and Bridge - Create Circular Stamp and Hole

19. Create basic Sheet Metal features - Create Flange on curved edge - Modify the Sheet Metal Design - Create a Rib

Note: Plotting of drawings must be done for each exercise and attached to the record work written by students.

Course Outcomes:

After completion of the course, the students would be able to:

CO1: Apply the fundamentals of drafting with the aid of CAD package.
CO2: Develop surfaces for different geometric entities with the aid of CAD package.
CO3: Model the various forms of screw threads with the aid of CAD package.
CO4: Model the various Engine Components using CAD package.
CO5: Assemble different elements of a machine using CAD package.

Mapping of COs to Pos:

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

TEXT BOOKS:

1. A text book of Machine Drawing – R. K. Dhawan, S.Chand Publications
2. Machine Drawing –K.L.Narayana, P.Kannaiah & K. Venkata Reddy / New Age/ Publishers

REFERENCES:

1. A text book of Machine Drawing – P. S. Gill
2. Machine Drawing – N D Bhatt / Charotar Publishers
3. Machine Drawing – G R Nagpal
4. Machine Drawing – N.Siddeswar, K.Kannaiah & V.V.S.Sastry – TMH
5. Machine Drawing – B Battacharya, Oxford
6. Machine Drawing – Ajeeth Singh, McGraw Hill
7. Machine Drawing – N.D. Junnarkar, Pearson

FLUID MECHANICS & HYDRAULIC MACHINERY LABORATORY

Subject Code: UGME3P0718	**L**	**T**	**P**	**C**
II B.Tech./I Sem.	**-**	**-**	**3**	**1.5**

SYLLABUS

S. No	**Name of the Experiment**
I	Calibration of Venturi meter.
II	Calibration of Orifice meter.
III	Determination of friction factor for a given pipe line.
IV	Determination of loss of head due to sudden contraction in a pipeline.
V	Verification of Bernoullis Theorem.
VI	Impact of jets on Vanes.
VII	Performance Test on Pelton Wheel.
VIII	Performance Test on Francis Turbine.
IX	Performance Test on Kaplan Turbine.
X	Performance Test on Single Stage Centrifugal Pump.
XI	Performance Test on Reciprocating Pump.
XII	Performance Test on Multi Stage Centrifugal Pump.

Note: At least Ten experiments to be done from the above list.

COURSE OUTCOMES:

CO1: Estimate minor and major losses in the pipes.
CO2: Determine the coefficient of discharge through various devices like venturi meter and orifice meter.
CO3: Test the impact of jet on vanes.
CO4: Examine the Bernoulli's theorem.
CO5: Assess the performance of various pumps and turbines.

Mapping of COs to Pos

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

REFERENCES:

1. Fluid Mechanics and Hydraulic Machines college lab manual.
2. Hydraulics, fluid mechanics and Hydraulic machinery MODI and SETH.
3. Fluid Mechanics and Hydraulic Machines by R K Bansal.

PRODUCTION TECHNOLOGY LABORATORY

Subject Code: UGME3P0818	**L**	**T**	**P**	**C**
II B.Tech./I Sem.	**0**	**0**	**3**	**1.5**

Experiments:

METAL CASTING:

EXP1: Sand Molding procedure for Casting

EXP2: Melting practice of Aluminium to make a desired casting EXP3: Determination of Permeability of a Sand Specimen

EXP4: Determination of Grain Fineness Number using Sieve Shaker

WELDING :

EXP5: Preparation of profile joint using TIG Welding EXP6:Preparation of Lap joint using Spot Welding

METAL FORMING:

EXP7: Blanking and piercing operation by simple process using hand press

EXP8: Bending Operation of sheet metal using V-bend die

PROCESSING OF PLASTICS:

EXP9: Preparation of bottle using Injection molding

EXP10: Preparation of bottle cap using blow molding

Course Outcomes:

After completion of the course, the students would be able to:

CO1: Prepare a sand mould to produce desired shape of casting.

CO2: Determine the properties of moulding sand.

CO3: Apply various welding techniques to join metals.

CO4: Make use of press tools for Blanking and piercing operations.

CO5: Develop plastic components using blow and injection moulding methods.

Mapping of COs to POs:

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

TEXT BOOKS:

1. Manufacturing Technology / P.N. Rao/TMH
2. Manufacturing Engineering and Technology/Kalpakjain S/ Pearson Edu.

REFERENCE BOOKS:

1. Production technology lab – college manual.
2. A Textbook Of Production Technology (Manufacturing Processes),P C Sharma

Effective Technical Communication

Subject Code: UGBS3A018	**L**	**T**	**P**	**C**
II B.Tech./I Sem.	**2**	**-**	**-**	**0**

SYLLABUS

Selected High GRE Words, Idioms & Phrases – Discourse Skills – using visuals – Synonyms and antonyms, word roots, one word substitutes, prefixes and suffixes, study of word origin, business vocabulary, analogy, idioms and phrases, collocations & usage of vocabulary. **(2 sessions)**

Reading Comprehension – General Vs Local Comprehension, reading for facts, guessing meanings from context, scanning, skimming, inferring meaning. **(2 sessions)**

Presentations (Technical) Group Discussion – Dynamics of Group Discussion, Intervention, summarizing, modulation of voice, body language, relevance, fluency and organization of ideas and rubrics for evaluation. **(2 sessions)**

Interview Skills – Concept and process – pre-interview planning, opening strategies, answering strategies, interview through teleconference & video-conference and mock interviews. **(3 sessions)**

COURSE OUTCOMES:

Upon the completion of the course, the student will be able to:
CO1: Develop skills in analogy, a wide range of vocabulary including business vocabulary for academic purpose.
CO2: Analyze various types of reading comprehension through different methods of reading.
CO3: Construct resumes, portfolio writing and short business/technical reports.
CO4: Make use of skills through presentations, rubrics of group discussion and Interview skills through teleconference, video conference and mock interviews.

Mapping of COs to POs:

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

SUGGESTED SOFTWARE:

1. K-Van solutions Software with CD
2. Oxford advanced learner's compass, 7th Edition

SUGGESTED READING:

1. Technical Communication by Meenakshi Raman & Sangeeta Sharma, Oxford University Press 009.
2. Business and Professional Communiction: Keys for Workplace Excellence. Kelly M. Quintanilla & Shawn T. Wahl. Sage South Asia Edition. Sage Publications. 2011.
3. English Vocabulary in Use Series, Cambridge University Press 2008.
4. Communication Skills by Leena Sen, PHI Learning Pvt. Ltd., New Delhi, 2009.
5. A Course Book of Advanced Communication Skills Lab published by University Press, Hyderabad.

II YEAR
II SEMESTER

MECHANICS OF SOLIDS

Subject Code: UGME4T0118	L	T	P	C
II Year/II Semester	2	2	0	4

UNIT-I: 13hrs

SIMPLE STRESSES & STRAINS: Elasticity and plasticity – Types of stresses & strains– Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio & volumetric strain – Elastic moduli & the relationship between them – Bars of varying section – composite bars – Temperature stresses. Complex stresses - stresses on inclined plane under different uniaxial & Biaxial stress conditions – principal planes & stresses - mohr's circle, Strain energy – Resilience – Gradual, sudden, impact and shock loadings.

UNIT-II: 13 hrs

SHEAR FORCE AND BENDING MOMENT : Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, u.d.l., uniformly varying loads and combination of these loads – Point of contra flexure – Relation between S.F., B.M and rate of loading at a section of a beam. Brief explanation of statically indeterminate beams and solution methods.

UNIT-III: 11 hrs

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

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

UNIT-IV: 9 hrs

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

UNIT-V: **9 hrs**

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

UNIT-VI: **9 hrs**

TORSION: Introduction, Torsion formula - Torsion of circular bars; Pure shear; Transmission of power by circular and hollow shafts, Stepped shafts, shafts in series, shafts in parallel.
COLUMNS: Buckling & Stability, Columns with pinned ends, Columns with other support Conditions, Limitations of Euler's Formula, Rankine's Formula.

COURSE OUTCOMES:

Upon the completion of the Course, the student will be able to
CO 1: Explain the fundamental concepts of stresses and strains in structures and mechanical components.
CO 2: Analyze shear forces, bending moments and stresses in beams of various cross sections subjected to flexural loads.
CO 3: Determine the deflection and slope at any point on a beam subjected to a combination of loads.
CO 4: Examine the internal and external pressures of cylinders by problem solving techniques.
CO 5: Determine the torsion of circular bars and stability of column under different conditions.

Mapping of COs to POs

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

TEXT BOOKS

1. Strength of Materials by S.Timshenko
2. Solid Mechanics by Popov
3. Mechanics of materials by-Ferdinand P Beer,E.Russell Johnston, and John T Dewolf.

4. Strength of Materials by R.K.Bansal

REFERENCES

1. Strength of Materials by Jindal, Umesh Publications.
2. Analysis Structure by Vazirani and Ratwani.
3. Mechanics of Structure Vol-III,byS.B.Junnarkar.
4. Strength of material by Bhavikatti,Lashmi publications.
5. Strength of Materialsby Andrew Pytel and FerdinondL.Singer Longman.
6. Strength of Materials by R.Subramania

KINEMATICS OF MACHINERY

Subject Code: UGME4T0218	**L**	**T**	**P**	**C**
II Year / II Semester	**2**	**2**	**0**	**4**

SYLLABUS:

UNIT–I: 8hrs

MECHANISMS: Elements or Links – Classification – Links – Types of kinematic pairs, constrained motion, Grubler's criteria, Grashof's law, Degree of freedom, Kutzbach criterian for planar mechanisms, Mechanism and machines – classification of machines— inversion of mechanism

LOWER PAIR MECHANISM: Exact and approximate copiers and generated types. Conditions for correct steering – Davis Steering gear, Ackermann steering gear – velocity ratio. HOOKE'S JOINT: Single and double Hooke's joint – Universal coupling – application.

UNIT–II: 7hrs

PLANE MOTION OF BODY: Instantaneous center of rotation, centroids and axodes – relative motion between two bodies – Three centres in line theorem – Graphical determination of instantaneous centre, diagrams for simple mechanisms and determination of angular velocity of points and links.

KINEMATIC ANALYSIS (position and velocity) : Position and Velocity – Motion of link in machine – Determination of Velocity diagrams – Graphical method – Application of relative velocity method four bar chain. Analysis of Mechanisms: Analysis of slider crank chain for displacement and velocity of slider.

UNIT–III: 9hrs

ACCELERATION ANALYSIS: acceleration– Determination of acceleration diagrams and Graphical method for four bar chain, slider crank mechanism, Kleins construction, Coriolis acceleration, determination of Coriolis component of acceleration.

UNIT–IV: 8hrs

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 3 cases. Analysis of motion of followers: Roller follower – circular cam with straight, concave and convex flanks.

UNIT – V: **10hrs**

GEARS: Higher pairs, friction wheels and toothed gears – types – law of gearing, condition for constant velocity ratio for transmission of motion, Form of teeth: cycloidal and involute profiles. Velocity of sliding – phenomena of interferences – Methods of interference. Condition for minimum number of teeth to avoid interference, expressions for arc of contact and path of contact – Introduction to Helical, Bevel and worm gearing.

GEAR TRAINS: Introduction – Train value – Classsifications. Methods of finding train value or velocity ratio – Epicyclic gear trains. Selection of gear box-Differential gear for an automobile.

UNIT - VI: **8hrs**

POWER TRANSMISSION: Introduction, Belt and rope drives, selection of belt drive-types of belt drives, V-belts, materials used for belt and rope drives, velocity ratio of belt drives, slip of belt, creep of belt, tensions for flat belt drive, angle of contact, centrifugal tension, maximum tension of belt, Chains- length, angular speed ratio, classification of chains.

COURSE OUTCOMES

Upon completion of this course, students should be able to:

CO1: Apply the concepts of links and joints for the mechanism of various machines
CO2: Analyse position, velocity & acceleration for the given mechanism
CO3: Analyse various mechanisms in mechanical systems.
CO4: Determine the velocity and acceleration of cam followers and develop their profiles
CO5: Familiarize with the mechanism of power transmission devices

Mapping of COs to Pos

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

TEXT BOOKS:

1. Theory of Machines by S S Rattan
2. Theory of Machines / Shiegly / MGH

REFERENCES:

1. Theory of machines – R S Khurmi & J.K Gupta
2. Theory of Machines R.K Bansal
3. Design an integrated approach Robert L.Nortan

AUTOMOTIVE PRIME MOVERS

Subject Code: UGME4T0318	L	T	P	C
II Year / II Semester	3	0	0	3

SYLLABUS

UNIT I: **12hrs**

ENGINES: classification-comparison of two-stroke and four-stroke engines- comparison of S.I. and C.I. engines-Valve timing and port timing diagrams.

ENGINE SYSTEMS: Carburetor, Fuel Injection System, Ignition, types of Cooling and Lubrication systems, the principle of Wankel engine, Introduction to Turbocharging and supercharging. Comparison of ideal and actual cycles, Time Loss Factor, Heat Loss Factor, Exhaust Blow down-Loss due to Gas exchange process, Loss due to Rubbing Friction.

UNIT-II: **6hrs**

COMBUSTION IN S.I. ENGINES: Normal combustion and abnormal combustion - Importance of flame speed and effect of engine variables - types of abnormal combustion pre-ignition and knock, Fuel requirements and fuel rating, anti-knock additives - Combustion chamber requirements and Types of the combustion chamber. Electronic fuel injection system, MPFI.

UNIT -III: **6hrs**

COMBUSTION IN C.I. ENGINES: Stages of combustion- Delay period and its importance-effect of engine variables, diesel knock. suction compression and combustion-induced turbulence, open and divided combustion chambers, Types of nozzles, Fuel requirements, and fuel rating.

UNIT –IV: **9hrs**

TESTING AND PERFORMANCE: Parameters of performance - measurement of cylinder pressure, fuel consumption, air intake, exhaust gas composition, Brake power. Determination of frictional losses and indicated power – Performance test – Heat balance sheet and chart.

UNIT-V: **6hrs**

EMISSION FROM IC ENGINES: Combustion and Exhaust Emissions, Sources of Pollution. Various emissions from Automobiles — Formation — Effects of pollutants on environment and human beings, Air pollution and their control: EGR and Catalytic Converters, Manifolds and Mufflers. Emission standards - EURO/Bharat Stage Norms: I, II, III, IV, and VI.

UNIT-VI: **9hrs**

HYDROGEN AS ENGINE FUEL Hydrogen: Properties, problems, Production methods, storage, and safety aspects. Issues & Limitations in Hydrogen. Methods of using hydrogen in engines. Performance, combustion and emission Characteristics in engines.

Hybrid and Electric Vehicles: Layout, Merits, and Demerits, Components, Electronic Control Systems. Different configurations of hybrid vehicles. Power split devices, Energy Regeneration, High energy and power density batteries, Introduction to PEM fuel cell.

Course Outcomes:

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

CO1: Classify the IC engines along with the working principles and combustion process.
CO2: Identify the functions and necessity of various systems in IC engines.
CO3: Analyse the performance parameters of IC engines.
CO4: Analyse the emissions in IC Engines.
CO5: Illustrate the importance of hybrid and electric vehicles.
CO6: Analyse the performance & emission characteristics of hydrogen as fuel in engines.

Mapping of COs to PO

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

TEXTBOOKS:

1. I.C. Engines / V. GANESAN - TMH
2. Fundamentals of Internal Combustion Engines / H. N. Gupta/ Prentice Hall of India Pvt Ltd.
3. I.C. Engines / Heywood /McGraw-Hill.
4. James Larminie, John Lowry, "Electric Vehicle Technology", Wiley publications, 1st Edition, 2003

REFERENCES:

1. IC Engines – Mathur & Sharma – Dhanpath Rai & Sons.
2. Thermal Engineering, by M.L.Mathur and F.S.Mehta, Jain Brothers.
3. Thermal Engineering – P L Bellaney / Khanna publishers.
4. Iqbal Hussein, "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, 2nd Edition, 2003.

METAL CUTTING AND MACHINE TOOLS

Subject Code: UGME4T0418	**L**	**T**	**P**	**C**
II B. Tech/II Sem.	**3**	**0**	**0**	**3**

SYLLABUS

UNIT – I : METAL CUTTING **10 Hrs.**

Introduction, Chip Formation, Shear Zone, Orthogonal Cutting, Shear Angle and Its Relevance, Nomenclature of single point cutting tool, Cutting Tool Materials, Thermal aspects, Tool Wear and Tool Life, Cutting Fluids, Merchant's force diagram, cutting forces**.**

Unit-II: MACHINE TOOLS **10 Hrs**

Classification of Machine Tools, Basic Elements of Machine Tools, Support Structures, Guide ways.

LATHE :

Introduction, Constructional Features of a Centre Lathe, Aids for Support and Location, Cutting Tools, Operations Performed in a Centre Lathe, Taper Turning Methods, Thread Cutting Methods, Special Attachments. Capstan and Turret Lathes, Automatic Lathes. Tooling Layout.

Unit -III: MILLING **13 Hrs**

Introduction, Types of Milling Machines, Milling Cutters, Milling Operations, Dividing Head, Gear Cutting.

HOLE MAKING OPERATIONS:

Introduction, Drilling, Reaming, Boring, Tapping, Other Hole Making Operations.

GRINDING:

Introduction, Grinding Wheel – Designation and Selection, Types of Grinding Machines, Grinding Process, Creep Feed Grinding.

Unit –IV: OTHER FINISHING PROCESSES: **9Hrs.**

Honing, Lapping, Broaching

OTHER MACHINE TOOLS:

Introduction to Shaper, Planer & Slotter. Working principles, Types, Quick return mechanisms.

Unit-V: JIGS AND FIXTURES: **8 Hrs.**

Introduction, Principles of design of Jigs and fixtures, Principles of location, Locating devices, Clamping devices, Typical examples of jigs and fixtures.

Unit-VI:

Introduction and need of Non-Traditional Machining methods 5 Hrs

INTRODUCTION – Need for non-traditional machining methods-Classification of modern machining processes. Applications of nontraditional machining methods.

Course Outcomes:

Upon the completion of the course, the students will able to:

CO1: Explain the principles of metal cutting and mechanism of material removal processes.

CO2: Categorize machine tools and learn various operations on lathe machine.

CO3: Apply the working principles, operations performed and different attachments in milling and hole making operations.

CO4: Choose various finishing processes to perform grinding operations.

CO5: Make use of principles and operations of Jigs & Fixtures.

CO6: Identify the need of applying unconventional machining processes.

Mapping of COs to PO

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

TEXT BOOKS:

1. Manufacturing Technology, Vol. 2, Metal Cutting and Machine Tools by P N Rao; Publisher: Tata McGraw Hill.
2. Production Technology by HMT; Publisher: Tata McGraw Hill.

REFERENCE BOOKS:

1. Manufacturing Engineering and Technology by Serope Kalpak Jain. Pub:Pearson
2. Production Technology by R. K. Jain & S. C. Gupta.
3. Workshop Technology- Vol. 2, by B. S. Raghuvamshi
4. Metal cutting and machine tools by Boothroyd

MECHANICS OF SOLIDS & METALLURGY LAB

Subject Code: UGME4P0618	**L**	**T**	**P**	**C**
II Year / II Semester	**0**	**0**	**3**	**1.5**

Mechanics of Solids Experiments:

Exp1: To study the stress-strain characteristics of mild steel bars by UTM
Exp2: To find young's modulus of the given material (steel or wood) by conducting bending test on simply supported beam.
Exp3: To find modulus of rigidity by conducting torsion test on solid circular shaft.
Exp4: To find the hardness of the given material by Brinell's Hardness test.
EXP5: To determine the hardness of the given material by Rockwell hardness tester.
EXP6: To find impact resistance of the given material by conducting Charpy / Izod test on impact testing machine.
EXP7: To determine the ultimate shear strength of steel rod in double shear.
EXP8: To determine the modulus of rigidity of the spring.
EXP9: Compression test on wood/ concrete Cubes.
EXP10: To find young's modulus of the given material (steel or wood) by conducting bending test on cantilever beam.

Metallurgy Lab Experiments:

Exp1: Preparation and study of the Microstructures of Conventional metals
Exp2: Preparation and study of the Microstructures of different types of Cast Irons
Exp3: Preparation and Study of the Microstructures of mild steels, medium carbon steels and high carbon steels.
Exp4: Study of the of Microstructures of Non-Ferrous alloys
Exp5: Study of the Microstructures of Heat treated steels
Exp6: Hardenability of steels by Jominy end Quench Test
Exp7: Hardness measurement of various treated and untreated steels
Exp8: Determination of grain size.

Course Outcomes

After completion of the course, the students would be able to:

CO1: Determine the metallurgical and mechanical properties of materials through written reports and illustrations
CO2: Examine the microstructure of ferrous and non-ferrous metals.
CO3: Measure hardness and hardenability of the metals.

CO4: Evaluating Modulus of elasticity using simply supported and cantilever beams.
CO5: Perform different tests under the conditions of tension, compression and torsional deformations of the materials.

Mapping of COs to POs

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

THERMAL ENGINEERING LAB

Subject Code: UGME4P0718	**L**	**T**	**P**	**C**
II Year / II Semester	**0**	**0**	**3**	**1.5**

Experiments:

EXP1: Valve Timing Diagram on 4-Stroke Diesel Engine.

EXP2: Port Timing Diagram on 2-Stroke Petrol Engine.

EXP3: Performance Test on 4 -Stroke Single Cylinder Diesel Engine.

EXP4: Performance Test on 2-Stroke Single Cylinder Petrol Engine.

EXP5: Heat Balance Test on 4 Stroke Single Cylinder Diesel Engine.

EXP6: Determination of Frictional Horse Power by retardation and motoring test on I. C. Engine

EXP7: Performance Test on Variable Compression Ratio Engines by economical speed test.

EXP8: Evaluation of Engine friction by conducting Morse test on 4-Stroke Multi-cylinder Petrol engine

EXP9: Performance Test on 4 -Stroke Single Cylinder Petrol Engine.

EXP10: Study of Boilers.

EXP11: Study of Assembling and Dismantling of I.C. Engines.

Course Outcomes:

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

CO1: Outline the valve timing diagram and port timing diagram of IC engines.

CO2: Analyse the performance parameters of IC engines.

CO3: Evaluate various efficiencies and energy balance for diesel and petrol engines.

CO4: Demonstrate the step-by-step procedure for dismantling and assembling of IC engines.

CO5: Demonstrate the working principle of various types of boilers.

Mapping of Cos to Pos:

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

REFERENCE BOOKS:

1. Thermal Engineering college lab manual
2. I.C. Engines / V. GANESAN- TMH
3. I.C. Engines / Heywood /McGraw Hill

Minor Project-1

UGME4J0818	L	T	P	C
II B. Tech./II Sem.	-	-	2	2

Objective: To provide students with the opportunity to synthesise knowledge from various areas of learning, and critically and creatively apply it to real life situations

COURSE OUTCOMES

At the end of the course students are able to:

CO1: Make links to across different areas of knowledge

CO2: Design, develop and evaluate ideas and information for performing specific task.

CO3: Acquire the skills to communicate effectively and to present ideas clearly and coherently to specific audience in both the written and oral forms.

CO4: Acquire collaborative skills through working in a team to achieve common goals

CO5: Learn on their own and make an appropriate action plan

Mapping of Cos to Pos:

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

ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE

Subject Code: UGBS4A0418	**L**	**T**	**P**	**C**
II Year / II Semester	**2**	**0**	**0**	**0**

UNIT I: INDIAN PHILOSOPHY & MODERN SCIENCE **2hrs.**

Origin of Indian philosophy- philosophy of Charvaka, Samkhya, Nyaya, Mimensa, Buddist and Jaina. Modern science in India

UNIT II MODERN SCIENCE IN JAIN GRANTHAS **2hrs.**

Introduction, Jain Ethics and Mortality, Non-violence and its facts: Root of non - violence, Meditation,Food, Thirthankars, Ritus, Ganadharas.

UNIT III TRADITION OF INDIAN SCIENCE **2hrs.**

Historical evaluation of medical tradition in ancient India.

Ayurveda: Principles of Ayurvedic Healing -Treating diseases to restore health.

Environmental Knowledge: Nature, flora and fauna, Manusmriti.

UNIT IV TRADITION OF INDIAN MATHS **2hrs.**

Early Historical period, Classical period, Vedic mathematics, Baskaracharya, Lilavati Bijaganitha,Srinivasa Ramanujan - Magic squares.

UNIT V HOLISTIC HEALTH **2hrs.**

History, Holistic approach: Enhance living – Mind fullness skills- Spirituality and Healing, StressManagement- Food—Work and Life style.

UNIT VI: PURE DIET AND PURE BODY **2hrs.**

Macro Nutrients: Carbohydrates, Proteins and Lipids.

Micro Nutrients: Vitamins and Minerals, Diet plans for individuals.

Yoga –Healthy Body: Introduction to Yoga, - Pranayama, Surya Namaskara and PersonalityDevelopment.

COURSE OUTCOMES

At the end of the course students are able to:

CO1: Summarize the Essence of Indian philosophy, Jain philosophy and Buddist philosophy.

CO2: Outline the evaluation process of Ayurvedic healing to restore health and tradition of Indian mathematics.

CO3: Make use of holistic health practices, spirituality ,stress management techniques for healthy life Style .

CO4: Relate with proper diet plans and Yoga practices to attain good personality.

Mapping of Cos to Pos:

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

REFERENCES

1. S. Radhakrishna, Indian Philosophy, Vol. 1 (London: George Allen and Unwin, (1962), 287.
2. J. P. Jain, Relgion and Culture of the Jains (Delhi: Bhartiya Jnanpith, 1977) 168
3. D. P. Sen Gupta, Current Science, 78 (12), 1569 (2000)
4. C. N. Srinivasa Iyengar, History of Indian Mathematics, World Press, Calcutta, 1967.
5. G. H Hardy, Ramanujan (Cambridge, 1940).
6. Nutritive Value of Indian Foods, C. Gopalan, B. V. Raman Sastri & S. C. Balasubramanian.
7. George Feuerstein: The Yoga Tradition (Its history, literature, philosophy and practice
8. Swami Sivananda Practice of Karma Yoga (The Divine Life Society, Shivananda Nagar, P.O., U.P.,Himalayas, India)

III YEAR
I SEMESTER

CAD/CAM

Subject Code: UGME5T0118	**L**	**T**	**P**	**C**
III Year / I Semester	**3**	**0**	**0**	**3**

SYLLABUS:

UNIT-I: INTRODUCTION **08hrs**

Introduction to CAD, Computers in Industrial Manufacturing, Product cycle, Raster scan, Random scan, transformation of geometry,2D and 3D transformations.

UNIT-II: GEOMETRICMODELING: **08 hrs**

Classification, Wire frame modeling, Surface modeling, Solid modeling, geometric models, geometric construction models, curve representation methods, surface representation methods, modeling facilities desired.

UNIT-III: **09hrs**

NUMERICAL CONTROL:NC, NC modes, NC elements, NC machine tools, structure of CNC machine tools.

CNC PART PROGRAMMING: Fundamentals, manual part programming methods, Computer Aided Part Programming. Computer Aided Processes Planning, Retrieval type and Generative type.

UNIT-IVCOMPUTER AIDED QUALITYCONTROL: **08hrs**

Terminology in quality control, the computer in QC, contact inspection methods, noncontact inspection methods-optical, noncontact inspection methods-non- optical, computer aided testing, integration of CAQC with CAD/CAM.

UNIT – V COMPUTER INTEGRATEDMANUFACTURINGSYSTEMS: **08hrs**

Types of Manufacturing systems, material handling systems, computer control systems, CIMS benefits

UNIT-VI INDUSTRY4.0: **08 hrs**

Introduction, Design Principles, Challenges in implementation of Industry 4.0, 6Cs of Industry 4.0, Impact of Industry 4.0

COURSE OUTCOMES:

After completion of this course, the students should be able to:
CO1: Describe the fundamental concepts and need of CAD/CAM
CO2: Compare the different types of modelling techniques and model engineering components using solid modelling
CO3: Prepare CNC part programs to manufacture industrial components
CO4: Explore different types of inspection and testing procedures in quality control
CO5: Get insight of types of automation and challenges in implementing industry 4.0.

Mapping of COs to POs

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

TEXT BOOKS:

1. CAD / CAM by A. Zimmers and P. Groover; Publisher: Prentice Hall International/Pearson Education
2. CAD/CAMPrinciplesandApplicationsbyPNRao;Publisher:TataMcGrawHill
3. CAD/CAMTheoryandPracticebyIbrahimZeid;Publisher:TataMcGrawHill
4. Industry 4.0: The industrial internet of things by AlasdairGilchrist

REFERENCES:

1. Automation, Production Systems and Computer integrated Manufacturing by Groover; publisher: PearsonEducation
2. CAD / CAM / CIM by Radhakrishnan and Subramanian; Publisher: PearsonEducation
3. Principles of Computer Aided Design and Manufacturing by Farid Amirouche; Publisher: Pearson Education
4. CAD/CAM: Concepts and Applications by Alavala; Publisher: Prentice HallInternational
5. Computer Numerical Control Concepts and programming by Warren S Seames; Publisher: Thomson

DYNAMICS OF MACHINERY

Subject Code: UGME5T0218
III Year/ I Semester

L	T	P	C
3	-	-	3

SYLLABUS:

UNIT – I: 7hrs

PRECESSION: Gyroscopes, effect of precession motion on the stability of moving vehicles such as motor car, motor cycle, aero planes and ships. Static and dynamic force analysis of planar mechanisms.

UNIT – II: 12hrs

FRICTION: Inclined plane, friction of screw and nuts, pivot and collar, uniform pressure, uniform wear, friction circle and friction axis: lubricated surfaces, boundary friction, and film lubrication.

CLUTCHES: Friction clutches- Single Disc or plate clutch, Multiple Disc Clutch, Cone Clutch, Centrifugal Clutch.

BRAKES AND DYNAMOMETERS: Simple block brakes, internal expanding brake, band brake of vehicle. Dynamometers – absorption and transmission types. General description and methods of operations.

UNIT – III: 8hrs

TURNING MOMENT DIAGRAM AND FLY WHEELS: Turning moment – Inertia Torque connecting rod angular velocity and acceleration, crank effort and torque diagrams – Fluctuation of energy – Fly wheels and their design.

UNIT – IV: 9hrs

GOVERNERS: Watt, Porter and Proell governors. Spring loaded governors – Hartnell and Hartung with auxiliary springs. Sensitiveness, isochronism and hunting.

UNIT – V: 10 hrs

BALANCING: Balancing of rotating masses Single and multiple – single and different planes.

BALANCING OF RECIPROCATING MASSES: Primary, Secondary, and higher balancing of reciprocating masses. Analytical and graphical methods. Unbalanced forces and couples – examination of "V" multi cylinder in line and radial engines for primary and secondary balancing, locomotive balancing – Hammer blow, Swaying couple, variation of tractive efforts.

UNIT – VI: 8hrs

VIBRATION: Free Vibration of mass attached to vertical spring – oscillation of pendulums, centers of oscillation and suspension. Transverse loads, vibrations of beams with concentrated and distributed loads. Dunkerly's methods, Raleigh's method. Whirling of shafts, critical speeds, torsional vibrations, two and three rotor systems. Simple problems on forced damped vibration, vibration Isolation & Transmissibility

COURSE OUTCOMES

Upon completion of this course, students should be able to:

CO1: Estimate the effect of gyroscopic couple on the stability of moving vehicles
CO2: Apply the concept of friction principles for operating clutches brakes & dynamometers
CO3: Analyze the speed variations in governors and energy fluctuations in flywheel
CO4: Balance rotating and reciprocating masses
CO5: Evaluate natural frequency for longitudinal, transverse and torsional vibrations

Mapping of COs to POs

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

TEXT BOOKS:

1. Theory of Machines / S.S Ratan/ Mc. Graw Hill Publ.
2. Theory of Machines / Shiegly / MGH

REFERENCES:

1. Theory of Machines - R S Khurmi & J.K Gupta
2. Theory of Machines / Thomas Bevan / CBS Publishers
3. Design an integrated approach Robert L. Nortan

DESIGN OF MACHINE ELEMENTS

(Design data book allowed)

Subject Code: UGME5T0318	**L**	**T**	**P**	**C**
III Year /I Semester	**2**	**2**	**0**	**4**

SYLLABUS:

UNIT-I: INTRODUCTION- STRESSES IN MACHINE MEMBERS 12hrs

INTRODUCTION: General considerations in the design of Engineering Materials and their properties –selection –Manufacturing consideration in design. Tolerances and fits –BIS codes of steels.

STRESSES IN MACHINE MEMBERS: Simple stresses – Combined stresses – Torsional and bending stresses – impact stresses – stress strain relation – Various theories of failure – factor of safety – Design for strength and rigidity – preferred numbers. The concept of stiffness in tension, bending, torsion and combined situations – Static strength design based on fracture toughness.

UNIT-II: DESIGN FOR DYNAMIC LOADING & POWER SCREWS 11hrs

DESIGN FOR DYNAMIC LOADING: Stress concentration - Theoretical stress concentration factor - Fatigue stress concentrations factor, Notch sensitivity – Design for fluctuating stresses Endurance limit – Estimation of Endurance strength – Goodman's line – Soderberg's line –Modified goodman's line.

POWER SCREWS: Types - Mechanics of power screws, efficiency, self-locking of screw and stresses in screw.

UNIT-III: DESIGN OF CURVED BEAMS 8hrs

Introduction, stresses in curved beams, Winkler-Bach formula, Expression for radius of neutral axis for rectangular, circular, trapezoidal, I and T-Section. Design of crane hooks, C –clamps.

UNIT-IV: DESIGN OF RIVETED & WELDED JOINTS 12hrs

DESIGN OF RIVETED JOINTS – types, failure of joints, and efficiency of joint. – Design of joints with initial stresses – eccentric loading - Boiler joints

DESIGN OF WELDED JOINTS -- types, failure of joints, and efficiency of joint. Strength of butt, parallel fillet and transverse fillet welded joints Stresses, Design of joints with initial stresses – eccentric loading

UNIT-V: BOLTED JOINTS 10hrs

Design of bolts with pre-stresses – Design of joints under eccentric loading – locking

devices – both of uniform strength, different seals. Torque requirement for bolt tightening. Eccentrically loaded bolted joints. Fluctuating loads on bolted joints. Joints with combined stresses

UNIT-VI: MECHANICAL SPRINGS **10hrs**

Stresses and deflections of helical springs – extension -compression springs – springs for fatigue loading, energy storage capacity – helical torsion springs – co-axial springs, leaf springs.

COURSE OUTCOMES:

Upon completion of this course, students should be able to:

CO1: Apply the design procedure to engineering problems, including the consideration of technical and manufacturing constraints.

CO2: Evaluate the stresses in machine members subjected to static and dynamic loading ensure safe design.

CO3: Determine the stresses resulting from bending of curved beams.

CO4: Design and analyze permanent joints under Static and Eccentric loading conditions.

CO5: Design and analyze temporary joints subjected to Static and Eccentric loading conditions.

CO6: Analyze the stresses for designing a spring.

Mapping of COs to POs

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

TEXT BOOKS:

1. Machine Design, V.BandariTmh Publishers
2. Machine Design, RS Khurmi, JK Gupta, S Chand
3. Machine Design, S MD Jalaludin, AnuRadha Publisher

4. Design Data hand Book, S MD Jalaludin, AnuRadha Publishers

REFERENCES:

1. Design of Machine Elements / V.M. Faires
2. Machine design / Schaum Series.
3. Machine design – Pandya& shah.
4. Data books (1) PSG College of technology (2) Mahadevan

AUTOMOBILE ENGINEERING

Subject Code: UGME5T0518	L	T	P	C
III Year / I Semester	3	0	0	3

(PROFESSIONAL ELECTIVE - I)

SYLLABUS:

UNIT I: **6hrs**

INTRODUCTION: Classification of Automobiles, Components of four wheeler automobile – chassis, Layout of Chassis, Types of Automobile Chassis, Body, Types of Automobile body– Drive Layouts of Automobiles – rear wheel drive, front wheel drive, 4 wheel drive

UNIT-II: **10hrs**

TRANSMISSION SYSTEM: Clutches, principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel – gear boxes, types, sliding mesh, construct mesh, synchronomesh gear box, epicyclic gear box , over drive torque converter. Propeller shaft Hotch – Kiss drive, Torque tube drive, universal joint, differential rear axles –types – wheels and tyres.

UNIT -III: **8hrs**

STEERING SYSTEM: Steering geometry – camber, castor, king pin rake, combined angle toe in, center point steering. Components steering system and of steering linkages, Types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism, power steering, steering gears – types - Under steer and Over steer.

SUSPENSION SYSTEM: Objectives of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system - Pneumatic suspension system.

UNIT –IV: **6hrs**

ELECTRICAL SYSTEM: Charging circuit, generator, current – voltage regulator – starting system, bendix drive mechanism solenoid switch, lighting systems, Horn, wiper, fuel gauge – oil pressure gauge, engine temperature indicator etc.

UNIT-V: **10hrs**

BRAKING SYSTEM: Mechanical brake system, Hydraulic brake system, Master cylinder, wheel cylinder tandem master cylinder Requirement of brake fluid, Pneumatic and vacuum brakes.

SAFETY SYSTEMS: Introduction to safety systems, seat belt, airbags, bumper Antilock brake system (ABS), Electronic Stability Program (ESP), wind shield, traction control, mirrors Central locking and electrical windows, speed control.

UNIT-VI: **8hrs**

EMISSION FROM AUTOMOBILES – Combustion and Exhaust Emissions, Air pollution and their control: EGR and Catalytic Converters, EURO/Bharat Stage Norms: I, II, III, IV and V., Manifolds and Mufflers, Engine Cooling and Lubrication.

ENGINE SERVICE: Introduction Service details of engine cylinder head, valves and valve mechanism Piston-connecting rod assembly, cylinder block crank shaft and main bearings engine service, reboring, decarburization, Nitriding of crank shaft. Engine reassembly-precautions

Course Outcomes:

Upon the completion of the course, the students will able to:

CO1: Identify different types of automobile vehicles and their category

CO2: Analyze different components necessity and their working related to transmission system from power unit to wheels

CO3: Explain the necessity and working of controlling systems like steering, braking and suspension

CO4: Identify different causes for troubles faced during the operation of engine and their remedies

CO5: Illustrate the vehicle safety systems and emission control methods

Mapping of COs to PO

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

TEXT BOOKS:

1. Automobile Engineering – Vol. 1 & Vol. 2 / Kirpal Sing.
2. Automobile Engineering – KK Jain/ RB Asthana, Tata McGraw Hill Publishing Company Ltd

REFERENCES:

1. Automotive Engineering / Newton Steeds & Garrett
2. Automotive Mechanics / G.B.S. Narang
3. Automotive Mechanics / Heitner
4. Automotive Engines / Srinivasan
5. Automobile Engineering – K.K. Ram lingam / SciTech Publications (India) PVT.

DESIGN FOR MANUFACTURING
(PROFESSIONAL ELECTIVE-I)

Subject Code: UGME5T0618	**L**	**T**	**P**	**C**
III B. Tech/I Sem.	**3**	**0**	**0**	**3**

SYLLABUS

UNIT-I: INTRODUCTION **8 hrs**

Design philosophy, Steps in design process, General design rules for manufacturability, Basic principles of designing for economical production, Creativity in design.

MATERIALS

Selection of materials for design, Criteria for material selection, Material selection interrelationship with process selection, Process Selection charts.

UNIT-II: METAL CASTING **6 hrs**

Appraisal of various casting processes, Selection of casting process, General design considerations for casting, Casting tolerances, Use of solidification simulation in casting design, Product design rules for sand casting

UNIT-III: MACHINING PROCESS **8 hrs**

Overview of various machining processes, General design rules for machining, Dimensional tolerance and surface roughness, Design for machining ease, Redesigning of components for machining ease with suitable examples, General design recommendations for machined parts.

UNIT-IV **10 hrs**

METAL JOINING

Appraisal of various welding processes, Factors in design of weldments, General design guidelines - Pre and post treatment of welds, Effects of thermal stresses in weld joints, Design of brazed joints**.**

FORGING

Design factors for Forging, Closed die forging design, Parting lines of die drop forging die design, General design recommendations.

UNIT-V: EXTRUSION AND SHEET METAL WORK **8 hrs**

Design guidelines for extruded sections, Design principles for Punching, Blanking, Bending, Deep Drawing, Keeler Goodman Forming Line Diagram, Component design for Blanking.

UNIT-VI: DESIGN OF MANUAL ASSEMBLY **8 hrs**

General design guidelines for manual assembly, Development of the systematic DFA methodology, Assembly efficiency, Classification system for manual handling, Classification system for manual insertion and fastening, Effect of part symmetry on handling time, Effect of part thickness and size on handling time, Effect of weight on handling time.

COURSE OUTCOMES:

Upon the completion of the Course, the student will be able to

CO1: Summarize the concept of design and procedure for material selection.
CO2: Explain the design principles of casting and the design rules for sand casting.
CO3: List the design rules for machining.
CO4: Apply the design concepts for metal joining and forging processes.
CO5: Design procedures for metal forming applications.
CO6: Develop the design guidelines for manual handling of parts and their assembly.

Mapping of COs to POs

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

TEXT BOOKS:

1. Assembly Automation and Product Design by Geoffrey Boothroyd, Marcel Dekker Inc.,
2. Engineering Design – Material and Processing Approach by George E. Dieter, McGraw Hill Intl.

REFERENCES:

1. Hand Book of Product Design by Geoffrey Boothroyd, Publisher: Marcel and Dekker
2. Computer Aided Assembly Planning by A. Delchambre, Publisher: Springer

TOOL DESIGN

(PROFESSIONAL ELECTIVE-I)

Subject Code: UGME5T0718	**L**	**T**	**P**	**C**
III B.Tech/ ISem.	**3**	**-**	**-**	**3**

SYLLABUS

UNIT-1: Metal cutting process: 8hrs

Selection of tool materials - Design of single point and multipoint cutting tool - Form tools, Drills, Milling cutters, broaches and chip breakers – Problems on design of single point cutting tools only.

UNIT-II: Locating and Clamping Methods: 8hrs

Basic Principles of Location - Locating methods and devices - Principles of clamping - Mechanical, Pneumatic and Hydraulic actuation - Clamping force analysis - Design problems.

UNIT-III: Types of drill jigs– 8hrs

General considerations in the design of drill jigs - Drill bushings -Types, methods of construction - Simple designs of Plate, Channel, Boxes, Post, Angle plate, Turnovers and Pot Jigs.

UNIT-IV :Design of Fixtures 8hrs

Design principles - Types of fixtures - Fixtures for machine tools: Lathe, Milling, Boring, Broaching and grinding - Assembly fixtures - Inspection and Weldingfixtures

UNIT-V: Design of Dies 8 hrs

Press tools - Fundamentals of die-cutting operations - Cutting action in punch and die operations - Die clearance - Blanking and Piercing Die construction – Pilots - Strippers and Pressure Pads - Press work materials - Strip layout.

Unit VI: Design of Progressive and Compound die: 8 hrs

Design of simple progressive and compound die sets - Forging Die – Flow lines, parting lines, open and close die forging; Materials for die block.

Course Outcomes:

Student will be able to

CO1: Learn the design procedures for single and multi point cutting tools

CO2: Understand the principles of locating and clamping

CO3: Apply the design principles for Jigs and Fixtures

CO4: Design press tools for blanking and piercing operations

CO5: Familiarized with the design procedures for forging

Mapping of COs to Pos

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

Text Books

1. Donaldson C., Lecain G.H. and Goold V.C. (2007), Tool Design, 3rd edition, Tata McGrawHill Publishing Company Ltd., New Delhi.

References

1. Joshi P. H., (2004) Jigs and Fixtures, 2nd Edition, Tata McGraw-Hill Publishing Company Ltd., NewDelhi.
2. Edward G. Hoffman (2004) Jigs and Fixtures Design, Thomson - Delmar Learning Series,Singapore.
3. Jeff Lantrip, David A. Smith and John G. Nee, (2003) Fundamentals of Tool Design, 5th Edition, Society of ManufacturingEngineers.

COMPUTER AIDED DESIGN LABORATORY

Subject Code: UGME5P0818	**L**	**T**	**P**	**C**
III Year / I Semester	**0**	**0**	**3**	**1.5**

Experiments:

EXP 1: Drafting of Orthographic views with Dimensioning

a. Fork
b. Anchor Bracket

EXP 2: Drafting of Isometric views with Dimensioning

a. Sliding Support
b. Centering Bearing

EXP 3: Part Modelling

a. Crane hook
b. Shaft Bracket
c. Gear

EXP 4: Assembly Modeling (Any Three)

a. Universal Coupling
b. Oldham Coupling
c. Screw jack
d. Knuckle Joint
e. Stuffing Box

EXP 5: Sheet Metal design (Any Two exercises)

COURSE OUTCOMES

After completion of this course, the students should be able to:

CO1: Familiarize with the basic commands of CAD software
CO2: Construct sketches using modelling software
CO3: Generate part models of machine components
CO4: Assemble various parts of machine elements and draft their orthographic views

CO5: Design sheet metals for various engineering applications

Mapping of COs to PO

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

REFERENCES:

1. CAD / CAM by A. Zimmers and P. Groover; Publisher: Prentice HallInternational/Pearson Education
2. CAD/CAM Principles and Applications by P N Rao; Publisher: Tata McGrawHill
3. CAD LAB CollegeManual.

MACHINE TOOLS LAB

Subject Code: UGME5P0918	**L**	**T**	**P**	**C**
III Year / I Semester	**0**	**0**	**3**	**1.5**

Experiments:

EXP1: Perform step turning operation using Lathe machine.

EXP2: Perform knurling operation on the given workpiece using a Lathe machine.

EXP3: Prepare a flat surface by using the Surface grinding machine.

EXP4: Perform Taper turning operation on the given workpiece using lathe machine.

EXP5: Perform thread-cutting operation on the given workpiece using a Lathe machine.

EXP6: Produce V- grooves on the given workpiece by performing shaping operation using a Shaping machine.

EXP7: Produce a keyway slot in the given workpiece by performing a slotting operation using the Slotting machine.

EXP8: Machine a spur gear to the given module and the number of teeth in the given workpiece using the Milling machine.

EXP9: Produce a hole by drilling and tapping operations on the given workpiece using a Radial Drilling machine.

EXP10: Grinding of Tool angles with Tool and Cutter Grinder.

Course Outcomes:

After completion of the course, the students would be able to:

CO1: Perform various operations on a lathe machine
CO2: Perform drilling and tapping operations on a drilling machine
CO3: Generate gears using the milling machine
CO4: Produce keyways & slots using shaping and slotting machines
CO5: Produce a finished surface on the given workpiece using a surface grinding machine

Mapping of COs to POs:

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

CO4	3	-	-	-	-	-	-	-	-	-	-	-	3	3
CO5	3	-	-	-	-	-	-	-	-	-	-	-	3	3

REFERENCE BOOKS:

Machine tools college lab manual.

COMPUTER AIDED MANUFACTURING and 3D PRINTING LABORATORY

Subject Code: UGME5P1018	**L**	**T**	**P**	**C**
III Year / I Semester	**0**	**0**	**3**	**1.5**

Computer Aided Manufacturing

Experiments:

1. Part programming for Turning, Facing, Chamfering, Grooving, Step turning, Taper turning operations.
2. Part programming for Point to point motions, Linear motions, Circular interpolation, Contour motion, Pocket milling - Circular, Rectangular and Mirror commands.
3. Part Programming using Fixed or Canned Cycles for Drilling, Peck drilling, Boring, Tapping, Turning, Facing, Taper turning, Thread cutting.
4. Generation of tool path, NC part program and its simulation.
5. Machining of given profiles using CNC Mill.
6. Development of NC code for free form and sculptured surfaces using CAM packages.

3D Printing Experiments:

1. Introduction to the Process of fabricating a prototype using FDM RP machine,
    i. Generate STL files from the CAD Models.
    ii. Process the CAD data in the software (Selection of Orientation, Supports generation, Slicing, Tool path generation).
    iii. Fabricate the given physical part on FDM RP machine.
    iv. Remove the supports & post processing (cleaning the surfaces).
2. Fabricate a prototype of Simple Gear on FDM RP machine.
3. Fabricate a prototype of Engine Mounting Bracket on FDM RP machine.
4. Fabricate a prototype of Planetary gear on FDM RP machine.
5. Fabricate a prototype of Connecting Rod on FDM RP machine.
6. Fabricate a prototype of Crane Hook on FDM RP machine.

Course Outcomes:

After completion of the course, the students would be able to:

CO1: Prepare part programs for turning and milling operations using simulation software.
CO2: Produce components with different features using CNC machines and machining canters.
CO3: Generate 3D model by using modelling software and develop the part on rapid prototyping machine
CO4: Optimize the process parameters of FDM machine to improve the quality of the parts produced.
CO5: Build complex engineering assemblies in plastic material with less process planning.

Mapping of COs to POs

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

REFERENCE BOOKS:

1. CAD / CAM by A. Zimmers and P. Groover; Publisher: Prentice Hall International/ Pearson Education
2. CAD/CAM Principles and Applications by P N Rao; Publisher: Tata McGrawHill
3. Cam Lab College Manual.
4. 3D Printing Lab College Manual.

QUANTITATIVE ABILITY

Subject Code: UGBS5A0118	**L**	**T**	**P**	**C**
III B. Tech/I Sem.	**2**	**-**	**-**	**-**

UNIT	**TOPICS**
I	**Ratio, Proportion & Variation Ratio**-Duplicate, Triplicate, Sub-Duplicate, Sub-Triplicate and Inverse Ratio-Proportion - Mean, Third and Fourth Proportional - Rules of Proportion, Variation-Direct, Inverse and Joint variations
II	**Percentages** Percentage-Conversion of fraction to percentage and Percentage to Fraction-percentage excess & shortness, Effect of percentage change on a number-Effect of two step change-Effect of percentage change on product
III	**Simple & Compound Interest** Simple Interest-Effect of change in principal, Rate of interest or Time period-Interest as Multiples of principal-equal installment to repay-Compound Interest-Conversion period-Formula for EMI.
IV	**Profit, Loss &Discount** Cost price, selling price-Gain-Loss-Percentage-Relation among Cost price& selling price, Gain %, Loss %-Discount-Marked Price-Use of False Scale, %Gain or % Loss on Selling Price
V	**Partnership** Partners-Managing-sleeping – investment ratio - profit ratio - Investmentfor different durations
VI	**Time & Distance:** Speed - Average Speed - problems on trains - Relative speed - Boats and streams – Races - Flat & Circular.
VII	**Mixtures & Alligation:** Ratio of Mixtures-Mean price-Rule of Alligations.
VIII	**Time & Work:** Rate of work - Work as a single unit - No. of persons working together - No. of man days.Pipes & Cisterns: Pipe – Drain - Amount of workdone-Time to fill tank.

Course Outcomes:

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

CO1: Build a strong base in fundamentals of Arithmetic.
CO2: Illustrate the approaches and strategies to solve problems with speed and accuracy.
CO3: Develop appropriate skills to succeed in the selection process for recruitment.

Mapping of COs to POs

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

Reference Books:

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, 4th ed., TMH Publications.
2. Dinesh Khattar, The Pearson guide to Quantitative Aptitude for Competitive Exams, 3rd ed.,Pearson.
3. R.S. Aggarwal, Quantitative Aptitude, S.Chand Publications
4. R.S. Aggarwal, Objective Arithmetic, S. Chand Publications
5. M.Tyra, Magical book on Quicker Maths, BSC Publishing Co. Pvt. Ltd.

III YEAR
II SEMESTER

THERMAL SYSTEMS

Subject Code : UGME6T0118	**L**	**T**	**P**	**C**
III Year/ II Semester	**3**	**0**	**0**	**3**

SYLLABUS:

UNIT-I: STEAM BOILERS: 10hrs

BOILERS: Classification – Working principles of H.P. and L.P Boilers.

Performance, equivalent evaporation, efficiency and heat balance –Boiler Draught-Classification – Height of chimney for given draught and discharge, condition for maximum discharge, efficiency of chimney – artificial draught, induced and forced. Functions of mountings and accessories.

UNIT-II:STEAM NOZZLES AND STEAM CONDENSERS: 10hrs

STEAM NOZZLES: Function of nozzle – applications - types, Flow through nozzles, thermodynamic analysis – assumptions -velocity of fluid at nozzle exit-Ideal and actual expansion in nozzle, velocity coefficient, condition for maximum discharge, critical pressure ratio, criteria to decide nozzle shape: Super saturated flow, its effects, degree of super saturation - Wilson line.

STEAM CONDENSERS: Requirements of steam condensing plant – Classification of condensers – working principle of different types – vacuum efficiency and condenser efficiency – air leakage, sources and its affects, air pump- cooling water requirements and types.

UNIT-III:STEAMTURBINES: 10hrs

IMPULSE TURBINES: Classification – Impulse turbine; Mechanical details – Velocity diagram – effect of friction – power developed, axial thrust, blade or diagram efficiency – condition for maximum efficiency. De-Laval Turbine - its features. Methods to reduce rotor speed-Velocity compounding and pressure compounding, Velocity-pressure compounding, Velocity and Pressure variation along the flow – combined velocity diagram for a velocity compounded impulse turbine, condition for maximum efficiency.

REACTION TURBINES: Mechanical details – principle of operation, thermodynamic analysis of a stage, degree of reaction –velocity diagram – Parson's reaction turbine – condition for maximum efficiency, calculation of blade height.

UNIT-IV: GAS TURBINES AND JET PROPULSION ENGINES: 10hrs

GAS TURBINES : Simple gas turbine plant – Ideal cycle, essential components – parameters of performance – actual cycle – regeneration, inter cooling and reheating –

Closed and Semi-closed cycles – merits and demerits, types of combustion chambers.

JET PROPULSION : Principle of Operation –Classification of jet propulsive engines – Working Principles with schematic diagrams and representation on T-S diagram - Thrust, Thrust Power and Propulsion Efficiency – Turbo jet engines – Needs and Demands met by Turbo jet – Schematic Diagram, Thermodynamic Cycle, Performance Evaluation, Thrust Augmentation – Methods.

ROCKETS: Application – Classification - Working Principle, Propellant Type Solid and Liquid propellant Rocket Engines.

UNIT-V: RECIPROCATING AND ROTARY COMPRESSORS: 9hrs

COMPRESSORS –Classification. **Reciprocating Compressors**: Principle of operation, work required, Isothermal efficiency, volumetric efficiency and effect of clearance, stage compression, under cooling, saving of work, minimum work condition for stage compression.

ROTARY (POSITIVE DISPLACEMENT TYPE): Roots Blower, vane sealed compressor –mechanical details and principle of working – efficiency considerations.

UNIT-VI: DYNAMIC AND AXIAL FLOW COMPRESSORS: 10hrs

DYNAMIC COMPRESSORS: Centrifugal compressors: Mechanical details and principle of operation – velocity and pressure variation. Energy transfer-impeller blade shape-losses, slip factor, power input factor, pressure coefficient and adiabatic coefficient – velocity diagrams – power.

AXIAL FLOW COMPRESSORS: Mechanical details and principle of operation – velocity triangles and energy transfer per stage degree of reaction, work done factor - isentropic efficiency- pressure rise calculations –Polytrophic efficiency, advancements in compressor technologies.

COURSE OUTCOMES:

At the end of the course students are able to:

CO 1. Illustrate the working of various types of boilers and their mountings, accessories and determine their efficiencies.

CO 2. Analyze the flow of steam through nozzles and performance of steam condensers.

CO 3. Determine the performance of Steam & Gas turbines.

CO 4. Explain the working of Jet propulsion and Rocket propulsion engines.

CO 5. Calculate the power and efficiencies of different types of compressors.

Mapping of COs to PO

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

TEXT BOOKS:

1. Thermal Engineering / R. K. Rajput / Lakshmi Publications
2. Thermal Engineering-P. L. Bellaney/ Khanna publishers.
3. Gas Turbines – V. Ganesan /TMH
4. Thermal Science and Engineering – D. S. Kumar

REFERENCES:

1. Thermodynamics and Heat Engines / R. Yadav / Central Book Depot
2. Gas Turbines and Propulsive Systems – P. Khajuria & S. P. Dubey - / Dhanpatrai.
3. Gas Turbines / Cohen, Rogers and Saravana Muttoo / Addison Wesley – Longman.
4. Thermal Engineering-M. L. Marthur & Mehta/Jain bros.

DESIGN OF TRANSMISSION ELEMENTS

(Design data book allowed)

Subject Code: UGME6T0218	**L**	**T**	**P**	**C**
III Year/ II Semester	**3**	**0**	**0**	**3**

SYLLABUS:

UNIT-I: BEARINGS **12hrs**

Types of Journal bearings – Lubrication – Bearing Modulus – Full and partial bearings – Clearance ratio – Heat dissipation of bearings, bearing materials – journal bearing design – Ball and roller bearings – Static loading of ball & roller bearings, Bearing life.

UNIT-II: ENGINE PARTS **10hrs**

Connecting Rod: Thrust in connecting rod – stress due to whipping action on Connecting rod ends – Cranks and Crank shafts, strength and proportions of over hung and center cranks – Crank pins, Crank shafts. Pistons, Forces acting on piston – Construction Design and proportions of piston. Cylinder, Cylinder liners.

UNIT-III: KEYS, COTTERS AND KNUCKLE JOINTS **10hrs**

Design of Keys-stresses in keys-cotter joints-spigot and socket, sleeve and cotter, jib and cotter joints- Knuckle joints.

UNIT-IV: SHAFTS & SHAFT COUPLING **10hrs**

SHAFTS: Design of solid and hollow shafts for strength and rigidity – Design of shafts for combined bending and axial loads – Shaft sizes – BIS code.

SHAFT COUPLING: Rigid couplings – Muff, Split muff and Flange couplings. Flexible couplings –Flange coupling (Modified).

UNIT-V: POWER TRANSMISSIONS SYSTEMS, PULLEYS **12hrs**

Transmission of power by Belt and Rope drives, Transmission efficiencies, Belts – Flat and V types – Ropes - pulleys for belt and rope drives, Materials, Chain drives.

UNIT-VI: SPUR & HELICAL GEAR DRIVES **10hrs**

Spur gears- Helical gears – Load concentration factor – Dynamic load factor. Surface compressive strength – Bending strength – Design analysis of spur gears – Estimation of center distance, module and face width, check for plastic deformation. Check for dynamic and wear considerations.

Course Outcomes:

Upon the completion of the course, the students will able to:

CO1: Select the suitable bearing based on the application of the loads, speeds and predict the life of the bearing.

CO2: Design internal combustion engine components for safe and continuous operation.

CO3: Analyze and Design shafts, keys and couplings under loading conditions.

CO4: Select the belt, rope and chain drives from manufacturers catalogues under given loading conditions.

CO5: Apply the design concepts to estimate the strength of the gear.

Mapping of COs to POs

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

TEXT BOOK:

1. Machine Design, V.BandariTmh Publishers
2. Machine Design, S MD Jalaludin, Anuradha Publishers
3. Machine Design, RS Khurmi, JK Gupta, S Chand
4. Machine Design, Kannaiah/ Scietech.
5. Design Data hand Book, S MD Jalaludin, Anuradha Publishers
6. Machine Design, Pandya & Shaw, Charotar publishers

REFERENCES:

1. Machine Design / R.N. Norton
2. Data Books: (I) P.S.G. College of Technology (ii) Mahadevan
3. Mech. Engg. Design / JE Shigle.

FINITE ELEMENT METHOD

Subject Code:	**L**	**T**	**P**	**C**
UGME6T0318				
III Year / II Semester	**2**	**2**	**0**	**4**

SYLLABUS

UNIT-I: INTRODUCTION TO FINITE ELEMENT METHOD 13hrs

Discretization of domain, element shapes, discretization procedures, assembly of stiffness matrix, band width, node numbering, mesh generation, interpolation functions, local and global coordinates, convergence requirements, treatment of boundary conditions. stress and equilibrium, strain – displacement relations, stress – strain relations, variational and weighted residual methods, concept of potential energy.

UNIT-II: 1D ELEMENTS 11hrs

Types of 1D elements, Displacement function, Global and local coordinate systems, Order of element, shape functions and its properties. Formulation of elemental stiffness matrix and load vector for spring and bar. Assembly of global stiffness matrix and load vector, Stress calculations

UNIT -III 11hrs

ANALYSIS OF TRUSSES

Finite element modeling coordinates and shape functions, assembly of global stiffness matrix and load vector, finite element equations, treatment of boundary conditions, stress, strain and support reaction calculations.

ANALYSIS OF BEAMS

Element stiffness matrix for Hermite beam element, derivation of load vector for concentrated and UDL, simple problems on beams.

UNIT –IV: AXISYMMETRIC PROBLEMS 13hrs

plane stress and plane strain conditions, Finite element modeling of two-dimensional stress analysis with constant strain triangles and treatment of boundary conditions, formulation of axisymmetric problems.

UNIT-V: ISOPARAMETRIC ELEMENTS 9hrs

One dimensional quadratic and cubic elements in natural coordinates, two dimensional four noded isoparametric elements and numerical integration.

UNIT-VI **10hrs**

DYNAMIC ANALYSIS

Formulation of finite element model, element consistent and lumped mass matrices, evaluation of eigen values and eigen vectors, free vibration analysis.

STEADY STATE HEAT TRANSFER ANALYSIS : Introduction, Governing differential equation, steady-state heat transfer formulation of 1D element for conduction and convection problem, boundary conditions and solving for temperature distribution.

Course Outcomes:

Upon the completion of the course, the students will able to:

CO1: Explaining the basic concepts of FEM. And apply the concepts of minimum potential energy principles, weighted residual methods to solve structural mechanics problems.

CO2: Apply the finite element procedures to solve 1-D element problems.

CO3: Apply the finite element procedure for stress analysis and design of load carrying structures.

CO4: Apply the FEM procedures to solve axisymmetric problems.

CO5: Apply the finite element procedures for iso parametric elements and numerical integration

CO6: Estimate Eigen values and eigenvectors to find natural frequency and mode shapes for simple dynamic systems and 1-D heat transfer analysis.

Mapping of COs to PO

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

TEXT BOOKS:

1. Introduction to Finite Elements in Engineering, 2E, by Tirupathi R. Chandrupatla, Ashok D. Belegundu; Publisher: Prentice Hall of India.

REFERENCES:

1. Finite Element Method by Zienkiewicz.
2. An Introduction to Finite Element Methods by J. N. Reddy.
3. Finite Element Method by S. S. Rao.

PRODUCTION PLANNING AND CONTROL
(PROESSIONAL ELECTIVE-II)

Subject Code: UGME6T0518	**L**	**T**	**P**	**C**
III Year / II Semester	**3**	**0**	**0**	**3**

SYLLABUS:

UNIT-I: INTRODUCTION **6hrs**

Definition – Objectives of production planning and control – Functions of production planning and control – Elements of production control – Types of production – Organization of production planning and control department – Internal organization of department.

UNIT-II: **8hrs**

Forecasting - Importance of forecasting – Types of forecasting and their uses – General principles of forecasting - Forecasting techniques – qualitative methods and quantitative methods.

UNIT -III: **9hrs**

Inventory management – Functions of inventories – relevant inventory costs – ABC analysis – VED analysis – EOQ model.
Introduction to MRP & ERP, LOB (Line of Balance), JIT inventory.

UNIT-IV: **9hrs**

Routing – Definition – Routing procedure –Route sheets – Bill of material – Factors affecting routing procedure.

UNIT-V: **9hrs**

Schedule – definition, Scheduling Policies – Techniques, Standard scheduling methods. Implement various scheduling techniques to schedule shop floor activities of the industry, Introduction to Aggregate planning, Chase planning, Expediting.

UNIT-VI: **8hrs**

Dispatching – Activities of dispatcher – Dispatching procedure – follow up – definition types of follow up, applications of computer in production planning and control.

Course Outcomes:

At the end of the course students are able to:

CO1: Explain the basic concepts and explain the functions of production planning and control

CO2: Appraise different forecasting techniques and estimate the future demand of product

CO3: Optimize the inventory parameters to minimize the total variable cost

CO4: Apply different planning tools for better management of production system

CO5: Illustrate the duties of dispatcher and functions of follower.

CO6: Appreciate the role of computers in Production Planning and control

Mapping of COs to POs

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

TEXT BOOKS:

1. Elements of Production Planning and Control / Samuel Eilon.
2. Modern Production/ operation managements / Baffa & Rakesh Sarin

REFERENCE BOOKS:

1. Operations Management – S.N. Chary.
2. Inventory Control Theory and Practice / Martin K. Starr and David W. Miller.
3. Production Control A Quantitative Approach / John E. Biegel.
4. Operations Management / Joseph Monks.

ROBOTICS (PROFESSIONAL ELECTIVE-II)

Subject Code:UGME6T0618	**L**	**T**	**P**	**C**
III B. Tech/II Sem.	**3**	**0**	**0**	**3**

Syllabus

UNIT-1: Introduction to Robotics **6hrs**

Major component of a robot, robotic like devices, classification of robots – Classification by coordinate system and by control method, Precision of movement, Specifications of robots, fixed versus flexible automation, economicanalysis.

UNIT-II: Robot end Effectors **8 hrs**

Introduction, end effectors, types of end effectors, grippers, classification of grippers, Gripper mechanisms, Other types of grippers-Vacuum cups, Magnetic grippers, adhesive grippers and miscellaneous types. Tool as end effectors, Interfacing, considerations in gripper selection and design, remote centered devices. **Machine Vision:** Introduction, Functions of machine vision, applications of machine vision

UNIT-III: TRANFOMATIONS AND KINEMATICS **10 hrs**

TRANSFORMATIONS Homogeneous coordinates, transformations as applicable to translation, rotation, problems.

KINEMATICS: Introduction to Robot Kinematics-forward solution, Denavit-Hartenberg (D-H) Notation, Forward kinematics, Simple problems involving planar manipulators, Simple inverse kinematic problems.

UNIT-IV:ROBOT DYNAMICS **8 hrs**

Differential transformation and manipulators, Jacobians – problems. Dynamics: Lagrange – Euler and Newton – Euler formations – Problems.

UNIT-V: Robotic Sensory Devices **8hrs**

Objective, Non-optical position sensors – potentiometers, synchros, optical position sensors – opto interrupters, optical encoders (absolute & incremental).

Proximity sensors: Contact type, non contact type – reflected light scanning laser sensors. **Touch & slip sensors :** Tactile sensors – proximity rod & photo detector sensors, slip sensors – Forced oscillation slip sensor, interrupted type slipsensors.

UNIT-VI: Robot Application In Manufacturing **8hrs**

Material Transfer, Material handling, loading and unloading, Processing, spot and continuous arc welding & spray painting Assembly and Inspection.

Course Outcomes:

Upon completion of this course the students will be able to

CO1: Demonstrate the knowledge of industrial robots and their characteristics, endeffectors, actuators

CO2: Apply spatial transformation to obtain forward and reverse kinematics

CO3: Solve robot dynamics Problems

CO4: Learn the working principle of robot sensory devices and machine vision system

CO5: Acquire the knowledge of robot applications in manufacturing

Mapping of COs to POs

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

TEXT BOOKS :

1. Industrial Robotics / Groover M P /PearsonEdu.
2. Robotics and Control / Mittal R K & Nagrath I J /TMH.
3. Robotic Engineering by Richard D.Klafter, Prentice Hall, Tata Mc Graw-Hill, 1995. 3rd Edition.

REFERENCES :

1. Robotics / Fu K S/ McGrawHill.
2. An Introduction to Robot Technology, / P. Coiffet and M. Chaironze / Kogam Page Ltd. 1983London.
3. Robotic Engineering / Richard D. Klafter, PrenticeHall
4. Robot Analysis and Intelligence / Asada and Slow time / WileyInter-Science.

RAPID PROTOTYPING (PROFESSIONAL ELECTIVE-II)

Subject Code: UGME6T0718	**L**	**T**	**P**	**C**
III Year / II Semester	**3**	**0**	**0**	**3**

SYLLABUS:

UNIT-I: INTRODUCTION **7hrs**

Prototyping fundamentals, Historical development, Fundamentals of rapid Prototyping, Advantages and Limitations of Rapid Prototyping, commonly used Terms, Classification of RP process, Rapid Prototyping Process chain, Fundamental Automated process Chain.

UNIT-II: **6hrs**

LIQUID- BASED RAPID PROTOTYPING SYSTEMS: Stereo lithography Apparatus (SLA): Models, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning. Applications, Advantages and Disadvantages, Solid ground curing (SGC): Models, Process, working principle, Applications, Advantages and Disadvantages.

UNIT -III: **8hrs**

SOLID- BASED RAPID PROTOTYPING SYSTEMS: Laminated Object manufacturing (LOM): Models, Process, working principle, Applications, Advantages and Disadvantages. Fused Deposition Modeling (FDM): Models, Process, working principle, Applications, Advantages and Disadvantages. Paper Lamination Technology (PLT)

UNIT –IV: **9hrs**

POWDER BASED RAPID PROTOTYPING SYSTEMS: Selective lased sintering (SLS): Models, Process, working principle, Applications, Advantages and Disadvantages- Three dimensional printing(3DP): Models, Process, working principle, applications, Advantages and Disadvantages. Laser Engineered Net Shaping (LENS)

UNIT-V: **10hrs**

RAPID TOOLING: Introduction to rapid Tooling (RT), Conventional Tooling Vs. RT, Need for RT, Rapid Tooling classification: Indirect Rapid Tooling Methods: Spray Metal Deposition, Ceramic tools, Die casting Sand casting, 3D Keltool process. Direct Rapid Tooling methods: Direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP

RAPID PROTOTYPING FORMATS: STL Format, STL File problems Consequence of

Building valid and invalid tessellated model.

UNIT-VI: 8hrs

Rapid prototyping software's: Features of various RP software's like Magics, Mimics, solid view, view Expert, 3D view, velocity 2, Rhino, STL view 3 Data expert and 3D doctor.

RP APPLICATIONS: Application – Material Relationship, Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture. RP Medical and Bioengineering applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Bimolecular.

Course Outcomes:

At the end of the course students are able to:

CO1: Assess the need of RPT in product development
CO2: Get acquainted with the working principles & applications of liquid, solids and powder based RPT systems
CO3: Judge the correct RPT process for product/prototype development.
CO4: Use appropriate rapid tooling software for development of prototype model
CO5: Figure out the technical challenges in 3D printing
CO6: Learn the application of Rapid prototyping in various industries

Mapping of COs to POs:

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

TEXT BOOKS:

1. "Rapid Prototyping: Principles and Applications", Chua, C. K., K. F. Leong and C. S. Lim, World Scientific, River Edge, NJ., 2003.

2. "Rapid Prototyping - A Brief Introduction", Amitabh Ghosh, Affiliated East West Press Pvt. Ltd., 1997.
3. "Stereo lithography and other RP & M Technologies Paul F. Jacobs , SME, NY 1996

REFERENCE BOOKS:

1. "Rapid Tooling: Technologies and Industrial Applications", Peter D. Hilton, Hilton/Jacobs, Paul F. Jacobs, CRC press, 2000.
2. "Rapid Prototyping: Theory and Practice", Ali K. Kamrani, Emad Abouel Nasr,Springer, 2006.
3. "Rapid Prototyping and Engineering applications: A tool box for prototype development", Liou W. Liou, Frank W. Liou, CRC Press, 2007.
4. "Reverse Engineering", Ingle Kathryn A., McGraw Hill Publication Ltd.

MECHANICS OF MACHINES LAB

Subject Code: UGME6P0818	**L**	**T**	**P**	**C**
III Year/ II Semester	**0**	**0**	**3**	**1.5**

EXPERIMENTS:

1. Determination of speed and force for given watt governor setup.
2. Determination of speed and force for given portor governor setup.
3. Determination of speed and force for given proell governor setup.
4. Determination of speed and force for given Hartnel governor setup.
5. CAM Analysis
6. Gyroscopic couple verification.
7. Balancing of Thin Rotors Set-Up
8. Static & Dynamic Balancing Machine
9. Balancing Of Reciprocating Masses Apparatus
10. Spring Mass System (Un-Damped & Damped Conditions)
11. Determination of Natural Frequency for single rotor viscous damping
12. Determination of torsional vibration for single rotor system. (Undamped)
13. Determination of torsional vibration for two rotor system. (Undamped)
14. Determination of Equivalent Spring Mass System (Free Vibration)
15. Determination of Equivalent Spring Mass System (Forced Vibrations)
16. Whirling of shafts/ determination of critical speed with and without Rotors.

COURSE OUTCOMES:

Upon completion of this course, students should be able to:

CO 1: Evaluate forced vibration of equivalent spring mass system.
CO 2: Draw force and couple polygons for analyzing force system.
CO 3: balance rotating and reciprocating masses
CO 4: Perform static and dynamic analysis of various mechanisms
CO 5: Analyse various mechanisms in mechanical systems.
CO 6: Familiarize with the mechanism of power transmission devices

Mapping of COs to Pos

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

CO5	2	2	-	-	-	-	-	-	-	-	-	-	-	-
CO6	3	2	-	2	-	-	-	-	-	-	-	-	-	-

TEXT BOOKS:

1. Theory of Machines / S.S Ratan/ Mc. Graw Hill Publ.
2. Theory of Machines / Shiegly / MGH

Finite Element Analysis Lab

Subject Code: UGME6P0918	**L**	**T**	**P**	**C**
III Year / II Semester	**0**	**0**	**3**	**2**

Experiments:

EXP 1: Structural Analysis of a 2D Plane Stress Bracket
EXP 2: Determine the nodal deflections, reaction forces, and stress for the truss system using Ansys simulation
EXP 3: Determine the nodal deflections, reaction forces, and stress for the stepped bar
EXP 4: Linear and nonlinear of structural analysis of a buckling column.
EXP 5: Structural Analysis of a cantilever beam with different loads (UVL, UDL).
EXP 6: Analyze the hoop and longitudinal stresses of thin pressure vessel.
EXP 7: Structural Analysis of a Gear blank.
EXP 8: Analyze the temperature distribution of a simple 2D with mixed boundary
EXP 9: Analyze the temperature distribution of a transient conduction problem.
EXP 10: Analyze the temperature distribution of a transient conduction problem with varying thermal conductivity.
EXP 11: Coupled analysis of fixed beam using Ansys simulation.

COURSE OUTCOMES:

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

CO1: Explaining the basic tools functions of the software.
CO2: Create models and analyze by using ANSYS software.
CO3: Apply FEA to 2-D plane-stress, plane-strain and perform 1-D numerical integration
CO4: Apply FEA to 1-D steady state heat transfer and understand FE of 1-D problems
CO5: Analyze parameter studies to attain a better understanding of sources of error in FE models.

Mapping of COs to POs

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

REFERENCES:

1. Finite Element Analysis College Lab Manual.

Minor Project-2

Subject Code:UGME6J1018	**L**	**T**	**P**	**C**
III B. Tech/II Sem.	**0**	**0**	**2**	**2**

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COURSE OBJECTIVES: To develop the ability to conceptualize an idea, apply standard/innovative techniques for mechanical engineering problems.

COURSE OUTCOMES:

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

CO1: Demonstrate a sound technical knowledge of their selected project topic.

CO2: Undertake problem identification, formulation and solution.

CO3: Design engineering solutions to the problems.

CO4: Communicate with engineers and the community at large in written an oral form.

CO5: Demonstrate the knowledge, skills and attitudes of a professional engineer.

Mapping of COs to POs

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

LOGICAL REASONING

Subject Code: UGBS5A0218	L	T	P	C
III B. Tech/II Sem.	2	-	-	-

SYLLABUS

UNIT-1: Probability **3hrs**

Basic problems - Addition theorem of probability for 2, 3, or 4 events - Conditional Probability.

UNIT-II: Permutations & Combinations **3hrs**

Sum & Product Rules, Permutations and Combinations without repetitions, with repetitions and with constrained repetitions – ncr, npr & n! formulas – Binomial coefficients – Principle of inclusion and exclusion.

UNIT-III: Coding, Decoding, Letter and Number Series: **2hrs**

Letter Coding, Direct Letter coding, Number / Symbol coding, Substitution Coding, Deciphering message word coding and its types, Number series, Letter Series, Analogy

UNIT-IV: Calendar **2hrs**

Odd days - Ordinary year-Leap year - Day for given date - Years with same Calendar.

UNIT-V: Directions **2hrs**

Direction Names - Starting Direction - Ending Direction – Distance.

UNIT-VI: Data Analysis and Interpretation **3hrs**

Tabulation- Pie Charts – Bar Diagrams – Line Graphs

Course Outcomes:

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

CO1: Distinguish the basic elements of arguments and recognize the different types of arguments.

CO2: Construct natural language statements in the language of propositional and predicate logic.

CO3: Examine logical relations among statements; and analyze logically complex statements into their truth- functional or quantificational components.

CO4: Distinguish valid deductive arguments from invalid ones.

CO5: Make use of appropriate arithmetic formulae to draw conclusions on logical problems.

Mapping of COs to POs

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

Reference Books:

1. M.Tyra, Magical book on Quicker Maths, BSC Publishing Co. Pvt. Ltd.
2. R.S. Aggarwal, A modern approach to Logical reasoning, S. Chand Publications
3. Edgar Thorpe, Test of reasoning for competitive Examinations, TMH publications
4. R.V. Praveen, Quantitative Aptitude and Reasoning, 3rd ed., PHI publications.

IV YEAR
I SEMESTER

HEAT TRANSFER

Subject Code: UGME7T0118	L	T	P	C
IV Year / I Semester	2	2	0	4

SYLLABUS:

UNIT-I: 16hrs

ONE DIMENSIONAL STEADY STATE CONDUCTION HEAT TRANSFER:

Modes and mechanisms of heat transfer – Basic laws of heat transfer. General discussion about applications of heat transfer.

Conduction Heat Transfer: General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates. Initial and boundary conditions.

ONE DIMENSIONAL STEADY STATE CONDUCTION HEAT TRANSFER: Homogeneous slabs, hollow cylinders and spheres – overall heat transfer coefficient – electrical analogy – Critical radius of insulation. Systems with variable Thermal conductivity – systems with heat sources or Heat generation.

UNIT-II: 14hrs

EXTENDED SURFACE (FINS) AND TRANSIENT CONDUCTION:

Extended Surface (Fins) – Long Fin, Fin with insulated tip and Short Fin, application to error measurement of temperature.

One Dimensional Transient Conduction Heat Transfer: Systems with negligible internal resistance – Significance of Biot and Fourier Numbers - Chart solutions of transient conduction systems.

Convective Heat Transfer: – Classification of convective heat transfer.

Dimensional Analysis: as a tool for experimental investigation – Buckingham Pi Theorem for forced and free convection, application for developing semi – empirical non-dimensional correlation for convection heat transfer. Significance of non-dimensional numbers.

UNIT- III: FORCED AND FREE CONVECTION: 12hrs

Forced convection: External Flows: Concepts about hydrodynamic and thermal boundary layer-Concepts of Continuity, Momentum and Energy Equations and use of empirical correlations for convective heat transfer -Flat plates and Cylinders.

Internal flows: Concepts about hydrodynamic and thermal entry lengths-Division of internal flow based on this- Use of empirical relations for Horizontal Pipe Flow and annulus flow.

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

UNIT-IV: BOILING AND CONDENSATION: 10hrs

Boiling: – Pool boiling – Regimes, Calculations on Nucleate boiling, Critical Heat flux and Film boiling.

Condensation: Film wise and drop wise condensation – Nusselt's Theory of condensation on a vertical plate-Film condensation on vertical and horizontal cylinders using empirical correlations.

UNIT-V: HEAT EXCHANGERS: 9hrs

Heat Exchangers: Classification of heat exchangers – overall heat transfer Coefficient and fouling factor – Concepts of LMTD and NTU methods- Problems using LMTD and NTU methods.

UNIT-VI: RADIATION HEAT TRANSFER: 10hrs

Emission characteristics and laws of black-body radiation – Irradiation–total and monochromatic quantities- laws of Planck, Wien, Kirchoff, Lambert, Stefan and Boltzmann–heat exchange between two black bodies – concepts of shape factor – Emissivity – heat exchange between grey bodies, radiation shields-electrical analogy for radiation networks.

COURSE OUTCOMES:

At the end of the course students are able to:

CO1: Explain the basic modes and laws of heat transfer.
CO2: Analyze one dimensional steady and transient heat conduction through various systems.
CO3: Analyze natural and forced convective heat transfer process.
CO4: Illustrate the principles of radiation heat transfer.
CO5: Describe the concepts of boiling and condensation.
CO6: Analyze heat exchangers using LMTD and NTU methods.

Mapping of COs to PO

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

TEXT BOOKS:

1. Heat Transfer / HOLMAN/TMH
2. Fundamentals of Engg. Heat and Mass Transfer / R.C.Sachdeva / New Age International
3. Heat and Mass Transfer –Cengel- McGraw Hill.

REFERENCE BOOKS:

1. Heat Transfer – Ghoshdastidar – Oxford University Press – II Edition
2. Heat Transfer – P.K.Nag/ TMH
3. Heat and Mass Transfer – R.K. Rajput – S.Chand & Company Ltd.
4. Heat and Mass Transfer – D.S.Kumar / S.K.Kataria & Sons
5. Heat and Mass Transfer Data Book- Kondandaraman
6. Fundamentals of Heat Transfer & Mass Transfer- Incropera & Dewitt/John Wiley Pub.

METROLOGY AND MEASUREMENTS

Subject Code: UGME7T0218	L	T	P	C
IV B.Tech./ISem.	3	-	-	3

SYLLABUS:

UNIT-I: SYSTEMS OF LIMITS AND FITS, LINEAR MEASUREMENT 13hrs

Introduction, normal size, tolerance limits, deviations, allowance, fits and their types – unilateral and bilateral tolerance system, hole and shaft basis systems – interchangeability and selective assembly. Indian standard Institution system – British standard system, International Standard system for plain ad screwed work.

Length standard, line and end standard, slip gauges – calibration of the slip gauges.

UNIT-II: Measurement Of Angles And Tapers, Limit Gauges, Optical Measuring Instruments. 11hrs

Different methods – Bevel protractor – angle slip gauges – spirit levels – sine bar , rollers and spheres used to determine the tapers.

Taylors principle – Design of go and No-go gauges, plug, ring, snap, gap, taper, profile and position gauges.

Tool maker's microscope and its uses – collimators, optical projector – optical flats and their uses, interferometer.

UNIT-III: Surface Roughness Measurement, Measurement Through Comparators 11hrs

Differences between surface roughness and surface waviness-Numerical assessment of surface finish – CLA,R, R.M.S Values – Rz values, Rz value, Methods of measurement of surface finish-profilograph. Talysurf, ISI symbols for indicate on of surface finish.

Comparators–Mechanical, Electrical and Electronic Comparators, pneumatic comparators and their uses in mass production.

UNIT –IV: 13hrs

Measurement of Displacement, Measurement of Temperature

Theory and construction of various transducers to measure displacement– Piezo electric, Inductive, capacitance, resistance, ionization and Photo electric transducers, Calibration procedures.

Classification – Ranges – Various Principles of measurement– Expansion, Electrical Resistance – Thermistor – Thermocouple – Pyrometers – Temperature Indicators.

UNIT-V: **11hrs**

Measurement of Pressure , Measurement of Force, Torque and Power

Units – classification – different principles used. Manometers, Piston, Bourdon pressure gauges, Bellows – Diaphragm gauges. Low pressure measurement – Thermal conductivity gauges – ionization pressure gauges, McLeod pressure gauge.
Elastic force meters, load cells, Torsion meters, Dynamometers.

UNIT-VI: Stress Strain Measurements, Flow Measurement 9hrs

Various types of stress and strain measurements – electrical strain gauge – gauge factor – method of usage of resistance strain gauge for bending compressive and tensile strains – usage for measuring torque, Strain gauge Rosettes.
Rotameter, magnetic, Ultrasonic, Turbine flow meter, Hot – wire anemometer, Laser Doppler Anemometer (LDA).

Course Outcomes:

Upon the completion of the course, the students will able to:

CO1: Analyze and calibrate the characteristics of measuring instruments through reports to make the engineers to apply the science of measurement.
CO2: Make use of limits and fits concept for gauge design.
CO3: Select appropriate measuring instruments and right technique for measuring taper angles and flatness.
CO4: Compare different methods of measuring surface roughness.
CO5: Apply the methods of measuring displacement, temperature, pressure, force, torque and power.
CO6: Categorize different methods of using strain gauges and flow measurement.

Mapping of COs to PO

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

TEXT BOOKS:

1.Measurement Systems: Applications & design by D.S Kumar.
2.Mechanical Measurements/BeckWith, Marangoni,Linehard, PHI/PE
3.Engineering Metrology / I C Gupta./ Danpath Rai
4. Engineering Metrology / R.K. Jain / Khanna Publishers

REFERENCE BOOKS:

1. Measurement systems: Application and design, Doeblin Earnest. O.Adaptation by Manik and Dhanesh/ TMH.
1. Experimental Methods for Engineers / Holman.
3. Mechanical and Industrial Measurements / R.K. Jain/ Khanna Publishers. Instrumentation, measurement & analysis by B.C.Nakra & K.K.Choudhary, TMH
4. BIS standards on Limits & Fits, Surface Finish, Machine Tool Alignment etc.

MANAGEMENT SCIENCE

Subject Code: UGMB7T0118	L	T	P	C
IV B.Tech./ISem.	3	-	-	3

SYLLABUS

UNIT-I: Introduction to Management **7 hrs**

Concept and importance of Management, Functions of management, Evaluation of Management thought, Fayol's principles of Management, Fayol's principles of Management, Herzberg's two factor theory of Motivation, Decision making process, Designing organizational structure, Principles of Organization, Types of organization structures.

UNIT-II: Operations management **8 hrs**

Principles and types, Work study, Statistical Quality control Charts – R Chart, c chart, p chart, Simple problems on R, c and p charts, Materials Management: Objectives - need for inventory control- EOQ, ABC, HML, SDE, VED and FSN analysis

UNIT-III: Human Resources management **6 hrs**

(HRM): concepts of HRM, HRD & Personnel management and industrial relations, Basic functions of HR manager Wage payment plans (simple problems) Job evaluation and merit Rating

UNIT-IV: Marketing Management **6 hrs**

Functions of marketing -Marketing Mix- Marketing strategies based on Product life cycle Channels of distribution

UNIT-V :Project Management(PERT/CPM) **8 hrs**

Network analysis Programme Evaluation and Review Technique (PERT) Critical path method(CPM) Identifying critical path Difference between PERT & CPM Probability Project Crashing (simple problems)

UNIT-VI: Strategic Management **6 hrs**

Mission, Goals, objectives, policy, strategy Elements of corporate planning process, Environmental scanning SWOT analysis Steps in strategy formulation and implementation Generic strategy alternatives.

Course Outcomes:

CO1: Understand the evolutionary development of management thought and general principles of management.

CO2: Apply quality engineering tools for process control.
CO3: Familiarize with the roles of human resources in personal management, industrial relations and learn time strategies for marketing.
CO4: Examine marketing management functions and various strategies.
CO5: Analyze the network for project scheduling and apply the principles of strategic management.

Mapping of COs to PO/PSO

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

Text Books

1. Dr. Arya Sri – Management Science, TMH 2011
2. Principles & Practices of Management-L.M.PRASAD

Reference Books:

1. Production and Operations Management- K.ASWATHAPPA and K.SRIDHARA BHAT
2. Marketing Management- PHILIP KOTLER
3. HRM & IR- P.SUBBA RAO
4. Business Policy & Strategic Management- FRANCIS CHER

ADVANCED MATERIALS

Subject Code: UGME7T0518	L	T	P	C
IV Year / I Semester	3	-	-	3

SYLLABUS:

UNIT-I:INTRODUCTION TO COMPOSITE MATERIALS 10hrs

Introduction ,Constituents of composites ,classification of composites, different types of fibers (Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibres),whiskers, different Particulates.

Polymer Matrix Composites:

Introduction, CFRP composites, Manufacturing method (Autoclave, tape production, moulding methods, filament winding, man layup, pultrusion, RTM), applications.

UNIT-II: Metal and Ceramic Matrix Composites
8hrs

Introduction, Basic of sintering and compaction, advantages and disadvantages, manufacturing methods (solid and liquid state route) , applications.

UNIT -III: MACROMECHANICAL ANALYSIS OF A LAMINA 10hrs

Introduction, Generalized Hooke's Law, Reduction of Hooke's Law in Three Dimensions to Two Dimensions, Relationship of Compliance and Stiffness Matrix to Engineering Elastic Constants of an orthotropic Lamina, Laminate-Laminate code.

UNIT –IV: NANO MATERIALS 6hrs

Introduction to nano-materials, their properties comparison with bulk materials, advantages, disadvantages. synthesis of nanomaterial (Ball milling, CVD, PVD, Sol- Gel), Applications of nano materials

UNIT-V: **FUNCTIONALLY GRADED MATERIALS 6hrs**

Types of Functionally graded materials, FGM classification, Properties of FGM and their applications

UNIT-VI: SMART MATERIALS 8hrs

Shape memory alloy characteristics, types of shape memory effects , SMA applications, phase change material and their characteristics, applications of phase change materials

Course Outcomes:

Upon the completion of the course, the students will able to:

CO1: Demonstrate the need of advanced materials and their importance

CO2: Apply the knowledge on composites, FGM, Smart materials & Nano materials and their applications

CO3: Classify different types of advanced materials and learn their behavior

CO4: Choose appropriate manufacturing methods of Composites, FGM, smart materials and Nano materials.

Mapping of COs to PO

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

TEXT BOOKS:

1.Nano material by A.K. Bandyopadyay, New age Publishers

2.Material science and Technology- Cahan

3.Engineering Mechanics of Composite Materials by Isaac and M Daniel, Oxford University Press

REFERENCE BOOKS:

1. R. M. Jones, Mechanics of Composite Materials, McGraw Hill Company, New York, 1975.
2. L. R. Calcote, Analysis of Laminated Composite Structures, Van Nostrand Rainfold.
3. B. D. Agarwal and L. J. Broutman, Analysis and performance of fiber Composites, Wiley-Interscience, New York, 1980
4. Mechanics of Composite Materials, Second Edition (Mechanical Engineering), Autar K.Kaw, CRC

REFRIGERATION AND AIR CONDITIONING

(PROFESSIONAL ELECTIVE - III)

Subject Code: UGME7T0618	**L**	**T**	**P**	**C**
IV Year / I Semester	**3**	**0**	**0**	**3**

UNIT I: **8hrs**

INTRODUCTION TO REFRIGERATION: Necessity and applications – Unit of refrigeration and C.O.P. – Mechanical Refrigeration – Types of Ideal cycles of refrigeration. Air Refrigeration: Bell Coleman cycle, Open and Dense air systems, Refrigeration systems used in Aircraft & problems.

UNIT-II: **8hrs**

VAPOUR COMPRESSION REFRIGERATION working principle and essential components of the plant – simple Vapour compression refrigeration cycle – COP – Representation of cycle on T-S and p-h charts – effect of subcooling and superheating – cycle analysis – Actual cycle Influence of various parameters on system performance – Use of p-h charts – numerical Problems.

UNIT -III: **8hrs**

SYSTEM COMPONENTS: Compressors – General classification – comparison – Advantages and Disadvantages. Condensers – classification – Working Principles, Evaporators – classification – Working Principles, Expansion devices – Types – Working Principles.

REFRIGERANTS – Desirable properties – classification of refrigerants used – Nomenclature – Ozone Depletion – Global Warming. Alternate Refrigerants.

UNIT –IV: **8hrs**

VAPOR ABSORPTION SYSTEM – Calculation of max COP – description and working of NH_3 – water system and Li Br – water (Two shell & Four shell) System. Principle of operation of Three Fluid absorption system, salient features.

STEAM JET REFRIGERATION SYSTEM Working Principle and Basic Components. Principle and operation of Thermoelectric refrigerator and Vortex tube or Hilsch tube.

UNIT-V: **8hrs**

INTRODUCTION TO AIR CONDITIONING: Psychometric Properties & Processes – Characterization of Sensible and latent heat loads –– Need for Ventilation, Consideration of Infiltration – Load concepts of RSHF, GSHF- Problems, Concept of ESHF and ADP temperature.

UNIT-VI: **8hrs**

Requirements of human comfort and concept of effective temperature- Comfort chart – Comfort Air Conditioning – Requirements of Industrial air-conditioning, Air-conditioning Load Calculations.

AIR CONDITIONING SYSTEMS- Classification of equipment, cooling, heating humidification and dehumidification, filters, grills and registers fans and blowers. Heat Pump – Heat sources – different heat pump circuits. Introduction to Automotive air conditioning.

Course Outcomes:

Upon the completion of the course, the students will able to:

CO1: Analyze the Bell Coleman cycle used in air refrigeration system

CO2: Analyze and evaluate the performance of the vapour Compression Refrigeration System

CO3: Select environmentally friendly refrigerants considering international standards.

CO4: Illustrate the concept of vapour absorption and Steam Jet Refrigeration Systems

CO5: Select the appropriate air conditioning processes for any given application using principles of Psychrometry

CO6: Estimate cooling load and heating load considering human comfort and optimize the air conditioning system as per requirements.

Mapping of COs to PO

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

TEXTBOOKS:

1. A Course in Refrigeration and Air conditioning / SC Arora & Domkundwar / Dhanpatrai
2. Refrigeration and Air Conditioning / Manohar Prasad / New Age.

REFERENCES:

1. Refrigeration and Air Conditioning / CP Arora / TMH. 2. Principles of refrigeration - Dossat / Pearson Education.
2. Refrigeration and Air Conditioning-P. L. Bellaney
3. Refrigeration and Air Conditioning – R.S. Khurmi & J.K Gupta – S. Chand – Eurasia Publishing House (P) Ltd.

VIBRATIONS & VEHICLE DYNAMICS

(PROFESSIONAL ELECTIVE-III)

Subject Code: UGME7T0718	**L**	**T**	**P**	**C**
IV Year / I Semester	**3**	**0**	**0**	**3**

Syllabus

UNIT I: **8hrs**

INTRODUCTION to vibrations & basic concepts

SINGLE DEGREE OF FREEDOM SYSTEMS: Undamped and damped free vibrations, Forced vibrations, Coulomb damping, Response to harmonic excitation, Rotating unbalance and support excitation. Vibration isolation and transmissibility, Introduction to nonharmonic excitation.

UNIT-II: **10hrs**

TWO DEGREE FREEDOM SYSTEMS: Principal modes, Undamped and damped free and forced vibrations, Undamped vibration absorbers. Multirotor systems, Empirical relations

MULTI-DEGREE FREEDOM SYSTEMS: Matrix formulation, Stiffness and flexibility influence coefficients, Eigenvalue problem, Normal modes and their properties, Free and forced vibration by Modal analysis, Method of matrix inversion, Torsional vibrations of multi-rotor systems and geared systems, Discrete-time systems.

UNIT -III: **8hrs**

INFLUENCE OF TIRE DYNAMICS: Tire forces and moments, Tire structure, Longitudinal, and Lateral force at various slip angles, rolling resistance, Tractive and cornering properties of tire. Performance of tire on the wet surface. Ride property of tires. Magic formulae tire model, Estimation of tire-road friction. Test on Various road surfaces. Tire vibration.

UNIT –IV: **8hrs**

VERTICAL DYNAMICS: Human response to vibration, Sources of Vibration. Design and analysis of Passive, Semi-active and Active suspension using a Quarter car, half car and full-car model. Influence of suspension stiffness, suspension damping, and tire stiffness. The control law for LQR, H-Infinite, and Skyhook damping. The air suspension systems and their properties.

UNIT-V: **8hrs**

LONGITUDINAL DYNAMICS AND CONTROL: Aerodynamic forces and moments. Equation of motion. Tire forces, rolling resistance, Load distribution for three-wheeler and four wheeler. Calculation of Maximum acceleration, Reaction forces for Different drives.

Braking and Driving torque. Prediction of Vehicle performance. ABS, stability control, Traction control.

UNIT-VI: 8hrs

LATERAL DYNAMICS: Steady state handling characteristics. Steady-state response to steering input. Testing of handling characteristics. Transient response characteristics, Direction control of vehicles. Roll center, Roll axis, Vehicle underside forces. Stability of vehicle on the banked road, during a turn. Effect of suspension on cornering.

Course Outcomes:

Upon the completion of the course, the students will able to:

CO1: Appreciate the need and importance of vibration analysis in the mechanical design of machine parts that operate in vibratory conditions

CO2: Analyze the mathematical model of a linear vibratory system to determine its response

CO3: Use Lagrange's equation for a linear and nonlinear vibratory system

CO4: Determine vibratory responses of SDOF and MDOF systems to harmonic, periodic and nonperiodic excitation

CO5: Determine various forces and moments, load distribution on vehicles

CO6: Determine the suspension and tyre characteristics according to the various load and road conditions

Mapping of COs to PO

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

TEXT BOOKS:

1. Fundamentals of Vibrations by Leonard Meirovitch; Publisher: McGraw Hill
2. Mechanical Vibrations by Groower G. K.
3. J. Y. Wong, Theory of Ground Vehicles, 3rd Edition, Wiley-Interscience, 2001
4. Rajesh Rajamani, Vehicle Dynamics and Control, 1st edition, Springer, 2005

REFERENCES:

1. Mechanical Vibrations by Tse and Morse
2. Mechanical Vibrations by Rao S. S., Publisher: Pearson
3. Mechanical Vibrations by Rao V Dukkipati & J. Srinivas, Publisher: Prentice Hall
4. Mechanical Vibrations by V. Ram Murthy
5. Michael Blundell & Damian Harty, The Multibody Systems Approach to Vehicle Dynamics, Elsevier Limited, 2004
6. Hans B Pacejka, Tire and Vehicle Dynamics, 2nd edition, SAE International, 2005

John C. Dixon, Tires, Suspension, and Handling, 2nd Edition, Society of Automotive Engineers Inc, 1996

METROLOGY AND INSTRUMENTATION LAB

Subject Code: UGME7P0818	**L**	**T**	**P**	**C**
IIIB.Tech./I Sem.	**0**	**0**	**3**	**1.5**

Experiments:

EXP1: Calibration of Micrometer using Slip Gauge
EXP2: Angle and taper measurement using Bevel protractor and Sine bar
EXP3: Measurement of Screw thread parameters using Three wire method
EXP4: Study of gear tooth nomenclature and rake angle using Tool maker's Microscope.
EXP5: Checking flatness of surface plate by using spirit level.
EXP6: Alignments tests for lathe using various equipment such as spirit level, dial gauge, test mandrel, gauge blocks etc.
EXP7: Study the characteristics and working principle of Pt100 RTD
a) Calibrtion of Pt100 TD
EXP8:
a. Study the characteristics and working principle of J-type Thermocouple
b. Calibration of J-type Thermocouple

EXP9 : Study and Calibration of NTC Thermistor
EXP10: Study and Calibration of Strain Gauge
EXP11: Study and Calibration of Pressure Gauge
EXP12:
a. Study of Photo Pickups for the measurement of Speed
b. Study of Magnetic Pickups for the measurement of Speed

EXP13: Study and Calibration of L.V.D.T. for the measurement of Linear Displacement
EXP14: Study and Calibration of Rotameter for Water Flow Measurement

Course Outcomes:

After completion of the course, the students would be able to:

CO1: Operate the tools for linear and angular measurements
CO2: Study the profile of machine elements using Tool Maker's Microscope
CO3: Perform alignment tests on machine tools
CO4: Measure different parameters like pressure, displacement, speed, strain, temperature and flow rate.
CO5: Calibrate the given measuring instrument and record it through written reports

Mapping of COs to Pos :

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

TEXT BOOKS:

1. Engineering Metrology, R.K Jain, Khanna Publications, 1994.
2. Engineering Metrology, I.C Guptha, Dhanpath rai Publications, Delhi

REFERENCE BOOKS:

1. Metrology and Instrumentation Lab college Manual
2. Metrology & Measurments, Anand K. Bewoor and Vinay, A. Kulakarni, Tata McGraw Hill Pvt. Ltd., New Delhi.

HEAT TRANSFER LAB

Subject Code: UGME7P0918	**L**	**T**	**P**	**C**
IV Year / I Semester	**0**	**0**	**3**	**1.5**

Experiments:

EXP 1**:** Determination of Thermal Conductivity of a composite wall.

EXP 2: Determination of Heat Transfer Through Lagged pipe

EXP 3: Determination of Thermal Conductivity of a Metal Rod.

EXP 4: Transient Heat Conduction.

EXP 5: Determination of Heat Transfer Coefficient In Forced Convection

EXP 6: Determination of Heat Transfer Coefficient in Natural Convection.

EXP 7: Determination of Effectiveness of a Parallel & Counter Flow Heat Exchangers.

EXP 8: Determination of Surface Emissivity of a given surface.

EXP 9: Determining Stefan Boltzmann's Constant.

EXP 10: Determining Heat Transfer In Dropwise & Filmwise Condensation

EXP 11: Determining Critical Heat Flux Apparatus.

EXP 12: Determination of Thermal Conductivity of an Insulating material using concentric sphere.

EXP 13: Determination of Efficiency and Effectiveness of Pin Fin Apparatus.

EXP 14: Demonstration of heat pipe.

Course Outcomes:

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

CO1: Perform experiments in the different modes of heat transfer conduction, convection and radiation.

CO2: Familiarize with instrumentation used for heat transfer experiment.

CO3: Examine the heat transfer constants in different modes of heat transfer.

CO4: Analyze the experimental results of boiling and condensation.

CO5: Analyze experimental results in different types of heat exchangers.

Mapping of COs to POs:

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

IV YEAR
II SEMESTER

NON - DESTRUCTIVE EVALUATION

Subject Code: UGME8T0118	L	T	P	C
IV Year / II Semester	3	-	-	3

SYLLABUS:

UNIT-I:INTRODUCTION TO NDE **10hrs**

Definition of Non-destructive Testing, Need for NDT Techniques and its applications, Types of NDT techniques, Benefits from Non-Destructive Testing, Various steps involved in Non-Destructive Testing.

ULTRASONIC TESTING:

Principle of wave propagation, piezoelectric effect, Different kinds of ultra sonic Transducers and their characteristics, Acoustic impedance and the need for coupling medium, Reflection, Refraction and scattering of ultrasonic wave

UNIT-II: ULTRASONIC TESTING **8hrs**

Ultrasonic Equipment and Variable affecting ultrasonic test, Types of scan for data recording (a-scan, B-scan and C-scan),Thickness gauging , Flaw detection in welds , advantages , limitation and applications of Ultrasonic testing.

UNIT -III: RADIOGRAPHY PROCESSES **8hrs**

Production of X-rays and Gamma rays and their interaction with matter, Radiographic Testing, Radiographic equipment. Radio graphic screens, Industrial X-Ray films. advantages , disadvantages and its applications.

UNIT –IV: MAGNETIC PARTICLE TEST **8hrs**

Principle of magnetic flaw detection, Types and methods of magnetization, Magnetic particle testing equipment and test procedure. Dry and wet methods of magnetic particle inspection, Need for demagnetization. Advantages and disadvantages and Applications.

UNIT-V: **LIQUID PENETRANT TESTS** **7hrs**

Cohesion, adhesion and capillary rise of liquid penetrant for testing, Liquid penetrants testing principle, Liquid penetrant test procedure. Characteristics of penetrants and developers , advantages and limitation and applications

UNIT-VI: EDDY CURRENT TEST **7hrs**

Principle of eddy current, Factors effecting eddy current, Eddy current test system and arrangement, advantages and disadvantages and its applications

Course Outcomes:

Upon the completion of the course, the students will able to:

CO1: Identify surface and internal flaws in the material by NDT and take measures to eliminate them for different applications.

CO2: Differentiate various defect types and methods of detecting them using ultrasonic waves and radiographic techniques

CO3: Apply the surface testing methods like Liquid penetrant testing and Magnetic particle testing.

CO4: Select the right procedure and system for detecting flaws in the parts.

Mapping of COs to POs

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

TEXT BOOKS:

1. Prakash Ravi, "Nondestructive Testing Techniques", New Age International Publishers, 1st edition, 2007
2. Non-Destructive test and Evaluation of Materials by J Prasad and C.G.K Nair, McGraw Hill Education
3. Ultrasonic inspection & Training for NDT: E. A. Gingel, Prometheus Press

REFERENCE BOOKS:

1. ASTM Standards, Vol 3.01, Metals and alloys
2. Paul E Mix, "Introduction to non-destructive testing: a training guide", Wiley, 2nd edition New Jersey, 2005
3. ASM Handbook Vol. 11, 8th Edition – Non-destructive Testing and Evaluation
4. Baldev Raj, B. Venkataraman, D. J. Varde, Nerulikar, "Practical Magnetic Particle Testing", Narosa Publishing House, 2007 96
5. Charles, J. Hellier, "Handbook of non-destructive evaluation", McGraw Hill, New

MECHATRONICS (FREE ELECTIVE)

Subject Code: UGME8T0218	L	T	P	C
IVYear/IISemester	3	-	-	3

SYLLABUS:

UNIT -I : 8hrs

OVERVIEW OF MECHATRONICS: Mechatronics Definition, Mechatronic Design Approach System Interfacing, Instrumentation and Control Systems Microprocessor-Based Controllers and Microelectronics, An Introduction to Micro- and Nanotechnology Mechatronics: New Directions in Nano-, Micro-, and Mini-Scale Electromechanical Systems.

UNIT–II: 8hrs

PHYSICAL SYSTEM MODELING: Modeling Electromechanical Systems, Structures and Materials, Modeling of Mechanical Systems for Mechatronics Applications, Fluid Power Systems, Electrical Engineering, Engineering Thermodynamics, Modeling and Simulation for MEMS, Rotational and Translational Micro electro-mechanical Systems: MEMS Synthesis, Micro fabrication, Analysis, and Optimization, The Physical Basis of Analogies in Physical System Models.

UNIT–III: 9hrs

SENSORS AND ACTUATORS: Introduction to Sensors and Actuators, Fundamentals of Time and Frequency, Sensor and Actuator Characteristics, Sensors, Linear and Rotational Sensors, Acceleration Sensors, Force Measurement, Torque and Power Measurement, Flow Measurement, Temperature Measurements, Distance Measuring and Proximity Sensors, Light Detection Image and Vision Systems, Integrated Micro-sensors, Actuators, Electro-mechanical Actuators, Electrical Machines, Piezoelectric Actuators, Hydraulic and Pneumatic Actuation Systems.

UNIT-IV: 8hrs

SYSTEMS AND CONTROLS: The Role of Controls in Mechatronics, The Role of Modeling in Mechatronics Design, Kalman Filters as Dynamic System State Observers, Digital Signal Processing for Mechatronic Applications , Adaptive and Nonlinear Control Design Advanced Control of an Electro-hydraulic Axis ,Design Optimization of Mechatronic Systems

UNIT–V: 8hrs

COMPUTERS AND LOGIC SYSTEMS: Fault Analysis in Mechatronic Systems, Logic

System Design, Synchronous and Asynchronous Sequential Systems, Architecture, Control with Embedded Computers and Programmable Logic Controllers.

UNIT -VI: 9hrs

SOFTWARE AND DATA ACQUISITION: Introduction to Data Acquisition, Measurement Techniques: Sensors and Transducers, A/D and D/A Conversion, Signal Conditioning, Computer-Based Instrumentation Systems, Software Design and Development, Data Recording and Logging.

COURSE OUTCOMES

Upon completion of this course, students should be able to:

CO1: Familiarized with the concepts of microprocessor.

CO2: Understand a Mechatronic system component and perform physical system modelling.

CO3: Study different sensors and actuators and analyze the role of controls in mechatronics

CO4: Perform fault analysis in mechatronic systems and design computer based instrumentation system

CO5: Familiarized with digital signal processing.

CO6: understand conversion and computer-based instrumentation.

Mapping of COs to Pos

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

TEXT BOOKS:

T1. Robert H. Bishop "Mechatronic Systems, Sensors and Actuators", CRC press, Taylor and Francis Group

T2. John G. Webster "Measurement, Instrumentation, and Sensors Handbook" CRC Press, 999, 0-8493-2145-X

REFERENCE BOOKS:

R1. Ilene J. Bush Vishniac, "Electromechanical Sensors and Actuators", Springer

QUALITY AND RELIABILITY ENGINEERING

Subject Code: UGME8T0318	L	T	P	C
IV B.Tech./II Sem.	3	-	-	3

SYLLABUS

UNIT-I **6 hrs**

Quality value and engineering – quality systems – quality engineering in product design and production process – system design – parameter design – tolerance design, quality costs – quality improvement.

UNIT-II **8 hrs**

Statistical Process control X, R, p, c charts, other types of control charts, process capability, process capability analysis, process capability index. (SQC tables can be used in the examination)

UNIT-III **8 hrs**

Acceptance sampling by variables and attributes, design of sampling plans, single, double, sequential and continuous sampling plans, design of various sampling plan.

UNIT-IV **8 hrs**

Loss function, tolerance design – N type, L type, S type; determination of tolerance for these types. Online quality control – variable characteristics, attribute characteristics, parameter design.

UNIT-V **8 hrs**

Quality function deployment – house of quality, QFD matrix, total quality management concepts. Quality information systems, quality circles, introduction to ISO 9000 standards. Reliability – Evaluation of design by tests - Hazard Models, Linear, Releigh, Weibull. Failure data Analysis, reliability prediction based on weibull distribution, Reliability improvement.

UNIT-VI **8 hrs**

Complex system, reliability, reliability of series, parallel & standby systems & complex systems & reliability prediction and system effectiveness.

Maintainability, availability, economics of reliability engineering, replacement of items, maintenance costing and budgeting, reliability testing.

COURSE OUTCOMES

CO1: Demonstrate the approaches and techniques to assess and improve process and/or product quality and reliability.

CO2: Suggest the method of measurement for model times to failure using the appropriate probability distribution.

CO3: Differentiate the relationship between the time to failure distribution, the reliability function, and the hazard rate.
CO4: Determine a life test, estimate reliability values from the test data, and set confidence limits on the results.
CO5: Apply the design tools necessary to ensure a reliable product including prediction, allocation, and FMEA.
CO6: Predict the reliability of a repairable and a non- repairable system.

Mapping of COs to Pos

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

TEXT BOOKS:

1. Eugene Grant, Richard Leavenworth "Statistical Process Control",McGraw Hill.
2. G Taguchi, 'Quality Engineering in Production Systems', - McGraw Hill, 1989.
3. W.A. Taylor, 'Optimization & Variation Reduction in Quality', Tata McGraw Hill, 1991, 1st edition

REFERENCE BOOKS:

1. Frank.M.Gryna Jr. "Jurans Quality planning & Analysis", McGraw Hill.
2. Philipposs, 'Taguchi Techniques for Quality Engineering', McGraw Hill, 1996, 2nd Edition.
3. LS Srinath, 'Reliability Engineering', Affiliated East West Pvt. Ltd., 1991, 3rd Edition.
4. E.Bala Guruswamy, 'Reliability Engineering', Tata McGraw Hill, 1994

ALTERNATE FUELS AND POLLUTION CONTROL

(FREE ELECTIVE)

Subject Code: UGME8T0418	**L**	**T**	**P**	**C**
IV B.Tech./II Sem.	**3**	**-**	**-**	**3**

SYLLABUS:

UNIT-I: **8hrs**

EMISSION FROM SPARK IGNITION ENGINE AND ITS CONTROL:

Introduction: Sources of Pollution. Various emissions from Automobiles — Formation — Effects of pollutants on environment human beings. Emission control techniques – Emission standards.

Emission formation in SI Engines- Carbon monoxide- Unburned hydrocarbon, NOx, Smoke— Effects of design and operating variables on emission formation – controlling of pollutants - Catalytic converters — Charcoal Canister — Positive Crank case ventilation system, Secondary air injection, thermal reactor, Laser Assisted Combustion.

UNIT-II: **8hrs**

EMISSION FROM COMPRESSION IGNITION ENGINE AND ITS CONTROL:

Formation of White, Blue, and Black Smokes, NOx, soot, sulphur particulate and Intermediate Compounds – Physical and Chemical delay — Significance Effect of Operating variables on Emission formation — Fumigation, EGR, HCCI, Particulate Traps, SCR — Cetane number Effect.

UNIT- III: **7hrs**

TEST PROCEDURES & EMISSION MEASUREMENTS:

Constant Volume Sampling I and 3 (CVSI &CVS3) Systems- Sampling Procedures —Chassis dynamometer - Seven mode and thirteen mode cycles for Emission Sampling Sampling problems — Emission analysers —NDIR, FID, Chemiluminesecent, Smoke meters, Dilution Tunnel, SHED Test, Sound level meters.

UNIT-IV: **10hrs**

ALCOHOLS and VEGETABLE OILS AS FUELS:

Alternative fuels. Availability of different alternative fuels for engines. Alcohols – Properties, Production methods and usage in engines. Blending of Diesel and Gasoline fuels with the alcohol fuels. Performance, combustion and emission Characteristics in engines. Issues & limitation in alcohols.Vegetable oils (Soyabeen Oil, Jatropha, Pongamia,

Rice bran, Mahuaetc) and their important properties. Fuel properties characterization. Methods of using vegetable oils – Blending, preheating, Transesterification and emulsification – Performance, combustion and emaission Characteristics in diesel engines. Third generation biofuels - Biofuels from micro algae. Issues & limitation of using vegetable oils in IC engines.

UNIT-V: HYDROGEN AS ENGINE FUEL: 7hrs

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

UNIT-VI: HYBRID AND ELECTRIC VEHICLES: 8hrs

Layout, Merits and Demerits, Components, Electronic Control Systems. Different configuration of hybrid vehicles. Power split devices, Energy Regeneration, High energy and power density batteries, Introduction to PEM fuel cell.

COURSE OUTCOMES:

At the end of the course students are able to:

CO1: Explain various types of emissions and effects of pollutants on human health and environment and also emission standards.

CO2: Explain the formation mechanism of various types of pollutants and significance of emission control methods in SI and CI engines.

CO3: Interpret the construction and working of emission measuring instruments.

CO4: Identify the need of alternate fuels and understand the essential properties of alternate fuels for petrol and diesel engines.

CO5: Infer the storage and dispensing facilities and Performance and emission Characteristics of hydrogen as engine fuel.

CO6: interpret the importance of Hybrid and Electric vehicles.

Mapping of COs to Pos

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

CO6	2	-	-	2	-	3	3	-	-	-	-	-	-	-

TEXTBOOK:

1. Crouse and Anglin, 'Automotive Emission Control', McGraw Hill company. Newyork1993.

2. Engine Emissions: Pollutant formation and advances in control Technology, Authors: NorbePundir B.R., Publisher: Narosa Publishing House.

3. Watson, E.B., Alternative fuels for the combustion engine, ASME, 1990

REFERENCES:

1. V.Ganesan, 'Internal combustion Engines', Tata McGraw Hill Book Co, Eighth Reprint,2005.
2. G.P.Springer and D.J.Patterson, Engine Emissions, Pollutant formation, Plenum Press, New York, 1986.
3. Patterson, D.J, Henin.N.A, Emissions from Combustion engines and their Control, Anna Arbor Science, 1985. Linden.D, Handbook of Batteries and Fuel Cells, McGraw Hill, 1995.
4. Maxwell et al, Alternative Fuel: Emission, Economic and Performance, SAE, 1995

ADVANCED SOLIDS MECHANICS

(FREE ELECTIVE)

Subject Code: UGME8T0518	**L**	**T**	**P**	**C**
IV Year/I Semester	**3**	**-**	**-**	**3**

SYLLABUS:

UNIT-I: INTRODUCTION TO CARTESIAN TENSORS, STRAINS 8hrs

Concept of strain, derivation of small strain tensor and compatibility, Stress: Derivation of Cauchy relations and equilibrium and symmetry equations, principal stresses and directions

UNIT-II: CONSTITUTIVE EQUATIONS 8hrs

Generalized Hooke's law, Linear elasticity, Material symmetry; Boundary Value Problems: concepts of uniqueness and superposition.

UNIT-III: INTRODUCTION TO PRINCIPLE PLANES AND STRESSES 8hrs

Methods (Analytical and graphical) of determining the stresses on oblique section and Mohr's circle.

UNIT-IV: GOVERNING EQUATIONS 8hrs

Introduction to governing equations in cylindrical and spherical coordinates, axisymmetric problems.

UNIT-V: 8hrs

Application to thick cylinders, rotating discs, torsion of non-circular cross-sections, stress concentration problems, thermo-elasticity, 2-d contact problems.

UNIT-VI: 8hrs

Solutions using potentials. Energy methods. Introduction to plasticity.

Course Outcomes:

Upon completion of this course, students will be able understand

CO1: Understand the theory of elasticity including strain/displacement and Hooke's law relationships.

CO2: Analyze solid mechanics problems using classical methods and energy method.

CO3: Determine stress and strain invariants, principal stress, strains and their directions.

CO4: Solve torsion problems in bars, thick cylinders and thin walled members.

CO5: Propose materials and structural elements to the analysis of complex structures.

Mapping of COs to POs

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

TEXT BOOKS:

1. G. T. Mase, R. E. Smelser and G. E. Mase, Continuum Mechanics for Engineers, Third Edition, CRC Press, 2004.
2. Y. C. Fung, Foundations of Solid Mechanics, Prentice Hall International, 1965.
3. Lawrence. E. Malvern, Introduction to Mechanics of a Continuous Medium, Prentice Hall international, 1969.

REFERENCE BOOKS:

1. Strength of Materials -By Jindal, Umesh Publications.
2. Analysis of structures by Vazirani and Ratwani.
3. Mechanics of Structures Vol-III, by S.B.Junnarkar.
4. Strength of materials by Bhavikatti, Lakshmi publications.
5. Strength of Materials by Andrew Pytel and Ferdinond L. Singer Longman.

UNCONVENTIONAL MACHINING PROCESSES

(FREE ELECTIVE)

Subject Code: UGME8T0618	**L**	**T**	**P**	**C**
IV B.Tech./II Sem.	**3**	**-**	**-**	**3**

SYLLABUS

UNIT-1 **6 hrs**

INTRODUCTION – Need for non-traditional machining methods-Classification of modern machining processes – considerations in process selection- Materials and applications.

UNIT-II

MECHANICAL ENERGY BASED PROCESSES **8 hrs**

Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining-Ultrasonic Machining (AJM, WJM, AWJM, USM). Working Principles – equipment used – Process parameters – MRR – Applications.

UNIT-III

ELECTRICAL ENERGY BASED PROCESSES **7 hrs**

Electric Discharge Machining (EDM) - working Principles-equipment-Process Parameters- MRR – Dielectric – Flushing – Applications, Wire Cut EDM- Applications

UNIT-IV **8 hrs**

CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES

Chemical Machining and Electro-Chemical machining (CHM and ECM)-Etchants-maskants -techniques of applying maskants-Process Parameters – MRR-Applications-Principles of ECM-equipment-MRR-Processes Parameters.

UNIT-V **8 hrs**

THERMAL ENERGY BASED PROCESSES:

Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining (EBM), Principles-Equipment-Process Parameters - Applications.

UNIT-VI **6 hrs**

Magnetic abrasive finishing, Abrasive flow finishing, Electro-stream drilling, Shaped tube electrolytic machining.

COURSE OUTCOMES:

At the end of the course students are able to:

CO1: Identify the need of applying unconventional machining processes.
CO2: Outline the principle and mechanism of metal removal for mechanical energy-based processes.
CO3: Apply different methods of material removal by electrical and electro chemical machining processes.
CO4: Choose Thermal energy based unconventional machining process for metal removal.
CO5: Summarize the applications of different Unconventional finishing processes.

Mapping of COs to POs

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

TEXT BOOKS:

1. Advanced machining processes/ VK Jain/ Allied publishers.
2. Modern Machining Process / Pandey P.C. and Shah H.S./ TMH.

REFERENCES:

1. Nontraditional Manufacturing Processes by Benedict. G. F; Publisher: Marcel Dekker
2. Advanced Methods of Machining by McGeough; Publisher: Chapman and Hall, London
3. Unconventional Machining Processes by P. K. Mishra; Publisher: Narosa

EXPERIMENTAL STRESS ANALYSIS

Subject Code: UGME8T0718	**L**	**T**	**P**	**C**
IV Year / II Semester	**3**	**0**	**0**	**3**

SYLLABUS:

UNIT-I MEASUREMENTS: 08hrs

Principles of measurements-Accuracy, Sensitivity and Range of measurements.

UNIT – II EXTENSOMETERS: 08hrs

Mechanical, Optical, Acoustical and Electrical extensometers and their uses, advantages and disadvantages.

UNIT – III ELECTRICAL RESISTANCE STRAIN GAUGES: 08hrs

Principle of operation and requirements-Types and their uses-Materials for strain gauge. Calibration and temperature compensation-cross sensitivity, Rosette analysis-Wheatstone bridge and potentiometer circuits for static and dynamic strain measurements.

UNIT – IV PHOTOELASTICITY: 09 hrs

Two dimensional photo-elasticity- Concepts of light-photo-elastic effects- stress optic law-Interpretation of fringe pattern-Compensation and separation techniques-Photo-elastic materials.

Introduction to three dimensional photo-elasticity.

UNIT-V BRITTLE COATING AND MOIRE METHODS: 08 hrs

Fundamentals of brittle coating methods- Introduction to Moire techniques- Holography-Ultrasonic C-Scan- Thermography, Fiber-optic Sensors.

UNIT – VI NON-DESTRUCTIVE TESTING: 08 hrs

Fundamentals of NDT-Radiography-ultrasonics -Magnetic particle inspection- Fluorescent penetrant technique- Eddy current testing- Acoustic Emission Techniques.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to understand

CO1: Explain the types of strain gauges, mounting techniques and strain gauge

circuits explain the measurement of strain under static and dynamic loads.

CO2: Explain the Mechanical, optical, pneumatic and electrical strain gauges for strain measurement. Analysis of measuring circuits and strains of different strain gauge rosettes.

CO3: Apply different methods of 2 D photoelasticity along with properties of different materials for strain measurement.

CO4: Identify the different types of coatings, test strain data using brittle coating and birefringent coating.

CO5: Apply the Fundamentals of NDT, Acoustic Emission Techniques.

Mapping of COs to Pos

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

TEXT BOOKS

1. "Experimental Stress Analysis", Dally.J.W and Riley.W.F, McGraw Hill Inc., New York, 1978.
2. "Hand Book of Experimental Stress Analysis",Hetyenyi.M,John Wiley and Sons Inc., New York, 1972.

REFERENCES

1. "Experimental Stress Analysis", Srinath.L.S, Raghava.M.R, Lingaiah, Gargesha.K, G.Pant.B andRamachandra.K Tata McGraw Hill, New Delhi, 1984.
2. "Acoustic Emission in Acoustics and Vibrations Progress', Pollock.A.A, ed. by Stephens R.W.B.,Chapman and Hall, 1983.

COMPUTATIONAL FLUID DYNAMICS

Subject Code: UGME8T0818	L	T	P	C
IV Year / II Semester	3	0	0	3

SYLLABUS:

UNIT-I: ELEMENTARY DETAILS IN NUMERICAL TECHNIQUES: **10hrs**

Elementary details in numerical Techniques: Number system and errors, Representation of integers, Fractions, Floating point Arithmetic, loss of significance and error propagation, condition and instability, computational methods for error estimation, Convergence of Sequences.

UNIT-II: APPLIED NUMERICAL METHODS: **9hrs**

Applied Numerical Methods: Solution of a system of simultaneous Linear Algebraic Equations, iterative schemes of Matrix Inversion, Direct Methods for Matrix inversion, Direct Methods for banded matrices.

UNIT- III: **9hrs**

REVIEW OF EQUATIONS GOVERNING FLUID FLOW AND HEAT TRANSFER:

Review of Equations Governing Fluid Flow and Heat Transfer: Introduction, conservation of mass, Newton's second law of motion, expanded forms of Navier-stokes equations, conservation of energy principle, special forms of the Navier-stokes equations.

UNIT-IV: **10hrs**

FINITE DIFFERENCE APPLICATIONS IN HEAT CONDUCTION AND CONVENTION:

Steady flow, dimensionless form of Momentum and Energy equations, Stokes equation, conservative body force fields, stream function - Vorticity formulation.

Finite Difference Applications in Heat conduction and Convention – Heat conduction, steady heat conduction in a rectangular geometry, transient heat conduction, finite difference application in convective heat transfer, closure.

UNIT-V: FUNDAMENTALS OF FLUID FLOW MODELING: **10hrs**

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. Introduction to first order wave equation, stability of hyperbolic and elliptic equations, fundamentals of fluid

flow modeling, conservative property, the upwind scheme.

UNIT-VI: FINITE VOLUME METHOD: 8hrs

Finite Volume Method: Approximation of surface integrals, volume integrals, interpolation and differentiation practices, Upwind interpolation, Linear interpolation and Quadratic interpolation.

Course Outcomes:

Upon the completion of the course, the students will able to:

CO1: Explain the basic principles of numerical techniques.
CO2: Apply the finite difference method for heat transfer problems.
CO3: Analyze the governing equations for fluid flows and heat transfer concepts.
CO4: Analyze the basic concepts and equations of finite volume method.
CO5: illustrate flow physics and mathematical properties of governing Navier- Stokes equations.
CO6: Develop solution techniques for parabolic and hyperbolic equations.

Mapping of COs to POs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO 2
CO1	3	2	-	2	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	2	-	-	-	-	-	-	-	-	-	-
CO3	3	3	-	2	-	-	-	-	-	-	-	-	-	-
CO4	3	3	-	2	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	2	-	-	-	-	-	-	-	-	-	-
CO6	3	3	-	2	-	-	-	-	-	-	-	-	-	-

TEXT BOOKS:

1. Numerical heat transfer and fluid flow / Suhas V. Patankar- Butter-worth Publishers
2. Computational fluid dynamics - Basics with applications - John. D. Anderson / Mc Graw Hill.

REFERENCES:

1. Computational Fluid Flow and Heat Transfer/ Niyogi, Pearson Publications
2. Fundamentals of Computational Fluid Dynamics – Tapan K. Sengupta / Universities Press.
3. Computational Fluid Flow and Heat Transfer , by K. Muralidhar and T. Sundararajan –Narosa-Second Edition

AUTOMATION IN MANUFACTURING
(FREE ELECTIVE)

Subject Code: UGME8T0918	**L**	**T**	**P**	**C**
IV Year / II Semester	**3**	**0**	**0**	**3**

SYLLABUS:

UNIT-I: 8hrs

INTRODUCTION TO AUTOMATION: Types and strategies of automation, Automation in machine tools. Mechanical feeding and too changing and machine tool control transfer the automaton. Advanced Automation Functions, Levels of Automation.

UNIT-II: 7hrs

AUTOMATED FLOW LINES: Methods or work part transport transfer Mechanical buffer storage control function, design and fabrication consideration.

UNIT-III: 9hrs

ANALYSIS OF AUTOMATED FLOW LINES: General terminology and analysis of transfer lines without and with buffer storage, partial automation, implementation of automated flow lines.

UNIT–IV: 8hrs

ASSEMBLY SYSTEM AND LINE BALANCING: Assembly process and systems assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

UNIT-V: 10hrs

AUTOMATED MATERIAL HANDLING: Types of equipment, functions, analysis and design of material handling systems conveyor systems, automated guided vehicle systems.

AUTOMATED STORAGE SYSTEMS, Automated storage and retrieval systems; work in process storage, interfacing handling and storage with manufacturing.

UNIT-VI: 8hrs

CAD/CAM/CIM: Computer Aided Design, Computer Aided Manufacturing, Computer Integrated Manufacturing. Product Design and CAD, Application of Computersindesign. Fundamentals of ComputerAidedProcessPlanning,Concurrent Engineering and Design for Manufacturing.

Course Outcomes:

Upon the completion of the course, the students will able to:

CO1: Enumerate principles, strategies and advantages of industrial automation.

CO2: Discuss the design & major components of automation.

CO3: Awareness about automation, types, line balancing,FMS.

CO4: Automate shop floor controls and part/device identification methods.

CO5: Design material handling and material storage systems for an automated factory.

CO6: Describe the fundamental concepts and need of CAD/CAM

Mapping of COs to Pos

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO 2
CO1	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO6	3	-	3	-	3	-	-	-	-	-	-	3	-	-

TEXT BOOKS:

1. Automation, Production Systems and Computer Integrated Manufacturing : M.P. Groover./PE/PHI
2. CAD / CAM/ CIM byRadhakrishnan.

REFERENCE BOOKS:

1.Computer control of Manufacturing Systems by Yoram Coreom.

2.Automation by W. Buekinsham.

Seminar

Subject Code: UGME8S1018	**L**	**T**	**P**	**C**
IV B. Tech./II Sem.	**-**	**-**	**2**	**2**

Objective: To expose students to the 'real' working environment and get acquainted with the organization structure, business operations and administrative functions.

COURSE OUTCOMES

At the end of the course students are able to:

CO1: Utilize technical resources

CO2: write technical documents and give oral presentations related to the work completed.

CO3: promote and develop presentation skills and import a knowledgeable society

Mapping of COs to Pos

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PSO 2**
CO1	3	-	-	-	3	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	3	-	-	-	3	3	-	3	-	-
CO3	-	-	-	-	-	-	-	-	3	3	-	3	-	-

Project Work

Subject Code: UGME8J1118	L	T	P	C
IV B.Tech./IISem.	-	-	2	2

Course Objective:

Learn the technical Procedure of planning, scheduling and realizing an engineering product and further acquire the skills of technical report writing and data collection

COURSE OUTCOMES

At the end of the course students are able to:

CO1: Identify a topic in advanced areas of Mechanical Engineering.
CO2: Explore the methods to carry out experiments/develop code.
CO3: Implement innovative ideas for social benefit, environment and ethics.
CO4: Investigate and discuss the results to draw valid conclusions
CO5: Prepare a report as per the guidelines and defend the work.

Mapping of COs to Pos

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	-	-	-	3	3	2	3	3	-	-	-	3	3
CO2	3	3	-	3	-	3	3	3	3	-	3	3	3	3
CO3	3	3	3	-	3	3	3	3	3	-	3	3	3	3
CO4	3	-	3	3	-	3	-	3	3	-	3	3	3	3
CO5	3	-	-	3	3	3	-	3	3	-	3	3	3	3

Internship/Certification Course/EPICS/Foreign Languages/Yoga

Subject Code: UGME8I1118	L	T	P	C
IV B.Tech./IISem.	-	-	-	3

Guidelines/Instructions:
The student can do anyone of the following courses at anytime from first year to fourth year.

- Internship
- Certification Course
- EPICS
- Foreign Language
- Yoga

Internship: The student should do the Internship in a reputed company which is approved by the department. The minimum period of Internship shall be one month. However it can be completed in 3 to 4 slots/intervals which shall be a minimum of five days slot.

Certification Course: The student shall be permitted to take certification courses preferably from NPTEL/Swayam/Coursera or any other standard platform, which has to be approved by the department and it must be at least for a period of 8 weeks.

EPICS: EPICS is a service-learning design program in which teams of students partner with local and global community organizations to address human, community, and environmental needs. EPICS was founded at Purdue University in Fall 1995. Students who are interested can register for this program and should get completion certificate from Purdue University.

Foreign Languages: The student shall learn any Foreign Language and get certified from EFLU or a standard organization which has to be approved by the college.

Yoga: The student shall undergo training on Yoga for a period of 2 months and get certified by a standard organization which has to approved by the college.

Course Outcomes:

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

CO1: Prove personal commitment to ethical behaviour, competent practice, taking responsibility for their own work and acknowledging the work of others.

CO2: Appropriate engagement with relevant stakeholders, and identify, assess and manage risk.

CO3: Demonstrate effective communication, initiative, effective work practices in a multi-disciplinary team.

CO4: Develop proficient application and exploration of real-world problems and evaluation of the outcomes and impact of their work.

Mapping of COs to POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	-	-	-	-	3	3	3	3	3	-	3	-	-
CO2	3	3	-	3	-	3	3	3	3	3	3	3	-	-
CO3	-	3	3	3	-	3	3	-	3	3	-	3	3	3
CO4	3	3	3	3	3	3	3	-	-	-	-	3	3	3