VASIREDDY VENKATADRI INSTITUTE OF TECHNOLOGY

Nambur (V), Pedakakani (M), Guntur (Dt.), Andhra Pradesh – 522 508

DEPARTMENT OF MECHANICAL ENGINEERING

COURSE STRUCTURE AND SYLLABUS

for

B. Tech Mechanical Engineering

(Applicable for batches admitted from 2020-2021)

VASIREDDY VENKATADRI INSTITUTE OF TECHNOLOGY

(Autonomous)

Approved by AICTE, Permanently Affiliated to JNTUK,

NAAC Accredited with 'A' Grade, ISO 9001:2015 Certified

Nambur (V), Pedakakani (M), Guntur (Dt.), Andhra Pradesh – 522 508

About Institute:

Vasireddy Venkatadri Institute of Technology (VVIT) was established in the year 2007, with an intake of 240 students in four B. Tech programs under Social Educational Trust in Nambur village, Guntur, AP, by Er. Vasireddy Vidya Sagar. It is located strategically between Guntur and Vijayawada in the capital region of Amravati, AP. In a short span of ten years, with an annual intake capacity of 1260 and 81 students into B.Tech (CE, EEE, ME, ECE, CSE, IT, CSM, CSO, CIC and AID) and M. Tech (CSE, VLSI&ES, PEED, MD, SE) programs respectively, today almost 4000 students, 345 teaching staff and 225 non-teaching staff strive to fulfill the vision of VVIT.

VVIT has emerged as one of the top ten Engineering Colleges from the 200 engineering colleges affiliated to JNTU Kakinada. The Institute signed MoUs with Industry and Training & Placement Companies like Infosys, Tech Mahindra, Social Agro, Efftronics, AMCAT and Cocubes. Centre of Excellence (CoE) by Siemens India was established in the year 2016 by APSSDCto promote Industry Institute interface and strengthen employability skills in students, Google Inc. USA for establishing Google Code labs, University Innovative Fellowship (UIF) program by Stanford University USA and VDC established by Northeastern University

On achieving permanent affiliation to JNTUK, Kakinada, NAAC ‘A” grade certification (CGPA 3.09) and B. Tech programs (CE, EEE, ME, ECE, CSE, IT) accredited by NBA, VVIT has set its sight on centrally funded research projects with 10 completed and 6 running DST projects and consultancy service from other departments. VVIT as part of its commitment to research, has published 13 patents, 16 books and nearly 690 journal papers and also has a ‘Research Centre affiliated to JNTUK’.

Institute Vision

To impart quality education through exploration and experimentation and generate socially conscious engineers, embedding ethics and values, for the advancement in science and technology.

Institute Mission

To educate students with a practical approach to dovetail them to industry-needs. To govern the institution with a proactive and professional management with passionate teaching faculty.To provide holistic and integrated education and achieve over all development of students by imparting scientific and technical, social and cognitive, managerial and organizational skills. To compete with

the best and be the most preferred institution of the studious and the scholarly.To forge strong relationships and linkage with the industry.

Department Vision

To impart the knowledge of mechanical engineering with global perspectives for graduates to serve the industry in particular and the society at large through quality education and research.

Department Mission

- ➢ To enable graduates to be technically strong,ethically sound with good communication skills by innovative teaching methods
- ➢ To provide world class education to mould the students, so that they possess good leadership qualities and professional skills.
- ➢ To create a conducive environment and facilities to improve overall personality development of the students.
- ➢ To create an awareness of the social responsibilities of an engineer.
- ➢ To bond strong relationship with industries to upgrade the knowledge of the students through exposure for cutting edge technologies.

Program Educational Objectives (PEOs)

PEO1: To provide a solid foundation to build a professional career, take-up higher studies with sound knowledge in Mathematics, Science and Mechanical Engineering along with fundamentals in C-programming, modelling, designing to acquire problem solving skills with global competence.

PEO2: To instil strong ethical values and leadership qualities in graduates that makes them entrepreneurs with social responsibility.

PEO3: To widen the thirst for knowledge by encouraging them to develop R&D skills alongside lifelong learning skills.

Program Outcomes (POs)

PO1 : Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 : 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.

PO3 : 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.

PO4 : 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.

PO5 : 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.

PO6 : 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.

PO7 : 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.

PO8 : Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 : Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 : 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.

PO11 : 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 projects and in multidisciplinary environments.

PO12 : Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

PSO1 : Able to provide socially acceptable technical solutions to mechanical engineering problems with the application of modern and appropriate techniques for sustainable development.

PSO2 : Apply the appropriate techniques and modern engineering hardware and software tools in mechanical engineering to engage in life -long learning and successfully adapt in multidisciplinary environments.

ACADEMIC REGULATIONS (R20) FOR B. TECH (REGULAR)

Applicable for the students of B.Tech from the Academic Year 2020 – 21 onwards

1. Award of B. Tech. Degree

A student will be declared eligible for the award of B. Tech. degree if he/she fulfills the following:

- ➢ Pursues a course of study in not less than four and not more than eight academic years.
- ➢ After eight academic years from the year of their admission, he/she shall forfeit their seat in B. Tech course and their admission stands cancelled.
- ➢ Registers for 160 credits and must secure all the 160 credits.
- ➢ A student shall be eligible for the award of **B.Tech degree with Honors or Minor if he/she earns 20 credits in addition to the 160 credits. A student shall be permitted to register either for Honors or for Minor and not for both simultaneously.**

2. Courses of Study: The following courses of study are offered at present as specializations for the B. Tech. Courses

S. No.	Branch	Branch Short Form	Branch Code
1	Civil Engineering	CIV	01
2	Electrical and Electronics Engineering	EEE	02
3	Mechanical Engineering	MEC	03
4	Electronics and Communication Engineering	ECE	04
5	Computer Science and Engineering	CSE	05
6	Information Technology	INF	12

7	CSE (Artificial Intelligence and Machine Learning)	CSM	42
8	CSE (Internet of Things and Cyber Security with Block Chain Technology)	CIC	47
9	CSE (Internet of Things)	CSO	49
10	Artificial Intelligence and Data Science	AID	54

3. **Medium of Instruction:** The medium of instruction of the entire B. Tech undergraduate programme in Engineering & Technology (including examinations and project reports) will be in English only.

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

5. **Structure of the Undergraduate Engineering program:** Every course of B. Tech. Program shall be placed in one of the nine categories as listed in table below:

S.No.	Category	Breakup of Credits
1	Humanities and social science including Management courses	10.5 - 12
2	Basic Science courses	21 - 25
3	Engineering science courses	24
4	Professional core Courses	48 - 51
5	Open Elective Courses	12 - 18
6	Professional Elective Courses	15 - 18
7	Internship, seminar, project wok	15 – 16.5
8	Mandatory courses	NC
9	Skill Oriented Courses	----
	Total Credits	160

** Breakup of Credits based on AICTE /APSCHE

Assigning of Credits

- Hr. Lecture (L) per week - 1 credit
- Hr. Tutorial (T) per week - 1 credit
- Hr. Practical (P) per week - 0.5 credits

6. Programme Pattern

i. Total duration of the of B. Tech (Regular) Programme is four (three for lateral entry) academic years

ii. Each Academic year of study is divided in to two semesters.

iii. Minimum number of instruction days in each semester is 90.

iv. Grade points, based on percentage of marks awarded for each course will form the basis for calculation of SGPA (Semester Grade Point Average) and CGPA (Cumulative Grade Point Average).

v. The total credits for the Programme are 160.

vi. A three-week induction program is mandatory for all first year UG students (Physical activity, Creative Arts, Universal Human Values, Literary, Proficiency Modules, Lectures by Eminent People, Visits to local Areas, Familiarization to Dept./Branch & Innovations etc.,) and shall be conducted as per AICTE/UGC/APSCHE guidelines.

vii. Student is introduced to "Choice Based Credit System (CBCS)".

viii. A pool of interdisciplinary and job-oriented mandatory skill courses which are relevant to the industry are integrated into the curriculum of concerned branch of engineering (total five skill courses: two basic level skill courses, one on soft skills and other two on advanced level skill courses)

ix. A student has to register for all courses in a semester.

x. All the registered credits will be considered for the calculation of final CGPA.

xi. Each semester has - Continuous Internal Evaluation (CIE) and Semester End Examination (SEE). Choice Based Credit System (CBCS) and Credit Based Semester System (CBSS) as indicated by UGC and course structure as suggested by AICTE are followed.

xii. A 10 months industry/field mandatory internship, both industry and social, during the summer vacation and also in the final semester to acquire the skills required for job and make engineering graduates to connect with the needs of the industry and society at large.

xiii. All students shall be mandatorily registered for NCC/NSS activities. A student will be required to participate in an activity for two hours in a week during second and third semesters. Grade shall be awarded as Satisfactory or Unsatisfactory in the mark sheet on the basis of participation, attendance, performance and behavior. If a student gets an unsatisfactory Grade, he/she shall repeat the above activity in the subsequent years, in order to complete the degree requirements.

xiv. Courses like Environmental Sciences, Human Values, Ethics, Indian Constitution, Essence of Indian Traditional Knowledge etc., shall be included in the curriculum as non-credit mandatory courses. Environmental Sciences is to be offered compulsorily as mandatory course for all branches. A student has to secure 40% of the marks allotted in the internal evaluation for passing the course. No marks or letter grade shall be allotted for all mandatory non-credit courses.

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

xvi. Departments may swap some of the courses between first and second semesters to balance the work load.

xvii. The concerned Board of studies can assign tutorial hours to such courses wherever it is necessary, but without change in the total number of credits already assigned for semester.

8. Registration for Courses

i. The college shall invite registration forms from the students at the beginning of the semester for the registration for courses each semester. The registration process shall be closed within one week. If any student wishes to withdraw the registration, he/she shall submit a letter to the principal through the class teacher/instructor and HOD. The principal shall communicate the

registration and withdraw details courses of each student in a consolidated form to the college examination section and University without fail.

ii. There are four open electives in each branch. All Open Electives are offered to students of all branches in general. A student shall choose an open elective, by consulting the HOD/advisor, from the list in such a manner that he/she has not studied the same course in any form during the Programme. The college shall invite registration forms from the students at the beginning of the semester for offering professional and open elective courses. There shall be a limit on the minimum and maximum number of registrations based on class/section strength.

iii. A student shall be permitted to pursue up to a maximum of two elective courses under MOOCs during the programme. Students are advised to register for only for minimum 12 weeks in duration MOOCs courses. Student has to pursue and acquire a certificate for a MOOC course only from the SWAY/NPTE through online with the approved by the BoS in order to earn the 3 credits. The Head of the department shall notify the list of such courses at the beginning of the semester. The details of the MOOCs courses registered by the students shall be submitted to the University examination center as well as college examination center. The Head of the Department shall appoint a mentor for each of the MOOC subjects registered by the students to monitor the student's assignment submissions given by SWAYAM/NPTEL. The student needs to submit all the assignments given and needs to take final exam at the proctor center. The student needs to earn a certificate by passing the exam. The student will be awarded the credits given in curriculum only by submission of the certificate. In case if student does not pass subjects registered through SWAYAM/NPTEL, the same or alternative equivalent subject may be registered again through SWAYAM/NPTEL in the next semester with the recommendation of HOD and shall be passed.

iv. Two summer internships each with a minimum of six weeks duration shall be mandatorily done/ completed respectively at the end of second and third years (during summer vacations). The internship can be done by the students at local industries, Govt. Organizations, construction agencies, Industries, Hydel and thermal power projects and also in software MNCs. After completing the summer internship, the students shall register in the immediate respective odd semester and it will be evaluated at the end of the semester as per norms of the autonomy. The student has to produce the summer internship satisfactory report and certificate taken from the

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

v. In the final semester, the student should mandatorily register and undergo internship and in parallel he/she should work on a project with well-defined objectives. At the end of the semester the candidate shall submit an internship completion certificate and a project report. A student shall also be permitted to submit project report on the work carried out during the internship. The project report shall be evaluated with an external examiner.

vi. Curricular Framework for Skill oriented courses

a. There are five (05) skill-oriented courses shall be offered during III to VII semesters and students must register and pass the courses successfully.

b. For skill oriented/skill advanced course, one theory and 2 practical hours (1-0-2) or two theory hours (2-0-0) may be allotted as per the decision of concerned BOS.

c. Out of the five skill courses; (i) two shall be skill-oriented courses from the same domain and shall be completed in second year (ii) Of the remaining 3 skill courses, one shall be necessarily be a soft skill course and the remaining two shall be skill-advanced courses either from the same domain or job-oriented skill courses, which can be of inter disciplinary nature.

d. Students may register the interdisciplinary job-oriented skill courses based on the prerequisites and eligibility in consultation with HoD of the college.

e. The student shall be given an option to choose either the skill courses being offered by the college or to choose a certificate course being offered by industries/Professional bodies/APSSDC or any other accredited bodies. However, the department has to assign mentors in the college to monitor the performance of the students.

f. If a student chooses to take a certificate course offered by industries/Professional bodies/APSSDC or any other accredited bodies, in lieu of the skill advanced course offered by the department, then the department shall mark overall attendance of the student for the remaining courses in that semester excluding the skill course in all the calculations of mandatory attendance requirements

upon producing a valid certificate. However, the student is deemed to have fulfilled the attendance requirement of the course, if the external agency issues a certificate with satisfactory condition. If the certificate issued by external agency is marked with unsatisfactory condition, then the student shall repeat the course either in the college or at external agency. The credits will be awarded to the student upon producing the successful course completion certificate from the agency/professional bodies and after passing in the viva-voce examination conducted at college as per BoS norms at the end of the semester.

9. Attendance Requirements:

i. A student is eligible to write the semester-end examinations if he acquires a minimum of 40% in each subject and 75% of attendance in aggregate of all the subjects.

ii. Shortage of Attendance below 65% in aggregate shall in NO case be condoned. Students whose shortage of attendance is not condoned in any semester are not eligible to take their end semester examination of that class and their registration shall stand cancelled.

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

iv. A student will not be promoted to the next semester unless he satisfies the attendance requirements of the present semester, as applicable. They may seek readmission for that semester when offered next.

v. A student will be promoted to the next semester if he satisfies the (a) attendance requirement of the present semester and (b) minimum required credits (from Vth Semester onwards).

vi. If any candidate fulfills the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.

vii. For induction programme attendance shall be maintained as per AICTE norms.

viii. For non-credit mandatory courses the students shall maintain the attendance similar to credit courses.

10. Evaluation-Distribution and Weightage of marks

Paper setting and evaluation of the answer scripts shall be done as per the procedures laid down by the Academic Council of the institute from time to time.

i. A student is deemed to have satisfied the minimum academic requirements if he/she has earned the credits allotted to each theory/practical design/drawing subject/ project etc. by securing not less than 35% of marks in the end semester exam and minimum 40% of marks in the total of the internal marks and end semester examination marks together.

ii. For non-credit mandatory courses, like Environmental Sciences, Universal Human Values, Ethics, Indian Constitution, Essence of Indian Traditional Knowledge, the student has to secure 40% of the marks allotted in the internal evaluation for passing the course. No marks or letter grade shall be allotted for all mandatory non-credit courses.

iii. Distribution and Weightage of marks**:** The assessment of the student's performance in each course will be based on Continuous Internal Evaluation (CIE) and Semester-End Examination (SEE). The performance of a student in each semester shall be evaluated subject–wise with a maximum of 100 marks for theory subject, 50 marks for practical subject/Mini Project/Internship/Industrial Training/ Skill Development programmes/Research Project, and 200 marks for end Project Work.

iv. Guide lines for Continuous Internal Evaluation (CIE)

a. For theory subjects, during a semester, there shall be two mid-term examinations. Each mid-term examination consists of (i) one online objective examination (ii) one descriptive examination (iii) one assignment and (iv) one Subject Seminar. The online examination (objective) shall be 10 marks with duration of 20 minutes, descriptive examination shall be for 10 marks with a duration of 1 hour 30 minutes, assignment test shall be 5 marks with duration of 50 minutes (Open book system with questions of L4 standard on Bloom's scale) and 90 minutes for descriptive paper) and Subject Seminar 5 marks.

b. The first online examination (objective) is set with 20 multiple choice questions for 10 marks (20 questions x 1/2 marks) from first two and half units (50% of the syllabus).

c. The descriptive examination is set with 3 full questions for 10 marks each from first two and half units (50% of the syllabus), the student has to answer all questions.

d. The Assignment Test from first two and half units conducted for 20 Marks and will be scaled down to 5 Marks. The test is open book system and the duration of the exam is 50 minutes. Students can bring a maximum of three printed text books related to that subject. (Soft copies of the text books will not be allowed.) The assignments have to provide broadened exposure to the course. The questions shall include problem solving approach, problem analysis & design, implementation, case studies etc.

e. For the subject seminar 5 marks, each student shall be evaluated based on the presentation on any topic of his/her choice in the subject duly approved by the faculty member concerned.

f. For the subject having design and / or drawing (such as Engineering Graphics, Engineering Drawing, Machine Drawing) and estimation, the distribution shall be 30 marks for internal evaluation (15 marks for continuous Assessment (day–to–day work) and 15 marks for internal tests). In the similar lines, the mid-2 examinations shall be conducted on the rest of the syllabus.

g. For practical subjects there shall be continuous evaluation during the semester for 25 marks. The internal 25 marks shall be awarded as follows: day to day work 5 marks, record 5 marks and the remaining 15 marks are to be awarded by conducting an internal laboratory test of 3 hours duration.

h. The mid marks submitted to the examination section shall be displayed in the concerned department notice boards for the benefit of the students. If any discrepancy found in the displayed Mid marks, it shall be brought to the notice of examination section within two working days from the date of display.

i. Internal marks can be calculated with 80% weightage for better of the two mids and 20% Weightage for another mid exam.

Example:

Mid-1 marks = Marks secured in (online examination-1+descriptive examination-1 + one assignment-1 + Seminar-1)

Mid-2 marks = Marks secured in (online examination-2+descriptive examination-2 +one assignment-2 + Seminar-2)

Final internal Marks = (Best of (Mid-1/Mid-2) marks x 0.8 + Least of (Mid-1/Mid-2) marks x 0.2)

v. **Semester End Examinations Evaluation:**

a. The semester end examinations for theory subjects will be conducted autonomous examination section for 70 marks consists of five questions carrying 14 marks each. Each of these questions is from one unit and may contain sub-questions. For each question there will be an "either" "or" choice, which means that there will be two questions from each unit and the student should answer either of the two questions.

b. For practical subjects shall be conducted for 35 marks by the teacher concerned and external examiner appointed by Chief superintendent/ Controller of Examinations (CoE), VVIT. All the laboratory records and internal test papers shall be preserved in respective departments as per autonomous norms and shall be produced to the Committees as and when they ask for.

c. Evaluation of the summer internships: It shall be completed in collaboration with local industries, Govt. Organizations, construction agencies, Industries, Hydel and thermal power projects and also in software MNCs in the area of concerned specialization of the UG programme. Students shall pursue this internship during summer vacation just before its offering as per course structure. The minimum duration of this course shall be at least 6 weeks. The student shall register for the internship as per course structure after commencement of academic year. A supervisor/mentor/ advisor has to be allotted to guide the students for taking up the summer internship. The supervisor shall monitor the attendance of the students while taking up the internship. Attendance requirements are as per the norms of the academic regulations. After successful completion, students shall submit a summer internship technical report to the concerned department and appear for an oral presentation before the departmental committee consists of an external examiner appointed by Chief superintendent/ CoE; Head of the Department, supervisor of the internship and a senior faculty member of the department. A certificate from industry/skill development center shall be included in the report. The report and the oral presentation shall carry 40% and 60% weightages respectively. It shall be evaluated for 50 external marks at the end of the semester. There shall be no internal marks for Summer Internship. A student shall secure minimum 40% of marks for successful completion. In case, if a student fails, he/she shall reappear as and when semester supplementary examinations are conducted by the examination section.

d. The job-oriented skill courses may be registered at the college or at any accredited external agency. A student shall submit a record/report on the on the list skills learned. If the student completes job-oriented skill course at external agency, a certificate from the agency shall be included in the report. The course will be evaluated at the end of the semester for 50 marks (record: 15 marks and viva-voce: 35 marks) along with laboratory end examinations in the presence of external (appointed by the Chief superintendent/ CoE) and internal examiner (course instructor or mentor). There are no internal marks for the job-oriented skill courses.

e. Mandatory Course (M.C): Environmental Sciences, Universal Human Values, Ethics, Indian Constitution, Essence of Indian Traditional Knowledge etc. non-credit (zero credits) mandatory courses. Environmental Sciences shall be offered compulsorily as mandatory course for all branches. A minimum of 75% attendance is mandatory in these subjects. There shall be an external examination for 70 marks and it shall be conducted by the department internally. Two internal examinations shall be conducted for 30 marks and a student has to secure at least 40% of the marks for passing the course. There is no online internal exam for mandatory courses. No marks or letter grade shall be printed in the transcripts for all mandatory non-credit courses, but only Completed (Y)/Not-completed (N) will be specified.

f. Procedure for Conduct and Evaluation of MOOC: There shall be a Discipline Centric Elective Course through Massive Open Online Course (MOOC) as Program Elective course. The student shall register for the course (Minimum of 12 weeks) offered by SWAYAM/NPTEL/etc., through online with the approval of Head of the Department. The Head of the Department shall appoint one mentor for each of the MOOC subjects offered. The student needs to register the course in the SWAYAM/NPTEL portal. During the course, the mentor monitors the student's assignment submissions given by SWAYAM/NPTEL. The student needs to submit all the assignments given and needs to take final exam at the proctor center. The student needs to earn a certificate by passing the exam. The student will be awarded the credits given in curriculum only by submission of the certificate. In case if student does not pass subjects registered through SWAYAM/NPTEL, the same or alternative equivalent subject may be registered again through SWAYAM/NPTEL in the next semester with the recommendation of HOD and shall be passed.

g. Major Project (Project - Project work, seminar and internship in industry): In the final semester, the

student should mandatorily register and undergo internship and in parallel he/she should work on a project with well-defined objectives. At the end of the semester the candidate shall submit an internship completion certificate and a project report. A student shall also be permitted to submit project report on the work carried out during the internship. The project report shall be evaluated with an external examiner. Evaluation: The total marks for project work 200 marks and distribution shall be 60 marks for internal and 140 marks for external evaluation. The supervisor assesses the student for 30 marks (Report: 15 marks, Seminar: 15 marks). At the end of the semester, all projects shall be showcased at the department for the benefit of all students and staff and the same is to be evaluated by the departmental Project Review Committee consisting of supervisor, a senior faculty and HOD for 30 marks. The external evaluation of Project Work is a Viva-Voce Examination conducted in the presence of internal examiner and external examiner appointed by the Chief superintendent/ CoE and is evaluated for 140 marks.

vi. Recounting/ Revaluation/ Revaluation by Challenge in the End Semester Examination: A student can request for recounting/ revaluation/ revaluation by challenge of his/her answer book on payment of a prescribed fee as per autonomous norms.

vii. Supplementary Examinations: A student who has failed to secure the required credits can appear for a supplementary examination, as per the schedule announced by the examination section.

viii. Malpractices in Examinations: Disciplinary action shall be taken in case of malpractices during Mid/End examinations as per the rules framed by the academic council.

ix. If the student is involved in indiscipline/malpractices/court cases, the result of the student will be withheld.

11. Promotion Rules:

i. A student shall be promoted from first year to second year if he fulfills the minimum attendance requirements.

ii. A student will be promoted from II year to III year if he fulfills the academic requirement of 40% of credits up to either II year I-Semester or II year II-Semester from all the examinations, whether or not the candidate takes the examinations and secures prescribed minimum attendance in II year II semester.

iii. A student shall be promoted from III year to IV year if he fulfills the academic requirements of 40% of the credits up to either III year I semester or III year II semester from all the examinations, whether or not the candidate takes the examinations and secures prescribed minimum attendance in III year II semester.

12. **Course Pattern**

i. The entire course of study is for four academic years; all years are on semester pattern.

ii. A student eligible to appear for the end semester examination in a subject, but absent from it or has failed in the end semester examination, may write the exam in that subject when conducted next.

iii. When a student is detained for lack of credits/shortage of attendance, he may be re-admitted into the same semester/year in which he has been detained. However, the academic regulations under which he was first admitted shall continue to be applicable to him.

13. Grading:

The grade points and letter grade will be awarded to each course based on students' performance as per the grading system shown in the following Table.

% of Marks	Letter Grade	Level	Grade Points
≥ 90	**A+**	Outstanding	10
80 to 89	**A**	Excellent	9
70 to 79	**B**	Very Good	8
60 to 69	**C**	Good	7
50 to 59	**D**	Fair	6
40 to 49	**E**	Satisfactory	5
<40	**F**	Fail	0
ABSENT	**Ab**	Absent	0

14. Computation of SGPA and CGPA

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

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

where, C_i is the number of credits of the ith subject and G_i is the grade point scored by the student in the ith course

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

$$CGPA = \Sigma (C_i \times Si) / \Sigma Ci$$

where 'S_i' is the SGPA of the ith semester and C_i is the total number of credits in that semester

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

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

v. Grade Point: It is a numerical weight allotted to each letter grade on a 10-point scale.

vi. Letter Grade: It is an index of the performance of students in a said course. Grades are denoted by letters A+, A, B, C, D, E and F.

vii. As per AICTE regulations, conversion of CGPA into equivalent percentage as follows:

Equivalent Percentage = (CGPA – 0.75) x 10

viii. Illustration of Computation of SGPA and CGPA

Illustration for SGPA: Let us assume there are 6 subjects in a semester. The grades obtained as follows:

Course	Credit	Grade Obtained	Grade point	Credit x Grade Point
Subject 1	3	B	8	3 X 8 = 24
Subject 2	4	C	7	4 X 7 = 28
Subject 3	3	D	6	3 X 6 = 18

Subject 4	3	A^+	10	3 X 10 = 30
Subject 5	3	E	5	3 X 5 = 15
Subject 6	4	D	6	4 X 6 = 24
	20			139

Thus, SGPA (S_i) =139/20 =6.95=6.9 (approx.)

Illustration for CGPA:

	Sem-1	Sem-2	Sem-3	Sem-4	Sem-5	Sem-6	Sem-7	Sem-8
Credits	20	22	25	26	26	25	21	23
SGPA	6.9	7.8	5.6	6.0	6.3	8.0	6.4	7.5

$$CGPA = \frac{20\,X6.9 + 22X7.8 + 25X5.6 + 26X6.0 + 26X6.3 + 25X8.0 + 21X6.4 + 23X7.5}{188}$$

$$= \frac{1276.3}{188} = 6.78$$

15. Award of Class:

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

Class Awarded	CGPA to be secured
First Class with distinction*	≥7.5
First Class	≥6.5 &<7.5
Second Class	≥5.5 &<6.5
Pass Class	≥4 &<5.5
Fail	<4

* Awarded only if all the credit courses prescribed are cleared within four years for regular candidates and three years for lateral entry candidates. The students who are approved for break in study for entrepreneurships / startups will also be considered for 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 the program shall been considered

16. Gap - Year:

Gap Year – concept of Student Entrepreneur in Residence shall be introduced and outstanding students who wish to pursue entrepreneurship are allowed to take a break of one year at any time after I year/II year/III year to pursue entrepreneurship full time. This period shall be counted for the maximum time for graduation. An evaluation committee at university level shall be constituted to evaluate the proposal submitted by the student and the committee shall decide on permitting the student for availing the Gap Year.

17. Transitory Regulations

A candidate, who is detained or discontinued a semester, on re-admission shall be required to pass all the courses in the curriculum prescribed for such batch of students in which the student joins subsequently and the academic regulations be applicable to him/her which are in force at the time of his/her admission. However, exemption will be given to those candidates who have already passed in such courses in the earlier semester(s) and additional courses are to be studied as approved by Board of Studies and ratified by Academic Council.

18.Curricular Framework for Honors Programme

i. Students of a Department/Discipline are eligible to opt for Honors Programme offered by the same Department/Discipline.

ii. A student shall be permitted to register for Honors program at the beginning of 4th semester provided that the student must have acquired a minimum of 8.0 SGPA up to the end of 2nd semester without any backlogs. In case of the declaration of the 3rd semester results after the commencement of the 4th semester and if a student fails to score the required minimum of 8 SGPA, his/her registration for Honors Programme stands cancelled and he/she shall continue with the regular Programme.

iii. Students can select the additional and advanced courses from their respective branch in which they are pursuing the degree and get an honors degree in the same. e.g. If a Mechanical Engineering student completes the selected advanced courses from same branch under this scheme, he/she will be awarded B.Tech. (Honors) in Mechanical Engineering.

iv. In addition to fulfilling all the requisites of a Regular B.Tech Programme, a student shall earn 20 additional credits to be eligible for the award of B. Tech (Honors) degree. This is in addition to the credits essential for obtaining the Under Graduate Degree in Major Discipline (i.e., 160 credits).

v. Of the 20 additional Credits to be acquired, 16 credits shall be earned by undergoing specified courses listed as pools, with four courses, each carrying 4 credits. The remaining 4 credits must be acquired through two MOOCs, which shall be domain specific, each with 2 credits and with a minimum duration of 8/12 weeks as recommended by the Board of studies.

vi. It is the responsibility of the student to acquire/complete prerequisite before taking the respective course. The courses offered in each pool shall be domain specific courses and advanced courses.

vii. The concerned BoS shall decide on the minimum enrolments for offering Honors program by the department. If minimum enrolments criteria are not met then the students shall be permitted to register for the equivalent MOOC courses as approved by the concerned Head of the department in consultation with BoS.

viii. Each pool can have theory as well as laboratory courses. If a course comes with a lab component, that component has to be cleared separately. The concerned BoS shall explore the possibility of introducing virtual labs for such courses with lab component.

ix. MOOC courses must be of minimum 8 weeks in duration. Attendance will not be monitored for MOOC courses. Students have to acquire a certificate from the agencies approved by the BOS with grading or marks or pass/fail in order to earn 4 credits. If the MOOC course is a pass/fail course without any grades, the grade to be assigned will be as decided by the university/academic council.

x. The concerned BoS shall also consider courses listed under professional electives of the respective B. Tech programs for the requirements of B. Tech (Honors). However, a student shall be permitted to choose only those courses that he/she has not studied in any form during the Programme.

xi. If a student drops or is terminated from the Honors program, the additional credits so far earned cannot be converted into free or core electives; they will remain extra. These additional courses will find mention in the transcript (but not in the degree certificate). In such cases, the student may choose between the actual grade or a “pass (P)” grade and also choose to omit the mention of the

course as for the following: All the courses done under the dropped Minors will be shown in the transcript. None of the courses done under the dropped Minor will be shown in the transcript.

xii. In case a student fails to meet the CGPA requirement for Degree with Honors at any point after registration, he/she will be dropped from the list of students eligible for Degree with Honors and they will receive regular B.Tech degree only. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.

xiii. Honors must be completed simultaneously with a major degree program. A student cannot earn Honors after he/she has already earned bachelor's degree.

19. Curricular Framework for Minor Programme

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

ii. Student can also opt for Industry relevant tracks of any branch to obtain the Minor Degree, for example, a B.Tech Mechanical student can opt for the industry relevant tracks like Data Mining track, IOT track, Machine learning track etc.

iii. The BOS concerned shall identify as many tracks as possible in the areas of emerging technologies and industrial relevance / demand. For example, the minor tracks can be the fundamental courses in CSE, ECE, EEE, CE, ME etc., or industry tracks such as Artificial Intelligence (AI), Machine Learning (ML), Data Science (DS), Robotics, Electric vehicles, Robotics, VLSI etc.

iv. The list of disciplines/branches eligible to opt for a particular industry relevant minor specialization shall be clearly mentioned by the respective BoS.

v. There shall be no limit on the number of programs offered under Minor. The college can offer minor programs in emerging technologies based on expertise in the respective departments or can explore the possibility of collaborating with the relevant industries/agencies in offering the program.

vi. The concerned BoS shall decide on the minimum enrolments for offering Minor program by the department. If a minimum enrolments criterion is not met, then the students may be permitted to

register for the equivalent MOOC courses as approved by the concerned Head of the department in consultation with BoS.

vii. A student shall be permitted to register for Minors program at the beginning of 4th semester subject to a maximum of two additional courses per semester, provided that the student must have acquired 8 SGPA (Semester Grade point average) up to the end of 2nd semester without any history of backlogs. It is expected that the 3rd semester results may be announced after the commencement of the 4th semester. If a student fails to acquire 8 SGPA up to 3rd semester or failed in any of the courses, his registration for Minors program shall stand cancelled. An SGPA of 8 has to be maintained in the subsequent semesters without any backlog in order to keep the Minors registration active.

viii. A student shall earn additional 20 credits in the specified area to be eligible for the award of B. Tech degree with Minor. This is in addition to the credits essential for obtaining the Under Graduate Degree in Major Discipline (i.e., 160 credits).

ix. Out of the 20 Credits, 16 credits shall be earned by undergoing specified courses listed by the concerned BoS along with prerequisites. It is the responsibility of the student to acquire/complete prerequisite before taking the respective course. If a course comes with a lab component, that component has to be cleared separately. A student shall be permitted to choose only those courses that he/she has not studied in any form during the Programme.

x. In addition to the 16 credits, students must pursue at least 2 courses through MOOCs. The courses must be of minimum 8 weeks in duration. Attendance will not be monitored for MOOC courses. Student has to acquire a certificate from the agencies approved by the BOS with grading or marks or pass/fail in order to earn 4 credits. If the MOOC course is a pass/fail course without any grades, the grade to be assigned as decided by the University/academic council.

xi. Student can opt for the Industry relevant minor specialization as approved by the concerned departmental BoS. Student can opt the courses from Skill Development Corporation (APSSDC) or can opt the courses from an external agency recommended and approved by concerned BOS and should produce course completion certificate. The Board of studies of the concerned discipline of Engineering shall review such courses being offered by eligible external agencies and prepare a fresh list every year incorporating latest skills based on industrial demand.

xii. A committee should be formed at the level of College / department to evaluate the grades/ marks given by external agencies to a student which are approved by concerned BoS. Upon completion of courses the departmental committee should convert the obtained grades/marks to the maximum marks assigned to that course. The controller of examinations can take a decision on such conversions and may give appropriate grades.

xiii. If a student drops (or terminated) from the Minor program, they cannot convert the earned credits into free or core electives; they will remain extra. These additional courses will find mention in the transcript (but not in the degree certificate). In such cases, the student may choose between the actual grade or a "pass (P)" grade and also choose to omit the mention of the course as for the following: All the courses done under the dropped Minors will be shown in the transcript or None of the courses done under the dropped Minor will be shown in the transcript.

xiv. In case a student fails to meet the CGPA requirement for B.Tech degree with Minor at any point after registration, he/she will be dropped from the list of students eligible for degree with Minors and they will receive B. Tech degree only. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.

xv. Minor must be completed simultaneously with a major degree program. A student cannot earn the Minor after he/she has already earned bachelor's degree.

20. Industrial Collaborations (Case Study)

Institution-Industry linkages refer to the interaction between firms and universities or public research centers with the goal of solving technical problems, working on R&D, innovation projects and gathering scientific as well as technological knowledge. It involves the collaboration of Industries and Universities in various areas that would foster the research ecosystem in the country and enhance growth of economy, industry and society at large.

The Institutions are permitted to design any number of Industry oriented minor tracks as the respective BoS feels necessary. In this process the Institutions can plan to have industrial collaborations in designing the minor tracks and to develop the content and certificate programs. Industry giants such as IBM, TCS, WIPRO etc., may be contacted to develop such collaborations.

The Institutions shall also explore the possibilities of collaborations with major industries in the core sectors and professional bodies to create specialized domain skills.

21. Amendments to Regulations: The college may from time-to-time revise, amend or change the Regulations, Curriculum, Syllabus and Scheme of examinations through the Board of Studies with the approval of Academic Council and Governing Body of the college.

22. Transferred Students: The students seeking transfer to VVIT from various Universities/ Institutions have to obtain the credits of any equivalent subjects as prescribed by the Academic Council. Only the internal marks obtained in the previous institution will be considered for evaluation of failed subjects.

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ACADEMIC REGULATIONS (R20) FOR B. TECH.
(LATERAL ENTRY SCHEME)

Applicable for the students admitted into II-year B. Tech. from the Academic Year 2021-22 onwards

1. **Award of B. Tech. Degree:** A student will be declared eligible for the award of B. Tech. Degree if he fulfills the following academic regulations:

- ➢ A student shall be declared eligible for the award of the B. Tech Degree, if he pursues a course of study in not less than three academic years and not more than six academic years.
- ➢ The candidate shall register for 121 credits and secure all the 121 credits.
- ➢A student shall be eligible for the award of B.Tech degree with Honors or Minor if he/she earns 20 credits in addition to the 121 credits. A student shall be permitted to register either for Honors or for Minor and not for both simultaneously.

2. The attendance regulations of B. Tech. (Regular) shall be applicable to B.Tech Lateral Entry Students.

3. Promotion Rule

➢ A student shall be promoted from second year to third year if he fulfills the minimum attendance requirement.

➢ A student shall be promoted from III year to IV year if he fulfills the academic requirements of 40% of the credits up to either III year I semester or III year II semester from all the examinations, whether or not the candidate takes the examinations and secures prescribed minimum attendance in III year II semester.

4. Award of Class

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

Class Awarded	CGPA to be secured
First Class with distinction*	≥7.5
First Class	≥6.5 &<7.5
Second Class	≥5.5 &<6.5
Pass Class	≥4 &<5.5
Fail	<4

5. All the other regulations as applicable to B. Tech. 4-year degree course (Regular) will hold good for B. Tech Lateral Entry Scheme.

MALPRACTICE RULES

DISCIPLINARY ACTION FOR IMPROPER CONDUCT IN EXAMINATIONS

S.No.	Nature of Malpractices/Improper conduct	Punishment

1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket of the candidate is to be cancelled and sent to the University.

3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the subjects of the examination (including practical 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 University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.

6.	Refuses to obey the orders of the Chief Superintendent /Assistant – Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. 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 exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.

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 is also debarred and forfeits the seat.
9.	If 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 is also debarred and forfeits the seat. 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 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 clauses 1 to 11 shall be reported to the University for further action to award suitable punishment.	

Prohibition of ragging in educational institutions Act 26 of 1997

Salient Features

- Ragging within or outside any educational institution is prohibited.
- Ragging means doing an act which causes or is likely to cause Insult or Annoyance of Fear or Apprehension or Threat or Intimidation or outrage of modesty or Injury to a student

	Imprisonment upto		Fine Upto
Teasing, Embarrassing and Humiliation	6 Months	+	Rs. 1,000/-
Assaulting or Using Criminal force or Criminal intimidation	1 Year	+	Rs. 2,000/-
Wrongfully restraining or confining or causing hurt	2 Years	+	Rs. 5,000/-
Causing grievous hurt, kidnapping or Abducts or rape or committing unnatural offence	5 Years	+	Rs. 10,000/-
Causing death or abetting suicide	10 Months	+	Rs. 50,000/-

In case any emergency call Toll Free No. 1800 425 1288

LET US MAKE VVIT A RAGGING FREE CAMPUS

ABSOLUTELY NO TO RAGGING

1. Ragging is prohibited as per Act 26 of A.P. Legislative Assembly, 1997.
2. Ragging entails heavy fines and/or imprisonment.
3. Ragging invokes suspension and dismissal from the College.
4. Outsiders are prohibited from entering the College and Hostel without permission.
5. Girl students must be in their hostel rooms by 7.00 p.m.
6. All the students must carry their Identity Cards and show them when demanded
7. The Principal and the Wardens may visit the Hostels and inspect the rooms any time.

In case any emergency call Toll Free No. 1800 425 1288

LET US MAKE VVIT A RAGGING FREE CAMPUS

COURSE STRUCTURE

Definition of Credit (C)

1 Hour Lecture (L) per week	1 Credit
1 Hour Tutorial (T) per week	1 Credit
1 Hour Practical (P) per week	0.5 Credit

Structure of B. Tech program Regulation R20

S.No.	Category	Code	Suggested Breakup of Credits by AICTE	Suggested Breakup of Credits by APSCHE	Breakup of Credits
1	Humanities and Social Sciences including Management courses	HS	12	10.5	10.5
2	Basic Science courses	BS	25	21	21
3	Engineering Science courses including workshop, drawing, basics of electrical/ mechanical/ computer etc	ES	24	24	24
4	Professional core courses	PC	48	51	51
5	Professional Elective courses relevant to chosen specialization/ branch	PE	18	15	15
6	Open subjects – Electives from other technical and /or emerging subjects	OE	18	12	12
7	Project work, seminar and internship in industry or elsewhere	PR	15	16.5	16.5

8	Mandatory Courses [Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Traditional Knowledge]	MC	Non-Credit	Non-Credit	Non-Credit
9	Skill Oriented Courses	SC	--	10	10
Total			**160**	**160**	**160**

SEMESTER-WISE STRUCTURE OF CURRICULUM

Course structure for eight semesters during four years of study is as follows

I Year I Semester (Semester-1)						
S. No.	**Code**	**Course Name**	**L**	**T**	**P**	**C**
1	HS1101	Communicative English	3	1*	0	3
2	BS1101	Mathematics-I	2	1*	0	3
3	BS1102	Engineering Physics	3	1*	0	3
4	ES1101	Problem Solving using C	3	1*	0	3
5	ES1102	Engineering Graphics	1	0	4	3
6	HS1101L	Communicative English Lab	0	0	3	1.5
7	BS1102L	Engineering Physics and Virtual Lab	0	0	3	1.5
8	ES1101L	Problem Solving using C Lab	0	0	3	1.5
Total Credits			**19.5**			

Category	**CREDITS**
Basic Science Course	7.5
Engineering Science Course	7.5
Humanities and Social Science	4.5
TOTAL CREDITS	19.5

I Year II Semester (Semester-2)

S. No.	Code	Course Name	L	T	P	C
1	BS1201	Mathematics-II	2	1*	0	3
2	BS1202	Engineering Chemistry	3	1*	0	3
3	ES1201	Basic Electricals and Electronics Engineering	3	1*	0	3
4	ES1202	Materials Science	3	1*	0	3
5	ES1203	Engineering Mechanics	3	1*	0	3
6	BS1202L	Engineering Chemistry Lab	0	0	3	1.5
7	ES1201L	Basic Electricals and Electronics Engineering Lab	0	0	3	1.5
8	ES1204L	Workshop Practice Lab	0	0	3	1.5
9	MC1201	Environmental Science	2	0	0	0
Total Credits			**19.5**			

Category	CREDITS
Basic Science Course	**7.5**
Engineering Science Course	**12**
TOTAL CREDITS	**19.5**

II Year I Semester (Semester-3)

S.No.	Course Code	Course Title	L	T	P	C
1	BS2101	Mathematics – III	2	1*	0	3
2	PC2101	Mechanics of Solids	3	1*	0	3
3	PC2102	Kinematics of Machinery	3	1*	0	3
4	PC2103	Production Technology	3	1*	0	3
5	PC2104	Machine Drawing	1	0	2	1.5
6	ES2101	Thermodynamics	3	1*	0	3
7	PC2103L	Production Technology Lab	0	0	3	1.5
8	PC2101L	Materials and Mechanics of Solids Lab	0	0	3	1.5
9	SOC2101	Skill Oriented Course1: CAAED with NX	1	0	2	2
10	MC2101	Essence of Indian Traditional Knowledge	2	0	0	0

Total Credits						**21.5**
		Minor degree/Honours	3	0	2	4

Category	CREDITS
Basic Science Course	**3**
Professional Core courses	**13.5**
Engineering Science Course	**3**
Skill Oriented Course*	**2**
TOTAL CREDITS	**21.5**

II Year II Semester (Semester-4)						
S.No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	BS2201	Complex Variables and Statistical Methods	3	1*	0	3
2	PC2201	Applied Thermodynamics-I	3	1*	0	3
3	PC2202	Fluid Mechanics and Hydraulic Machines	3	1*	0	3
4	PC2203	Dynamics of Machinery	3	1*	0	3
5	PC2204	Design of Machine Members-I	3	1*	0	3
6	PC2201L	Thermal Engineering Lab	0	0	3	1.5
7	PC2202L	Fluid Mechanics and Hydraulic Machines Lab	0	0	3	1.5
8	ES2201L	Python Programming Lab	0	0	3	1.5
9	SOC2201	Skill course2: Die design	1	0	2	2
Total Credits						**21.5**
		Minor degree/Honours	**3**	**0**	**2**	**4**

*** At the end of II Year II Semester, students must complete summer internship spanning between 1 to 2 months (Minimum of 6 weeks), @ Industries/ Higher Learning Institutions/ APSSDC.**

Category	CREDITS
Basic Science Course	3

Professional Core courses	15
Engineering Science Course	1.5
Skill Oriented Course	2
TOTAL CREDITS	**21.5**

Summer Internship 2 months (Mandatory) during summer vacation

III Year I Semester (Semester-5)						
S.No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	PC3101	Design of Machine Members – II	3	1 *	0	3
2	PC3102	Metal Cutting and Machine Tools	3	1 *	0	3
3	HSM3101	Engineering Economics and Management	3	1 *	0	3
4	PE3101X	**Professional Elective- I** 1. Refrigeration and Air-conditioning 2. Materials Management 3. Industrial Robotics 4. Advanced Mechanics of Solids	3	1 *	0	3
5	OE3101X	**Open Elective- I** 1. MEMS 2. Optimization methods 3. Operations Management 4. Nano Technology	3	1 *	0	3
6	PC3103L	Theory of Machines Lab	0	0	3	1.5
7	PC3102L	Machine Tools Lab	0	0	3	1.5
8	SAC3101	Skill Course3: Soft Skills	1	0	2	2
9	MC3101	Indian Constitution	2	0	0	0

10	INTERN3101	Summer Internship 2 months (Mandatory) during summer vacation.	0	0	0	1.5
Total Credits						21.5
	Minor degree/Honours		**3**	**0**	**2**	**4**

Category	CREDITS
Professional Core courses	**9**
Professional Elective courses	**3**
Open Elective courses	**3**
Basic Science Courses	**3**
Skill Oriented Course*	**2**
Summer Internship	**1.5**
TOTAL CREDITS	**21.5**

III Year II Semester (Semester-6)						
S.No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	HSM3201	Universal Human Values-2	3	0	0	3
2	PC3201	Heat Transfer	3	1 *	0	3
3	PC3202	Instrumentation Control Systems and Engineering Metrology	3	1 *	0	3
4	PE3201X	**Professional Elective- II** 1. Finite Element Methods 2. Power Plant Engineering 3. Total Quality Management 4. Mechatronics	3	1 *	0	3

5	OE3201X	**Open Elective- II** 1. Green Engineering Systems 2. Robotics 3. Additive Manufacturing (3D printing) 4. Logistics and supply chain management	3	1 *	0	3
6	PC3201L	Heat Transfer Lab	0	0	3	1.5
7	PC3202L	Instrumentation Control Systems and Engineering Metrology Lab	0	0	3	1.5
8	PC3203L	Design Analysis Lab	0	0	3	1.5
9	SAC3201	Skill Course4: ANOVIA / CNC Programming and Machining	1	0	2	2
10	MC3201	Entrepreneurial Skill development	2	0	0	0
Total Credits						21.5
		Minor degree/Honours	**3**	**0**	**2**	**4**

Category	CREDITS
Humanities and Social Science	**3**
Professional Core courses	**10.5**
Professional Elective courses	**3**
Open Elective courses	**3**
Skill Oriented Course*	**2**
TOTAL CREDITS	**21.5**

Summer Internship 2 months (Mandatory) during summer vacation

IV Year I Semester (Semester-7)						
S.No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	PC4101	Applied Thermodynamics –II	3	1 *	0	3

2	PE4101X	**Professional Elective- III** 1. Industrial Engineering and Management 2. Composites and Nano Materials 3. Solar and Photo Voltaic systems 4. Design for Manufacturing	3	1 *	0	3
3	PE4102X	**Professional Elective- IV** 1. CAD/CAM 2. Product Design 3. Renewable Energy Sources 4. Production Planning Control	3	1 *	0	3
4	PE4103X	**Professional Elective- V** 1. Condition Monitoring 2. Optimization Techniques 3. Automobile Engineering 4. Advanced Manufacturing process	3	1 *	0	3
5	OE4101X	**Open Elective- III** 1. Organizational Behavior 2. Marketing Management 3. Ergonomics 4. Strategic Management	3	1 *	0	3
6	OE4102X	**Open Elective- IV** 1. Human Resource Management 2. Product Design & Development 3. Consumer Behavior 4. Materials for Engineering	3	1 *	0	3
7	SAC4101	Skill Course5: Advanced Simulation/DELMIA	1	0	2	2
8	INTERN4101	Summer Internship 2 months (Mandatory) during summer vacation	0	0	0	3

Total Credits					23
	Minor degree/Honours	**3**	**0**	**2**	**4**

Category	CREDITS
Professional Core courses	**3**
Professional Elective courses	**9**
Open Elective courses	**6**
Skill Oriented Course	**2**
Summer Internship	**3**
TOTAL CREDITS	**23**

IV Year II Semester (Semester-8)						
S. No.	**Code**	**Course Title**	**Hours Per week**			**Credits**
			L	**T**	**P**	
1	PROJ4201	Major Project Project work, Seminar & Internship in Industry	0	0	0	12
		Total Credits				12

PROFESSIONAL ELECTIVES

Professional Elective- I	**Professional Elective- II**	**Professional Elective- III**
1. Refrigeration and Air-conditioning	1. Finite Element Methods	1. Industrial Engineering and Management
2. Materials Management	2. Power Plant Engineering	2. Composites and Nano Materials
3. Industrial Robotics	3. Total Quality Management	3. Solar and Photo Voltaic systems
4. Advanced Mechanics of Solids	4. Mechatronics	4. Design for Manufacturing

Professional Elective- IV	Professional Elective- V
1. CAD/CAM	1. Condition Monitoring
2. Product Design	2. Optimization Techniques
3. Renewable Energy Sources	3. Automobile Engineering
4. Production Planning Control	4. Advanced Manufacturing process

OPEN ELECTIVES OFFERED BY DEPARTMENT

Open Elective- I	Open Elective- II
1. MEMS	1. Green Engineering Systems
2. Optimization methods	2. Robotics
3. Operations Management	3. Additive Manufacturing (3D printing)
4. Nano Technology	4. Logistics and supply chain management
Open Elective- III	**Open Elective- IV**
1. Organizational Behavior	1. Human Resource Management
2. Marketing Management	2. Product Design & Development
3. Ergonomics	3. Consumer Behavior
4. Strategic Management	4. Materials for Engineering

VVIT LIFE SKILLS

S No	Year/Sem	Course
1	I-I	Quantitative Aptitude
2	I-II	Verbal Ability
3	II-I	Understanding Self for Effectiveness
4	II-II	Design Thinking
5	III-I	Stress and Coping Strategies
6	III-II	Research Skills

CREDIT BREAKUP

CATEGORY	CREDITS
Basic Science Courses	21
Engineering Science Courses	24
Humanities and Social Science Courses	10.5
Professional Core Courses	51
Mandatory Courses	0
Professional Elective Courses	15
Open Elective Courses	12
Skill Oriented Courses	10
Summer Internships and Projects	16.5
TOTAL CREDITS	**160**

MINOR DEGREE COURSES

S.No	Name of SUBJECT	Pre-requisites	L	T	P	Credits	SEM
1	Thermodynamics	NIL	4	0	0	4	II-II
2	Engineering Mechanics and Strength of Materials	NIL	4	0	0	4	
3	Production Technology	Nil	4	0	0	4	
4	Materials Science	Nil	4	0	0	4	
5	Mechanics of Solids and Fluids	Engineering Mechanics	4	0	0	4	III-I
6	Applied Thermodynamics	Thermodynamics	4	0	0	4	
7	Theory of Machines	Engineering Mechanics	4	0	0	4	
8	Additive Manufacturing	Production Technology	4	0	0	4	
9	Fundamentals of Machine Design	Strength of Materials	4	0	0	4	

10	Power Plant Engineering	Thermodynamics	4	0	0	4	III-II
11	Heat Transfer	Thermodynamics	4	0	0	4	
12	Operations research	Mathematics	4	0	0	4	
13	Automobile Engineering	NIL	4	0	0	4	IV-I
14	Robotics	Engineering Mechanics	4	0	0	4	
15	Unconventional Manufacturing Processes	Manufacturing Technology	4	0	0	4	
16	B2B marketing	Engineering Economics and Management	4	0	0	4	

Note:

i. A student can select four subjects from the above six subjects, 04 credits per subject.
ii. Compulsory MOOC/NPTEL courses for 04 credits (02 courses @ 02 credits each.

HONOURS COURSES

S.No	Name of SUBJECT	Pre-requisites	L	T	P	Credits
POOL – 1 (II B.Tech II Semester)						
1	Advanced Thermodynamics	Thermodynamics	4	0	0	4
2	Waste heat Recovery Systems	Thermodynamics	4	0	0	4
3	Mechanical Behaviour of Materials	Mechanics of Solids	4	0	0	4
4	Analysis and Synthesis of Mechanisms	Kinematics of Machinery	4	0	0	4
5	Additive Manufacturing	Production Technology	4	0	0	4
POOL – 2 (III B.Tech I Semester)						

1	Advanced Mechanics of Fluids	Fluid Mechanics	4	0	0	4
2	Alternative Fuels for I.C. Engines	Applied Thermodynamics-I	4	0	0	4
3	Mechanical Vibrations	Dynamics of Machinery	4	0	0	4
4	Design of Press Tools and Dies	Production Technology				
5	Computer Integrated Manufacturing	Production Technology				
POOL-3 (III B.Tech II Semester)						
1	Computational Fluid Dynamics	Fluid Mechanics	4	0	0	4
2	Tribology	Design of Machine Members I and Design of Machine Members II	4	0	0	4
3	Design of Automobile Systems	Design of Machine Members I and Design of Machine Members II	4	0	0	4
4	Design of Jigs and Fixtures	MCMT	4	0	0	4
5	Design of Metal cutting tools and Accessories	MCMT	4	0	0	4
POOL-4 (IV B.Tech I Semester)						
1	Design of Heat Transfer Equipment	Thermodynamics, Heat Transfer	4	0	0	4
2	Green Engineering	NIL	4	0	0	4
3	Gear Engineering	Kinematics of Machinery, Dynamics of Machinery, Design of Machine Members I and Design of Machine Members II	4	0	0	4

4	Automation in Manufacturing	Production Technology	4	0	0	4
5	Experimental Techniques and Data Analysis	ICS and Metrology	4	0	0	4

MOOC-1*(NPTEL/SWAYAM) Duration: 12 Weeks Minimum
MOOC-2*(NPTEL/SWAYAM) Duration: 12 Weeks Minimum

***Course/Subject title can't be repeated**

SYLLABUS

I-Year-I Semester		L T P C
HS1101	Communicative English	3 1* 0 3

Course objectives:

The main objectives are

1. Adopt activity-based teaching-learning methods to ensure that learners would be engaged in use of language both in the classroom and laboratory sessions.
2. Facilitate effective listening skills for better comprehension of academic lectures and English spoken by native speakers
3. Focus on appropriate reading strategies for comprehension of various academic texts and authentic materials
4. Help improve speaking skills through participation in activities such as role plays, discussions and structured talks/oral presentations
5. Impart effective strategies for good writing and demonstrate the same in summarizing, writing well organized essays, record and report useful information
6. Provide knowledge of grammatical structures and vocabulary and encourage their appropriate use in speech and writing

Unit – 1: **13 HOURS**

Detailed Study: A Proposal to Girdle the Earth (Excerpt) by Nellie Bly

Theme: Exploration

Listening: Identifying the topic, the context and specific pieces of information by listening to short audio texts and answering a series of questions.

Speaking: Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others. **Reading:** Skimming to get the main idea of a text; scanning to look for specific pieces of information.

Reading for Writing: Beginnings and endings of paragraphs - introducing the topic, summarizing the main idea and/or providing a transition to the next paragraph.

Grammar and Vocabulary: Content words and function words; word forms: verbs, nouns, adjectives and adverbs; nouns: countable and uncountable; singular and plural; basic sentence structures; simple question form - wh-questions; word order in sentences.

Non-Detailed Study:

1. "How to Fashion Your Own Brand of Success" by Howard Whitman

2. "How to Recognize Your Failure Symptoms" by Dorothea Brande

Unit-2: **13 HOURS**

Detailed Study: An excerpt from The District School as It Was by One Who Went to It by Warren Burton

Theme: On Campus

Listening: Answering a series of questions about main idea and supporting ideas after listening to audio texts.

Speaking: Discussion in pairs/ small groups on specific topics followed by short structured talks.

Reading: Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together.

Writing: Paragraph writing (specific topics) using suitable cohesive devices; mechanics of writing - punctuation, capital letters.

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

Non-detailed Study:

3. "How to Conquer the Ten Most Common Causes of Failure" by Louis Binstock

4. "How to Develop Your Strength to Seize Opportunities" by Maxwell Maltz

Unit-3: **13 HOURS**

Detailed Study: The Future of Work?

Theme: Working Together

Listening: Listening for global comprehension and summarizing what is listened to.

Speaking: Discussing specific topics in pairs or small groups and reporting what is discussed

Reading: Reading a text in detail by making basic inferences - recognizing and interpreting specific context clues; strategies to use text clues for comprehension.

Writing: Summarizing - identifying main idea/s and rephrasing what is read; avoiding redundancies and repetitions.

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

Non-Detailed Study:

5. "How to Make the Most of Your Abilities" by Kenneth Hildebrand

6. "How to Raise Your Self-Esteem and Develop Self-confidence" by James W Newman

Unit-4: **13 HOURS**

Detailed Study: H.G Wells and the Uncertainties of Progress by Peter J. Bowler

Theme: Fabric of Change

Listening: Making predictions while listening to conversations/ transactional dialogues without video; listening with video.

Speaking: Role-plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions.

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

Writing: Information transfer; describe, compare, contrast, identify significance/trends based on information provided in figures/charts/graphs/tables.

Grammar and Vocabulary: Quantifying expressions - adjectives and adverbs; comparing and contrasting; degrees of comparison; use of antonyms

Non-Detailed Study

7. "How to Win Your War against Negative Feelings" by Dr Maxwell Maltz

8. "How to Find the Courage to Take Risks" by Drs. Tom Rusk and Randy Read

Unit-5: **13 HOURS**

Detailed Study: Leaves from the Mental Portfolio of a Eurasian by Sui Sin Far

Theme: Tools for Life

Listening: Identifying key terms, understanding concepts and answering a series of relevant questions that test comprehension.

Speaking: Formal oral presentations on topics from academic contexts - without the use of PPT slides.

Reading: Reading for comprehension.

Writing: Writing structured essays on specific topics using suitable claims and evidences

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

Non-Detailed Study

9. "How to Become a Self-Motivator" by Charles T Jones

10. "How to Eliminate Your Bad Habits" by OgMandino

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

CO1	identify the context, topic, and pieces of specific information from social or transactional dialogues spoken by native speakers of English and formulate sentences using proper grammatical structures and correct word forms **(Describe, relate, tell, find L-3)**
CO2	speak clearly on a specific topic using suitable discourse markers in informal discussions **(Discuss, outline, explain, predict – L3)**
CO3	write summaries based on global comprehension of reading/listening texts **(Use, categorize, complete, solve L-3)**
CO4	produce a coherent paragraph interpreting a figure/graph/chart/table **(Identify, compare, explain, illustrate- L4)**
CO5	take notes while listening to a talk/lecture to answer questions **(explain, relate, outline, complete -L3)**

Text books:

1. English All Round: Communication Skills for Undergraduate Learners-Volume 1, Orient Black Swan, 2019
2. University of Success by OgMandino, Jaico, 2015.

Reference books:

1. Bailey, Stephen. Academic writing: A handbook for international students. Routledge, 2014.
2. Chase, Becky Tarver. Pathways: Listening, Speaking and Critical Thinking. Heinley ELT; 2nd Edition, 2018.
3. Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.
4. Hewings, Martin. Cambridge Academic English (B2). CUP, 2012.

AICTE Recommended Books

5. Meenakshi Raman and Sangeeta Sharma. Technical Communication. Oxford University Press, 2018.
6. Pushplata and Sanjay Kumar. Communication Skills, Oxford University Press, 2018.
7. Kulbushan Kumar. Effective Communication Skills. Khanna Publishing House, Delhi

Sample Web Resources

Grammar / Listening / Writing

1-language.com

http://www.5minuteenglish.com/

https://www.englishpractice.com/

Grammar/Vocabulary

English Language Learning Online

http://www.bbc.co.uk/learningenglish/

http://www.better-english.com/

http://www.nonstopenglish.com/

https://www.vocabulary.com/

BBC Vocabulary Games

Free Rice Vocabulary Game

Reading

https://www.usingenglish.com/comprehension/

https://www.englishclub.com/reading/short-stories.htm

https://www.english-online.at/

Listening

https://learningenglish.voanews.com/z/3613

http://www.englishmedialab.com/listening.html

Speaking

https://www.talkenglish.com/

BBC Learning English – Pronunciation tips

Merriam-Webster – Perfect pronunciation Exercises

All Skills

https://www.englishclub.com/

http://www.world-english.org/

http://learnenglish.britishcouncil.org/

I-Year-I Semester		L T P C
BS1101	**Mathematics-I**	3 1* 0 3

Preamble: This course illuminates the students in the concepts of calculus.

Course objectives:

The main objectives are

1. To enlighten the learners in the concept of differential equations and multivariable calculus.
2. To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real-world problems and their applications.

Unit–1: **13 HOURS**

Differential equations of first order and first degree

Linear differential equations-Bernoulli's equations - Exact equations and equations reducible to exact form.

Applications: Newton's Law of cooling – Law of natural growth and decay – Orthogonal trajectories – Electrical circuits.

Unit–2: **13 HOURS**

Linear differential equations of higher order

Non-homogeneous equations of higher order with constant coefficients – with non-homogeneous term of the type $e^{ax}, \sin ax, \cos ax,$ polynomials in x^n , $e^{ax}V(x)$ and $x^nV(x)$ - Method of Variation of Parameters.

Applications: LCR circuit – Simple harmonic motion

Unit–3: **12 HOURS**
Mean value theorems
Mean value theorems (without proofs): Rolle's Theorem – Lagrange's mean value theorem – Cauchy's mean value theorem – Taylor's and Maclaurin's theorems with remainders.
Unit–4: **14 HOURS**
Partial differentiation
Introduction – Homogeneous function – Euler's theorem **-** Total derivative – Chain rule – Jacobian – Functional dependence – Taylor's and Mc Laurent's series expansion of functions of two variables. **Applications**: Maximum and Minimum of functions of two variables without constraints and Lagrange's method (with constraints).
Unit–5: **13 HOURS**
Multiple integrals
Double integrals (Cartesian and Polar) – Change of order of integration – Change of variables (Cartesian to Polar) –Triple integrals. **Applications**: Areas by double integrals and Volumes by triple integrals.

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

CO1	solve the differential equations related to various engineering fields.
CO2	utilize mean value theorems to real life problems.
CO3	familiarize with functions of several variables which is useful in optimization.
CO4	apply double integration techniques in evaluating areas bounded by region.
CO5	learn important tools of calculus in higher dimensions. Students will become familiar with 2-dimensional and 3 – dimensional coordinate systems.

Text books:
1. **B.S. Grewal,** Higher Engineering Mathematics, 44th Edition, Khanna Publishers. 2. **B.V. Ramana,** Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.
Reference books:

1. **H. K. Das,** Advanced Engineering Mathematics, 22nd Edition, S. Chand & Company Ltd.
2. **Erwin Kreyszig**, Advanced Engineering Mathematics, 10th Edition, Wiley-India.

Micro-Syllabus of MATHEMATICS – I (Calculus)

Unit-1: Differential equations of first order and first degree:

Linear differential equations-Bernoulli's equations - Exact equations and equations reducible to exact form.

Applications: Newton's Law of cooling – Law of natural growth and decay – Orthogonal trajectories – Electrical circuits.

Unit	**Module**	**Micro content**
1a. & 2a. Differential equations of first order and first degree	Linear differential equations	Solution of Linear differential equations in $'y'$
		Solution of Linear differential equations in $'x'$
		Initial value problem
	Non-Linear differential equations	Bernoulli's equations
		Equations reducible to Linear differential equations
	Exact differential equations	Solution of Exact differential equations
	Non-Exact differential equations	Equations reducible to Exact equations
		Integrating factor found by inspection
		Integrating factor of a Homogeneous equation
		Integrating factor for an equation of the type $f_1(xy)ydx + f_2(xy)xdy = 0$
		Integrating factor, if $\frac{\frac{\partial M}{\partial y} - \frac{\partial N}{\partial x}}{N}$ be a function of $'x'$
		Integrating factor, if $\frac{\frac{\partial N}{\partial x} - \frac{\partial M}{\partial y}}{M}$ be a function of $'y'$
1b. & 2b. Applications	Application of differential equations of first order and first degree	Newton's Law of cooling
		Law of natural growth and decay
		Orthogonal trajectories
		Electrical circuits

<table>
<tr><td colspan="3">Unit-2: Linear differential equations of higher order:
Non-homogeneous equations of higher order with constant coefficients – with non-homogeneous term of the type e^{ax}, $\sin ax$, $\cos ax$, polynomials in x^n, $e^{ax}V(x)$ and $x^nV(x)$ - Method of Variation of Parameters.
Applications: LCR circuit – Simple harmonic motion</td></tr>
<tr><td>Unit</td><td>Module</td><td>Micro content</td></tr>
<tr><td rowspan="6">3a. & 4a. Linear differential equations of higher order</td><td>Homogeneous equations of higher order with constant coefficients</td><td>Finding the Complementary function</td></tr>
<tr><td rowspan="5">Non-homogeneous equations of higher order with constant coefficients</td><td>Particular integral of the type $'e^{ax}'$</td></tr>
<tr><td>Particular integral of the type $'\sin ax'$ (or) $'\cos ax'$</td></tr>
<tr><td>Particular integral of the type x^n</td></tr>
<tr><td>Particular integral of the type $'e^{ax}\,V(x)'$</td></tr>
<tr><td>Particular integral of the type $'x^nv(x)'$</td></tr>
<tr><td rowspan="3">3b. & 4b. Applications</td><td rowspan="3">Applications of Non-homogeneous equations of higher order with constant coefficients</td><td>Method of variation of parameters</td></tr>
<tr><td>LCR circuit</td></tr>
<tr><td>Basic problems on simple harmonic motion</td></tr>
<tr><td colspan="3">Unit-3: Mean value theorems:
Mean value theorems (without proofs): Rolle’s theorem – Lagrange’s mean value theorem – Cauchy’s mean value theorem – Taylor’s and Maclaurin’s theorems with remainders.</td></tr>
<tr><td>Unit</td><td>Module</td><td>Micro content</td></tr>
<tr><td rowspan="2">5a. & 6a. Mean value theorems</td><td rowspan="2">Mean value theorems</td><td>Rolle’s theorem</td></tr>
<tr><td>Lagrange’s mean value theorem</td></tr>
<tr><td rowspan="2">5b. & 6b. Mean value</td><td rowspan="2">Mean value theorems</td><td>Cauchy’s mean value theorem</td></tr>
<tr><td>Taylor’s expansions of $f(x)$</td></tr>
</table>

theorems		Maclaurin's expansions of $f(x)$

Unit-4: Partial differentiation:

Introduction – Homogeneous function – Euler's theorem **-** Total derivative – Chain rule – Jacobians – Functional dependence – Taylor's and Mc Laurent's series expansion of functions of two variables.

Applications: Maxima and Minima of functions of two variables without constraints and Lagrange's method (with constraints).

Unit	**Module**	**Micro content**
7a. & 8a. Partial differentiation	**Partial Differentiation**	Euler's theorem
		Total derivative
		Chain rule
		Jacobians
7b. & 8b. Applications	**Applications of Partial Differentiation**	Taylor's and Mc Laurent's series expansion of functions of two variables
		Maxima and Minima of functions of two variables
		Lagrange's method of undetermined multipliers

Unit-5: Multiple integrals:

Double integrals (Cartesian and Polar) – Change of order of integration – Change of variables (Cartesian to Polar) –Triple integrals.

Applications: Areas by double integrals and Volumes by triple integrals.

Unit	**Module**	**Micro content**
9a. & 10a. Multiple integrals	Evaluation of Double Integrals	Double integrals
		Change of order of integration
		Double integrals in Polar co-ordinates
		Change of variables
9b. & 10b. Applications	Evaluation of Triple Integrals	Triple integrals
	Applications of Multiple Integrals	Areas by double integrals
		Volumes by triple integrals

I-Year-I Semester		L T P C
BS1102	ENGINEERING PHYSICS	3 1* 0 3

Course objectives:

Engineering Physics curriculum which is re-oriented to the needs of non-circuital branches of graduate engineering courses offered by Vasireddy Venkatadri Institute of Technology, which serves as a transit to understand the branch specific advanced topics.

The course is designed to:

- ➢ Impart Knowledge of physical optics phenomena like Interference and Diffraction required to design instruments with higher resolution.
- ➢ Impart knowledge in basic concepts of LASERs and Holography along with their engineering applications
- ➢ Impart the knowledge of materials with characteristic utility in appliances.
- ➢ Impart the knowledge on acoustic quality of concert halls and concepts of flaw detection techniques using ultrasonic.
- ➢ Study the structure- property relationship exhibited by solid materials within the elastic limit.

Unit-I: Wave Optics: **13 HOURS**

Interference: Principle of Superposition-Interference of light – Conditions for sustained Interference-Interference in thin films (reflected geometry) - Newton's Rings (reflected geometry)

Diffraction: Fraunhofer Diffraction: - Diffraction due to single slit (quantitative), double slit(qualitative), N –slits(qualitative) and circular aperture (qualitative) – Intensity distribution curves - Diffraction grating – Grating spectrum – missing order– resolving power – Rayleigh's criterion – Resolving powers of Microscope(qualitative), Telescope(qualitative) and grating (qualitative).

Unit– II: LASERs and Holography **13 HOURS**

LASERs: Interaction of radiation with matter – Spontaneous and Stimulated emission of radiation – population inversion – Einstein's coefficients & Relation between them and their significance - Pumping Mechanisms - Ruby laser – Helium-Neon laser – Applications.

Holography: Introduction – principle – differences between photography and holography – construction and reconstruction of hologram – applications of holograms

Unit-III: Magnetism and Dielectrics **13 HOURS**

Magnetism: Introduction - Magnetic dipole moment - Magnetization-Magnetic susceptibility and permeability- Origin of permanent magnetic moment - Bohr Magneton-Classification of magnetic materials: Dia, para & Ferro – Domain concept of Ferromagnetism - Hysteresis – soft and hard magnetic materials – applications of Ferromagnetic material.

Dielectrics: Introduction- Dielectricpolarization, Dielectric polarizability, Susceptibility and Dielectricconstant- Types of polarizations: Electronic and Ionic (Quantitative), Orientation Polarizations (Qualitative) - Lorentz Internal field-Claussius –Mossotti's equation- Frequency dependence of polarization - Applications of dielectrics.

Unit-IV: ACOUSTICS AND ULTRASONICS **15 HOURS**

Acoustics: Introduction – Reverberation - Reverberation time - Sabine's formula–absorption coefficient and its determination- factors affecting acoustics of buildings and their remedies.

Ultrasonics: Properties –Production of ultrasonics by Magnetostriction & Piezoelectric methods – Non-Destructive Testing – pulse echo system through transmission and reflection modes - A, B and C – scan displays–applications.

Unit-V: ELASTICITY **11 HOURS**

Stress & strain —stress &strain curve– generalized Hooke's law – different types of moduli and their relations – bending of beams – Bending moment of a beam – Depression of cantilever.

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

CO1	**Understand** the principles such as interference and diffraction to design and enhance the resolving power of various optical instruments.

CO2	**Learn** the basic concepts of LASER light Sources and Apply them to holography
CO3	**Study** the magnetic and dielectric materials to enhance the utility aspects of materials.
CO4	**Analyze** acoustic properties of typically used materials in buildings
CO5	**Understand** the concepts of shearing force and moment of inertia

Text books:

1. "Engineering Physics" by B. K. Pandey, S. Chaturvedi - Cengage Publications, 2012
2. "A Text book of Engineering Physics" by M.N. Avadhanulu, P.G.Kshirsagar - S.Chand, 2017.
3. "Engineering Physics" by D.K.Bhattacharya and Poonam Tandon, Oxford press (2015).
4. "Engineering Physics" by R.K Gaur. and S.L Gupta., - Dhanpat Rai publishers, 2012.

Reference books:

1. "Engineering Physics" by M.R.Srinivasan, New Age international publishers (2009).
2. "Optics" by AjoyGhatak, 6th Edition McGraw Hill Education, 2017.
3. "Solid State Physics" by A.J.Dekker, Mc Millan Publishers (2011).

Micro-Syllabus of Engineering Physics

Unit-I: Wave Optics:

Interference: Principle of Superposition – Interference of light – Conditions for sustained Interference – Interference in thin films (reflected geometry) - Newton's Rings (reflected geometry) **Diffraction:** Fraunhofer Diffraction:- Diffraction due to single slit (quantitative), double slit(qualitative), N –slits(qualitative) and circular aperture (qualitative) – Intensity distribution curves - Diffraction grating – Grating spectrum – missing order– resolving power – Rayleigh's criterion – Resolving powers of Microscope(qualitative), Telescope(qualitative) and grating (qualitative).

Unit	Module	Micro content
	Principle of Superposition & Interference of light	Introduction to interference
		Principle of superposition
		Coherence
		Conditions for sustained Interference
	Interference in thin	Interference in thin films by reflection (cosine's law)

Ia. Interference	Interference in thin films	Complementary nature
		Colours of thin film
	Newton's Rings	Newton's Rings(reflected geometry)
		Experimental arrangement & conditions for diameters
		Applications: determination of wavelength of monochromatic source and refractive index of the given transparent liquid.
Ib. Diffraction	Fraunhofer Diffraction - Diffraction due to single slit	Differences between Fresnel's and Fraunhofer's diffraction
		Differences between interference and diffraction
		Fraunhofer diffraction due to single slit(quantitative)
		Fraunhofer diffraction due to circular aperture (qualitative)
	double slit (qualitative) & N – slits(qualitative)	Fraunhofer diffraction due to double slit (qualitative)
		Fraunhofer diffraction due to grating (N- slits) (qualitative)
		Intensity distribution curves
	Diffraction grating& Resolving powers	Grating spectrum, missing orders and maximum number of orders possible with a grating
		Rayleigh's criterion for resolving power
		Resolving power of grating, Telescope and Microscope (qualitative)

Unit– II: LASERs and Holography

LASERs: Interaction of radiation with matter – Spontaneous and Stimulated emission of radiation – population inversion – Einstein's coefficients & Relation between them and their significance - Pumping Mechanisms - Ruby laser – Helium-Neon laser – Applications.

Holography: Introduction – principle – differences between photography and holography – construction and reconstruction of hologram – applications of holograms

Unit	Module	Micro content

IIa. LASERs	Interaction of radiation with matter	Introduction to LASERS
		Spontaneous emission
		Stimulated emission
	Einstein's coefficients	Einstein's coefficients
		Population inversion
		Pumping mechanisms
	LASERS construction and working	Ruby laser
		Helium-Neon laser
		Applications of Lasers
IIb. Holography	Principle of holography	Introduction and Principle of holography
		Differences between photography and holography
	construction and reconstruction of hologram	Construction of hologram
		Reconstruction of hologram
		Applications of holography

Unit-III: Magnetism and Dielectrics

Magnetism: Introduction - Magnetic dipole moment - Magnetization-Magnetic susceptibility and permeability- Origin of permanent magnetic moment - Bohr magneton-Classification of magnetic materials: Dia, para & Ferro – Domain concept of Ferromagnetism - Hysteresis – soft and hard magnetic materials – applications of Ferromagnetic material.

Dielectrics: Introduction- Dielectric polarization-Dielectric polarizability, Susceptibility and Dielectric constant- Types of polarizations: Electronic and Ionic (Quantitative), Orientation Polarizations (Qualitative) - Lorentz Internal field-Claussius –Mossotti's equation- Frequency dependence of polarization - Applications of dielectrics.

Unit	**Module**	**Micro content**
	Introduction& Origin of permanent magnetic moment	Introduction to Magnetism, Definitions of Magnetic dipole moment, Magnetization, Magnetic susceptibility and Permeability
		Origin of magnetic moment

	magnetic moment	Bohr magneton
IIIa. Magnetism	Classification of magnetic materials	Dia magnetic materials
		Para magnetic materials
		Ferro magnetic materials
	Domain concept of Ferromagnetism & Hysteresis	Domain concept of Ferromagnetism
		Hysteresis Curve
		Soft and hard magnetic materials classification based on Hysteresis Curve
		Applications of magnetic materials
IIIb. Dielectrics	Introduction& definitions	Introduction to dielectrics
		Dielectric polarization, Dielectric polarizability, susceptibility
		Dielectric constant
	Types of polarizations	Electronic polarization (Quantitative)
		Ionic polarization (Quantitative)
		Orientational polarizations (Qualitative)
	Internal field& Claussius – Mossotti's equation	Lorentz Internal fields in solids
		Clausius-Mossotti's equation
		Frequency dependence of polarization
		Applications of Dielectrics

Unit-IV: ACOUSTICS AND ULTRASONICS

Acoustics: Introduction – Reverberation - Reverberation time - Sabine's formula–absorption coefficient and its determination- factors affecting acoustics of buildings and their remedies.

Ultrasonics: Properties –Production of ultrasonics by Magnetostriction & Piezoelectric methods –Non-Destructive Testing – pulse echo system through transmission and reflection modes - A, B and C – scan displays–applications.

Unit	**Module**	**Micro content**
	Introduction & Reverberation	Introduction to acoustics
		Definition of Reverberation

IVa. Acoustics	Reverberation	Definition of Reverberation time
	Sabine's formula & absorption	Sabine's formula derivation
		Absorption coefficient
		Determination of Absorption coefficient
	Factors affecting acoustics of buildings	Basic requirements for acoustically good halls
		Factors affecting acoustics of buildings and their remedies
IVb. Ultrasonics	Properties &Production of ultrasonics	Introduction and Properties of Ultrasonics
		Production of ultrasonics by Magnetostriction method
		Production of ultrasonics by Piezoelectric method
	Non-Destructive Testing	Non-Destructive Testing using Pulse echo system
		Non-Destructive Testing through transmission and reflection modes
	Different scanning techniques	A - Scan
		B - Scan
		C - Scan
		Applications of Ultrasonics

Unit-V: ELASTICITY: Stress & strain –stress &strain curve– generalized Hooke's law – different types of moduli and their relations – bending of beams – Bending moment of a beam – Depression of cantilever.

Unit	**Module**	**Micro content**
V.ELASTICITY	Stress & strain	Introduction to Elasticity, Stress & Strain
		Stress & Strain curve (Behavior of a wire under increasing load)
		Generalized Hooke's law
	Different types of moduli and their relations	Young's modulus, Bulk modulus, Rigidity modulus and Poisson's ratio
		Relations among Young's, Bulk and Rigidity moduli
		Bending of beams

	Bending of beams	Bending moment of a beam
		Cantilever and depression of cantilever (Cantilever supported at its ends and loaded in the middle)

I-Year-I Semester		L T P C
ES1102	**Problem Solving using C**	3 1* 0 3

Course objectives:

The main objectives are

1. To familiarize to notion of an algorithm, editing and executing programs in Linux.
2. To Understanding branching, iteration.
3. To represent Data using arrays.
4. To use Modular programming and recursive solution formulation.
5. To familiarize pointers and dynamic memory allocation.
6. To handle data through files

UNIT-I: Introduction to C **13 HOURS**

Introduction to Computers: hardware, Memory hierarchy, Types of Computers, Types of Software – Operating Systems, Translators, Device drivers and packages. Algorithms and its characteristics, Program development steps. Structure of a C program, Features of C, The main () Function, Standard I/O functions.

Programming Style - Indentation, Comments, Identifiers, Data Types**,** Operators, Precedence and Associativity. Variables and Declarations, Format Modifiers, Escape Sequences, Types of Statements

Casting - Implicit Type Conversions, Explicit Type Conversions, Mathematical Library Functions

UNIT-II: Control Flow & Modules **13 HOURS** **Selection**: if-else Statement, nested if, examples, Multiway selection: switch, else-if, examples. **Repetition**: Basic Loop Structures, Pre-test and Post-test Loops, Counter-Controlled and Condition-Controlled Loops, for, while and do while. **Branching**: break & continue. **Modular Programming:** Function and Parameter Declarations, Returning a Value, Types of parameters. Parameter – scalar data as argument. **Recursion:** Definition, Base condition for recursion, Mathematical Recursion, Recursion versus Iteration.
UNIT-III Arrays & Strings **12 HOURS** **Arrays:** Introduction to Arrays, Input and Output of Array Values, Array Initialization, Arrays as Function Arguments, Two-Dimensional Arrays, Larger Dimensional Arrays- Matrices, 1D & 2D arrays as arguments. **Strings:** String Fundamentals, String Input and Output, String Processing, Library Functions, Strings as arguments.
Unit – IV Pointers & Structures **14 HOURS** **Pointers**: Concept of a Pointer, Initialization of Pointer variables, Pointers as function arguments, Passing by address, Dangling memory, Pointer Arithmetic, Character pointers, Pointers to Pointers, Array of pointers & Pointer to array, Dynamic memory management functions, Command line Arguments. **Structures**: Derived types, Structure's declaration, Initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self-referential structures, unions, typedef, enum, bit-fields.
UNIT-V: Files **13 HOURS** Storage classes – auto, static, extern, register. Pre-processor statements **Data Files**: Declaring, Opening, and Closing File Streams, File handling functions, Reading from and Writing to Text Files, File copy, merge, Writing and reading records, Random File Access.

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

CO1	**Understand** algorithms and basic terminology of C
CO2	**Solve** problems using control structures and modular approach
CO3	**Make** use of 1D and 2D arrays along with strings for linear data handling
CO4	**Determine** the use of pointers and structures
CO5	**Implement** various operations on data files.

Text books:

1. ANSI C Programming, E Balaguruswamy, Mc-GrawHill, 5th Edition
2. ANSI C Programming, Gary J. Bronson, Cengage Learning.
3. Programming in C, ReemaThareja, OXFORD Publications

Reference books:

1. C Programming-A Problem Solving Approach, Forouzan, Gilberg, Cengage.
2. Let us C, YashwantKanetkar, BPB Publications
3. Mastering in C, KR Venu Gopal, TMH

Micro-Syllabus of Problem Solving and Programming in C

UNIT I: Introduction to Computers: Hardware, Memory hierarchy, Types of Computers, Types of Software – Operating Systems, Translators, Device drivers and packages. Algorithms and its characteristics, Program development steps. Structure of a C program, Features of C, The main () Function, Standard I/O functions.

Programming Style - Indentation, Comments, Identifiers, Data Types**,** Operators, Precedence and Associativity. Variables and Declarations, Format Modifiers, Escape Sequences, Types of Statements

Casting - Implicit Type Conversions, Explicit Type Conversions, Mathematical Library Functions

Unit	Module	Micro content
	Introduction to Computers	Components of Computer: Hardware & Software
		Algorithm and its characteristics
		Program development steps
		Structure of a C Program

Introduction to C		Features of C
		The main () function and standard I/O functions
	Programming Style	Indentation, Comments, Identifiers, Data Types
		Operators, Precedence and Associativity. Variables and Declarations
		Format Modifiers, Escape Sequences
		Types of Statements
	Casting	Implicit Type Conversions
		Explicit Type Conversions
		Mathematical Library Functions
UNIT II: Selection: if-else Statement, nested if, examples, Multi-way selection: switch, else-if, examples. **Repetition**: Basic Loop Structures, Pre-test and Post-test Loops, Counter-Controlled and Condition-Controlled Loops, for, while and do while. **Branching**: break & continue. **Modular Programming:** Function and Parameter Declarations, Returning a Value, Types of parameters. Parameter – scalar data as argument. **Recursion:** Definition, Base condition for recursion, Mathematical Recursion, Recursion versus Iteration.		
Control Flow & Modular Programming	Selection Statements	if else, nested if examples
		Multi Way Selection: switch, else if examples
	Iterative Statements	Counter Controlled Loops
		Logic Controlled Loops
	Unconditional Branching	Break & Continue
	Modular Programming	Function and Parameter Declarations
		Returning a Value
		Types of parameters. Parameter – scalar data as argument.
	Recursion	Definition, Base condition for recursion
		Mathematical Recursion

		Recursion versus Iteration
UNIT III: Arrays: Introduction to Arrays, Input and Output of Array Values, Array Initialization, Arraysas Function Arguments, Two-Dimensional Arrays, Larger Dimensional Arrays- Matrices, 1D & 2D arrays as arguments. **Strings:** String Fundamentals, String Input and Output, String Processing, Library Functions, Strings as arguments.		
Arrays & Strings	Arrays	Introduction to Arrays, Input and Output of Array Values, Array Initialization
		Arraysas Function Arguments
		Two-Dimensional Arrays, Larger Dimensional Arrays
		Matrices, 1D & 2D arrays as arguments
	Strings	String Fundamentals, String Input and Output
		String Processing, Library Functions
		Strings as arguments
UNIT IV: Pointers: Concept of a Pointer, Initialization of Pointer variables, Pointers as function arguments,Passing by address, Dangling memory, Pointer Arithmetic, Character pointers, Pointers to Pointers, Array of pointers & Pointer to array, Dynamic memory management functions, Command line Arguments. **Structures**: Derived types, Structures declaration, Initialization of structures, accessing structures,nested structures, arrays of structures, structures and functions, pointers to structures, self-referential structures, unions, typedef, enum, bit-fields.		
Pointers and Structures	Pointers	Concept of a Pointer, Initialization of Pointer variables
		Pointers as function arguments,Passing by address
		Dangling memory, Pointer Arithmetic, Character pointers
		Pointers to Pointers
		Dynamic Memory Allocation
		Pointer to Arrays and Array of Pointers
	Command line Arguments	Command line Arguments

	Structures	Derived types, Structures declaration, Initialization of structures
		Accessing structures,nested structures, arrays of structures
		structures and functions, pointers to structures, self-referential structures
		Unions, typedef, enum, bit-fields.
UNIT V: Storage classes – auto, static, extern, register. Preproessor statements **Data Files**: Declaring, Opening, and Closing File Streams, File handling functions, Reading from and Writing to TextFiles, File copy, merge, Writing and reading records, Random File Access.		
Storage Classes and Files	Storage Classes	auto, static, extern and register
	Preprocessor Statements	Preprocessor Statements
	Data Files	Declaring, Opening, and Closing File Streams
		File handling functions, Reading from and Writing to TextFiles
		File copy, merge, Writing and reading records
		Random File Access

I-Year-I Semester		L T P C
ES1101	ENGINEERING GRAPHICS	1 0 4 3

Course objectives:

The main objectives are

1. Expose the students to use Drafting packages for generating Engineering curves and conventions followed in Preparation of engineering drawings.
2. Make the students to understand the concepts of orthographic projections of Lines and Plane Surfaces.
3. To understand the concepts of orthographic projections of Regular Solids.
4. Develop the ability of understanding sectional views and Development of Solid Surfaces.
5. Enable them to use computer aided drafting packages for Conversion of Isometric view to Orthographic Projection and vice versa.

UNIT-I: INTRODUCTION TO AUTOCAD: 15 HOURS Basic commands, Customization, ISO and ANSI standards for coordinate dimensioning, Annotations, layering, 2D drawings of various mechanical components, 2D drawings of various electrical and electronic circuits. Creation of engineering models- floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing practice; (Experiments should be Planned According to respective Core Branch Applications)
UNIT-II: THEORY OF PROJECTION: 12 HOURS Principles of Orthographic Projections-Convention: Projections of Points, Projections of Lines inclined to both planes, Projections of planes inclined to one Plane & Projections of planes inclined to both Planes
UNIT III: PROJECTIONS OF REGULAR SOLIDS: 12 HOURS Projections of Solids –with the axis perpendicular to one of the principal planes, with the axis Inclined to one of the principal planes, Projections of Solids –with the axis Inclined to Both the principal planes
UNIT IV: DEVELOPMENT OF SURFACES & SECTIONAL ORTHOGRAPHIC VIEWS 13 HOURS Development of surfaces of Right Regular Solids – Prism, Pyramid, Cylinder and, Cone. Draw the sectional orthographic views of geometrical solids
UNIT V: ISOMETRIC PROJECTIONS 13 HOURS Conversion of isometric views to orthographic views, drawing of isometric views - simple Solids, Conversion of orthographic views to isometric views of simple Drawings

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

CO1	Prepare engineering drawings as per BIS conventions Understand level, KL2}
CO2	Produce computer generated of orthographic projections of Lines and Plane surfaces using CAD software {Apply level, KL3}

CO3	Use the knowledge of orthographic projections of Solids to represent engineering information/concepts and present the same in the form of drawings {Apply level, KL3}
CO4	Use the knowledge of sectional views and Development of Solid Surfaces in Real time Applications {Apply level, KL3}
CO5	Develop isometric drawings of simple objects reading the orthographic projections of those objects {Analyze level, KL4}

Text books:

1. Engineering Drawing by N.D. Butt, Chariot Publications
2. Engineering Graphics with Autocad by Kulkarni D.M, PHI Publishers
3. Engineering Drawing + AutoCad – K Venugopal, V. Prabhu Raja, New Age
4. Engineering Drawing by Agarwal & Agarwal, Tata McGraw Hill Publishers

Reference books:

1. Engineering Drawing by K.L.Narayana & P. Kannaiah, Scitech Publishers
2. Engineering Graphics for Degree by K.C. John, PHI Publishers
3. Engineering Graphics by PI Varghese, McGrawHill Publishers
4. AutoCAD 2018 Training Guide (English, Paperback, Sagar Linkan) ISBN: 9789386551870, 938655187X RUPAPUBLICATIONS

I-Year-I Semester		L T P C
HS1101L	COMMUNICATIVE ENGLISH LAB	0 0 3 1.5

Course Objective:

The main objective of the course is to adopt activity-based teaching-learning methods to ensure that learners would be engaged in use of language both in the classroom and laboratory sessions and appear confidently for competitive examinations for career development.

The specific objectives of the course are to

1. Facilitate effective listening skills for better comprehension of academic lectures and English spoken by native and non-native speakers
2. Focus on appropriate reading strategies for comprehension of various academic texts and authentic materials like newspapers, magazines, periodicals, journals, etc.
3. Help improve speaking skills through participation in activities such as role plays, discussions and structured talks/oral presentations
4. Impart effective strategies for good writing and demonstrate the same in summarizing, writing well organized essays, record and report useful information
5. Provide knowledge of grammatical structures and vocabulary and encourage their appropriate use in speech and writing

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

CO1: Prioritize information from reading texts after selecting relevant and useful points and paraphrase short academic texts using suitable strategies and conventions (L3)

CO2: Make formal structured presentations on academic topics using PPT slides with relevant graphical elements (L3)

CO3: Participate in group discussions using appropriate conventions and language strategies (L3)

CO4: Prepare a CV with a cover letter to seek internship/ job (L2)

CO5: Collaborate with a partner to make presentations and Project Reports (L2)

Detailed Syllabus CALL based activity. English course books selected for classroom teaching will be used for practice in thecomputer-based language labs. Watching and listening to Video clips.

Listening Activity: Selected speeches of eminent personalities, audio texts, dialogues and discussions

Speaking: JAM, Oral Presentations, Group Discussions **Writing:** Different types of reports

Project: Power point presentation of 5 min on a specific topic

Pair work, Role play, conversational practice and Individual speaking activities based on following essays from ***University of Success***.

1. "How to Get Yourself Organized" by Michael LeBeouf
2. "How to Turn Your Desires into Gold" by Napoleon Hill
3. "How to Look Like a Winner How to Increase Your Value" by OgMandino
4. "How to Swap a Losing Strategy" by Auren Uris and Jack Tarrant
5. "How to Bounce Back from Failure" by OgMandino
6. "How to Prevent Your Success from Turning into Ashes" by Allan Fromme
7. "How to Have a Happy Life" by Louis Binstock
8. "How to Keep the Flame of Success Shining Brightly" by Howard Whitman Any tenSupplementary Language Activities from ***UN Global Goals***document

1. "Developing children's understanding of the Global Goals" by Carol Read
2. "End poverty in all its forms everywhere" by SylwiaZabor-Zakowska
3. "End hunger, achieve food security and improved nutrition and promote sustainable agriculture" by Linda Ruas

4 'Ensure healthy lives and promote well-being for all at all ages" by Carmen Flores

5. "Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" by Daniel Xerri
6. "Achieve gender equality and empower all women and girls" by Jemma Prior and Tessa Woodward

7. “Ensure availability and sustainable management of water and sanitation for all” by Wei KeongToo
8. “Ensure access to affordable, reliable, sustainable and modern energy for all” by Phil Wade
9. “Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all” by Nik Peachey
10. “Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation” by MaluSciamarelli
11. “Reduce inequality within and among countries” by Alan Maley
12. “Make cities and human settlements inclusive, safe, resilient and sustainable” by David Brennan
13. “Ensure sustainable consumption and production patterns” by Laszlo Katona and Nora Tartsay
14. “Take urgent action to combat climate change and its impacts” by Maria Theologidou
15. “Conserve and sustainably use the oceans, seas and marine resources for sustainable development” by Jill Hadfield and Charlie Hadfield
16. “Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss” by ChrysaPapalazarou
17. “Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels” by Rebeca Duriga
18. “Strengthen the means of implementation and revitalise the global partnership for sustainable development” by Jennifer Verschoor and Anna Maria Menezes
19. “Content and the Sustainable Development Goals: going beyond language learning” by AdrianTennant
20. “Using extensive reading creatively to raise awareness of issues of equality and justice” by SueLeather
21. “Storytelling for a better world” by David Heathfield

22. “Using the Sustainable Development Goals in the EAP classroom” by Averil Bolster and PeterLevrai

Text Books

1. Alan Maley and Nik Peachy. *Integrating global issues in the creative English Classroom: Withreference to the United Nations Sustainable Development Goals.* British Council Teaching English, 2018 (Public Domain UN Document)

2. *University of Success* by OgMandino, Jaico, 2015 (Reprint).

Reference Books

1. Bailey, Stephen. *Academic writing: A handbook for international students*. Routledge, 2014.

2. Chase, Becky Tarver. *Pathways: Listening, Speaking and Critical Thinking.* Heinley ELT; 2nd Edition, 2018.

3. Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.

4. Hewings, Martin. *Cambridge Academic English (B2)*. CUP, 2012.

5. Chaturvedi, P. D. and ChaturvediMukesh. *The Art and Science of Business Communication:Skills, Concepts, Cases and Applications.* 4Ed. Pearson, 2017.

AICTE Recommended Books

1. Meenakshi Raman and Sangeeta Sharma. *Technical Communication.* Oxford University Press,2018.

2. Pushplata and Sanjay Kumar. *Communication Skills*, Oxford University Press, 2018.

3. Kulbushan Kumar. *Effective Communication Skills.* Khanna Publishing House, Delhi

Sample Web Resources

Grammar / Listening / Writing 1-language.com http://www.5minuteenglish.com/ https://www.englishpractice.com/ Grammar/Vocabulary English Language Learning Online http://www.bbc.co.uk/learningenglish/ http://www.better-english.com/ http://www.nonstopenglish.com/ https://www.vocabulary.com/ BBC Vocabulary Games Free Rice Vocabulary Game	Reading https://www.usingenglish.com/comprehension/ https://www.englishclub.com/reading/short stories.htm https://www.english-online.at/ Listening https://learningenglish.voanews.com/z/3613 http://www.englishmedialab.com/listening.html Speaking https://www.talkenglish.com/ BBC Learning English – Pronunciation tips Merriam-Webster – Perfect pronunciation Exercises
All Skills https://www.englishclub.com/ http://www.world-english.org/	

I-Year-I Semester		L T P	C
BS1102L	ENGINEERING PHYSICS AND VIRTUAL LAB	0 0 3	1.5

Course Objectives: The Applied Physics Lab is designed to:

- ➢ Understand the concepts of interference and diffraction and their applications.
- ➢ Apply the concept of LASER in the determination of wavelength.
- ➢ Recognize the importance of energy gap in the study of conductivity and Hall Effect.
- ➢ Illustrate the magnetic and dielectric materials applications.
- ➢ Apply the principles of semiconductors in various electronic devices.

Course Outcomes: The students will be able to:

1. Operate optical instruments like microscope and spectrometer
2. Determine thickness of a paper with the concept of interference
3. Estimate the wavelength of different colours using diffraction grating and resolving power
4. Plot the intensity of the magnetic field of circular coil carrying current with distance
5. Calculate the band gap of a given semiconductor

LIST OF EXPERIMENTS (Any 10 of the following listed 15 experiments)

1. Determination of wavelength of a Source-Diffraction Grating-Normal incidence.
2. Newton's rings – Radius of Curvature of Plano - Convex Lens.
3. Determination of thickness of a spacer using wedge film and parallel interference fringes.
4. Magnetic field along the axis of a current carrying coil – Stewart and Gee's apparatus.
5. Energy Band gap of a Semiconductor p - n junction.
6. Characteristics of Thermistor – Temperature Coefficients
7. Determination of dielectric constant by charging and discharging method

8. Variation of dielectric constant with temperature
9. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
10. LASER - Determination of wavelength by plane diffraction grating
11. Verification of laws of vibrations in stretched strings – Sonometer.
12. Determine the radius of gyration using compound pendulum
13. Rigidity modulus of material by wire-dynamic method (torsional pendulum)
14. Dispersive power of diffraction grating.
15. Determination of Hall voltage and Hall coefficients of a given semiconductor using Hall Effect.

I-Year-I Semester		L T P C
ES1103L	PROBLEM SOLVING USING C LAB	0 0 3 1.5

Course Objectives:

1. Apply the principles of C language in problem solving.
2. To design flowcharts, algorithms and knowing how to debug programs.
3. To design & develop of C programs using arrays, strings pointers & functions.
4. To review the file operations, pre-processor commands.

Exercise - 1 Control Flow - I

a) Write a C Program to Find Whether the Given Year is a Leap Year or not.

b) Write a C Program to find second biggest of three numbers (Assume that all the numbers are unique).

Exercise – 2 Control Flow - II

b) Write a C Program to Find Whether the Given Number is

i) Prime Number

ii) Armstrong Number

Exercise – 3 Control Flow - III

a) Write a C program to print Floyd Triangle

b) Write a C Program to print Pascal Triangle

c) Write a C program to display a Pyramid

Exercise – 4 Arrays - Demonstration of arrays

a) Search-Linear.

b) Sorting-Bubble

c) Operations on Matrix. - Add, Subtract, Multiply

Exercise – 5 Strings

a) Implementation of string manipulation operations **with** library function: Copy, length, compare

b) Implementation of string manipulation operations **without** library function: copy, length, compare

Exercise – 6 Functions

a) Write a C Program demonstrating of parameter passing in Functions and returning values.

b) Write a C Program illustrating Fibonacci, Factorial with Recursion without Recursion

Exercise – 7 Functions - Continued

Write a C Program to compute the values of sin x and cos x and ex values using Series expansion. (Use factorial function)

Exercise - 8 Arrays, Strings and Pointers

a) Write a C Program to find min and max of an array of elements using pointers

b) Write a C Program to concatenate one string to another using pointer.

Exercise – 9 Dynamic Memory Allocations

Write a C program to represent 1D and 2D arrays using malloc () function.

Exercises - 10 Structures

a) Write a C Program to Store Information of a Movie Using Structure

b) Write a C Program to sort a set of student records in ascending order.

c) Write a C Program to Add, subtract & multiply Two Complex Numbers.

Exercise -11 Files

a) Write a C programming code to open a file and to print it contents on screen.

b) Write a C program to copy the content of one file to another.

C) Write a C program merges two files and stores their contents in another file

Course Outcomes: By the end of the Lab, the student able to

1. **Comprehend** the various concepts of a C language
2. **Develop** algorithms and flowcharts

3. **Design** and development of C problem solving skills.
4. **Acquire** modular programming skills.

I-Year-II Semester		L T P C
BS1201	MATHEMATICS-II	3 1* 0 3

Course objectives:

The main objectives are

1. To elucidate the different numerical methods to solve nonlinear algebraic equations
2. To disseminate the use of different numerical techniques for carrying out numerical integration
3. To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real-world problems and their applications

UNIT-1: Iterative methods **11 HOURS** Introduction–Bisection method–Method of false position–Iteration method–Newton-Raphson method (one variable)–Jacobi and Gauss-Seidel methods for solving system of equations.
UNIT-2: Interpolation **14 HOURS** Introduction–Errors in polynomial interpolation–Finite differences–Forward differences–Backward differences–Central differences –Relations between operators–Newton's forward and backward formulae for interpolation–Gauss's forward and backward formulae for Interpolation – Interpolation with unequal intervals–Lagrange's interpolation formula–Newton's divide difference formula.
UNIT-3: Numerical integration and solution of ordinary difference equations **12 HOURS** Trapezoidal rule–Simpson's $1/3^{rd}$ and $3/8^{th}$ rule–Solution of ordinary differential equations by Taylor's series–Picard's method of successive approximations–Euler's method–Modified Euler's method–Runge-Kutta method (second and fourth order).

UNIT–4: Laplace Transforms: 14 HOURS Laplace transforms of standard functions – Shifting theorems – Transforms of derivatives and integrals – Unit step function – Dirac's delta function –Periodic function - Inverse Laplace transforms – Convolution theorem (without proof) Applications: Evaluation of integrals using Laplace transforms - Solving ordinary differential equations (Initial value problems) using Laplace transforms.
UNIT 5: Fourier series and Fourier Transforms: 14 HOURS Fourier series: Introduction – Periodic functions – Fourier series of periodic function – Dirichlet's conditions – Even and odd functions – Change of interval – Half-range sine and cosine series. Fourier Transforms: Fourier integral theorem (without proof) - Fourier sine and cosine integrals – Sine and cosine transforms – Properties – Inverse transforms – Finite Fourier transforms.

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

CO1	Evaluate approximate in the roots of polynomial and transcendental equations by different algorithms (EVALUATE)
CO2	Solve system of linear algebraic equations using Gauss Jacobi, Gauss Seidel and apply Newton's forward and backward interpolation and Lagrange's formulae for equal and unequal intervals (SOLVE,APPLY, FIND)
CO3	Apply different algorithms for approximating the solutions of ordinary differential equations to its analytical computations and also by Laplace the transforms for solving differential equations (SOLVE,APPLY, FIND)
CO4	Find or compute the Fourier series of periodic signals (SOLVE, APPLY, FIND, ANALYSE)
CO5	Know and be able to apply integral expressions for the forwards and inverse Fourier transform to range of non-periodic waveforms (SOLVE, APPLY, FIND)

Text books:
1. **B.S. Grewal,** Higher Engineering Mathematics, 44th Edition, Khanna Publishers
Reference books:

1. **B.V. Ramana,** Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.
2. **H.K.Das,** Advanced Engineering Mathematics, 22nd Edition, S. Chand & Company Ltd.
3. **Erwin Kreyszig**, Advanced Engineering Mathematics, 10th Edition, Wiley-India.

Micro-Syllabus of MATHEMATICS-II

UNIT-1: Iterative methods: Introduction–Bisection method–Method of false position–Iteration method–Newton-Raphson method (one variable)–Jacobi and Gauss-Seidel methods for solving system of equations.

Unit	Module	Micro content
1a. Solving given polynomial	Numerical solution of algebraic and transcendental polynomials	Bisection method
		Method of false position
		Iteration method
		Newton-Raphson's method
1b. Solving linear system	Solving linear system	Jacobi's method
		Gauss-seidel method

UNIT-2: Interpolation: Introduction–Errors in polynomial interpolation–Finite differences–Forward differences–Backward differences–Central differences –Relations between operators–Newton's forward and backward formulae for interpolation–Gauss's forward and backward formulae for

Interpolation – Interpolation with unequal intervals–Lagrange's interpolation formula–Newton's divide difference formula.

Unit	Module	Micro content
2a. Equal-Spaced difference tables	Finite difference tables	Forward, backward & central difference tables
		Errors in polynomials
	Finding functional values for given data	Newton's forward and backward difference interpolation formula
		Gauss forward and backward difference interpolation formula

2b. Unequal spaced data & relation between various operators	Unequal spaced data & relation between various operators	Lagrange's interpolation formula
		Relation between various operators (Shift, forward, backward, central, average & differential operators)
UNIT-3: Numerical integration and solution of ordinary difference equations: Trapezoidal rule–Simpson's 1/3rd and 3/8th rule–Solution of ordinary differential equations by Taylor's series–Picard's method of successive approximations–Euler's method–Modified Euler's method–Runge-Kutta method (second and fourth order).		
Unit	**Module**	**Micro content**
3a. Numerical integration	Numerical Integration	Trapezoidal rule
		Simpson's 1/3rd rule
		Simpson's 3/8th
	Numerical solution of ordinary differential equations for single variable	Taylors series method
		Picard's method
		Euler's method
3b. Numerical solution of ordinary differential equations for single variable		Modified Euler's method
UNIT – 4: Laplace Transforms: Laplace transforms of standard functions – Shifting theorems – Transforms of derivatives and integrals – Unit step function – Dirac's delta function –Periodic function - Inverse Laplace transforms – Convolution theorem (without proof) Applications: Evaluation of integrals using Laplace transforms - Solving ordinary differential equations (Initial value problems) using Laplace transforms.		
Unit	**Module**	**Micro content**

4a Laplace Transforms	Laplace transforms and theorem	Shifting theorems
		Derivatives and integrals
		Multiplication and division
4b. Inverse Laplace transforms and Applications	Periodic functions & Inverse Laplace Transforms	Periodic functions
		Dirac delta functions
		Evaluation integrals using Laplace Transforms
		Solving differential equations using Laplace transforms

UNIT 5: Fourier series and Fourier Transforms:

Fourier series: Introduction – Periodic functions – Fourier series of periodic function – Dirichlet's conditions – Even and odd functions – Change of interval – Half-range sine and cosine series.

Fourier Transforms: Fourier integral theorem (without proof) - Fourier sine and cosine integrals – Sine and cosine transforms – Properties – Inverse transforms – Finite Fourier transforms.

Unit	**Module**	**Micro content**
5a. Fourier Series	Fourier Series	Periodic functions
		Dirichlet's conditions
		Even and odd function's
		Change of interval
		Half range sine and cosine series
5b. Fourier Transforms	Fourier Transforms	Fourier Sine and Cosine integral
		Properties of Fourier Transforms
		Fourier and Inverse Fourier Transforms
		Fourier cosine and Inverse Fourier cosine Transforms
		Fourier sine and Inverse Fourier sine Transforms
		Finite Fourier Transforms
		Inverse Finite Fourier Transforms

I-Year-II Semester		L T P C
BS1202	ENGINEERING CHEMISTRY	3 1* 0 3

Course objectives:

The main objectives are

1. Significance and use of plastics in household appliances and composites (FRP) in aerospace and automotive industries.
2. Outline the basics for the construction of electrochemical cells, batteries and fuel cells.Understand the mechanism of corrosion and how it can be prevented.
3. Importance of advanced materials and their engineering applications.
4. Differentiate and discuss the materials used in major industries like steel industry, metallurgical industries, construction industries, electrical equipments and manufacturing industries. Lubrication is also summarized.
5. Essentiality of fuel technology.
6. Need of water purification and importance of various water purification methods.

UNIT-I: POLYMER TECHNOLOGY **13 HOURS**

Polymerisation*:* Introduction-Methods of polymerisation-(emulsion and suspension)-Physical and mechanical properties.

Plastics*:* Compounding-Fabrication (compression, injection, blown film, extrusion)-Preparation, properties and applications of PVC, ploycarbonates and Bakelite-Mention some examples of plastic materials used in electronic gadgets, recycling of e-plastic waste.

Elastomers*:* Natural rubber-Drawbacks-Vulcanization-Preparation-Propertiesand applications of synthetic rubbers (Buna S, thiokol and polyurethanes)

Composite Materials: Fiber reinforced plastics-CFRP and GFRP.

Conducting polymers: Polyacetylene, doped conducting polymers- p-type and n-type doping.

Bio degradable polymers: Biopolymers and biomedical polymers.

UNIT-II: ELECTROCHEMICAL CELLS AND CORROSION **13 HOURS**

Single electrode potential-Electrochemical series and uses of series-Standard hydrogen electrode, calomel electrode, concentration cell, construction of glass electrode, Batteries: Dry cell, Ni-Cd cells, Ni-Metal hydride cells, Li-ion battery, Zinc air cells, Fuel cells-H_2 –O_2, CH_3OH-O_2, phosphoric acid, molten carbonate.

Corrosion*:* Definition-theories of corrosion (chemical and electrochemical)-galvanic corrosion, differential aeration corrosion, stress corrosion, water-line corrosion- passivity of metals-galvanic series-factors influencing rate of corrosion-corrosion control: (proper designing, cathodic protection)-protective coatings: cathodic and anodic coatings, electroplating, electroless plating (nickel), paints (constituents and its functions).

UNIT-III: CHEMISTRY OF MATERIALS **14 HOURS**
Nano materials**:* Introduction, sol-gel method, characterization by BET, SEM and TEM methods, applications of graphene- carbon nanotubes and fullerenes: Types, preparation of carbon nanomaterials by carbon-arc, laser ablation method, and applications. ***Refractories: Definition , classification, properties (refractoriness, refractoriness under load, porosity and thermal spalling), failure of refractories. ***Lubricants***: Definition, mechanism of lubricants and properties (definition and importance). ***Cement***: Constituents, manufacturing, parameters to characterize the Clinker formation: lime saturation factor (LSF), silica ratio (SR), and alumina ratio (AR). Chemistry of setting and hardening, deterioration of cement.
UNIT-IV: FUELS **13 HOURS**
Introduction-calorific value - HCV and LCV – problems using Dulong's formula – proximate and ultimate analysis of coal sample – significance of these analysis – problems – petroleum (refining – cracking) – synthetic petrol (Fischer-Tropsch & Bergius) – petrol knocking, diesel knocking – octane and cetane rating – anti-knocking agents – introduction to alternative fuels (bio-diesel, ethanol, methanol, natural gas, LPG, CNG) – Flue gas analysis by Orsat apparatus – rocket fuels.
UNIT-V: WATER TECHNOLOGY **12 HOURS**
Hardness of water – determination of hardness by complexometric method – boiler troubles (priming and foaming, scale formation, boiler corrosion, caustic embrittlement) – internal treatments – softening of hard water (zeolite process and ion exchange process) – treatment of industrial waste water – potable water and its specifications – steps involved in purification of water – chlorination, break point chlorination – reverse osmosis and electro dialysis.

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

CO1	explain the preparation, properties and applications of thermoplastics, thermosettings, elastomers and conducting polymers.
CO2	know the importance of various materials and their uses in the construction of batteries and fuel cells.
CO3	to acquire the knowledge of nanomaterials, refractories, lubricants and cement.
CO4	assess the quality of various fuels.

CO5	understand the importance of water and its usage in various industries.

Text books:
1. Engineering Chemistry by Jain & Jain; Dhanpat Rai Publicating Co., Latest Edition 2. Engineering Chemistry by Shikha Agarwal; Cambridge University Press, 2019 Edition. 3. Engineering Chemistry by Prasanth Rath, B. Ramadevi, Ch. Venkata Ramana Reddy, Subendu Chakravarthy; Cengage Publications, 2019 Edition.
Reference books:
1. A text book of Engineering Chemistry by S.S. Dara, S. S. Umare; S. Chand & Co., Ltd., Latest Edition. 2. Engineering Chemistry by Shashi Chawla; Dhanpat Rai Publicating Co., Latest Edition.

Micro-Syllabus of Engineering Chemistry

UNIT-I: POLYMER TECHNOLOGY **14 HRS**

***Polymerisation**:*Introduction-Methods of polymerisation-(emulsion and suspension)-Physical and mechanical properties.
***Plastics**:* Compounding-Fabrication (compression, injection, blown film, extrusion)-Preparation, properties and applications of PVC, ploycarbonates and Bakelite-Mention some examples of plastic materials used in electronic gadgets, recycling of e-plastic waste.
***Elastomers**:* Natural rubber-Drawbacks-Vulcanization-Preparation-Properties and applications of synthetic rubbers (Buna S, thiokol and polyurethanes)
Composite Materials: Fiber reinforced plastics-CFRP and GFRP.
Conducting polymers: Polyacetylene, doped conducting polymers- p-type and n-type doping.
Bio degradable polymers: Biopolymers and biomedical polymers.

Unit	Module	Micro content
Ia. Polymerization	Introduction, Methods of Polymerization And Properties of Polymers	Introduction - Polymer, monomer, functionality and polymerization. Methods of polymerisation - Emulsion and suspension Physical and mechanical properties of polymers.

Plastics	Compounding of plastics, fabrication of polymer articles, preparation, properties and applications of some polymers, e-plastic and disposal of e-plastic waste	Compounding of plastics Fabrication of polymer articles – compression, injection, blowing, extrusion Preparation, properties and applications of PVC, ploycarbonates and Bakelite Mention some examples of plastic materials used in electronic gadgets, recycling of e-plastic waste.
Elastomers	Natural Rubber, vulcanization, synthetic rubbers	Natural rubber – Drawbacks – Vulcanization Preparation – Properties and applications of synthetic rubbers – Buna S, thiokol and polyurethane rubbers.
Composite materials	Fiber reinforced plastics	Fiber Reinforced Plastics (FRP) – CFRP and GFRP.
Conducting polymers	Polyacetylene polymer, p-type and n-type doping	Polyacetylene, doped conducting polymers- p-type and n-type doping.
Biodegradable polymers	Biopolymers and biomedical polymers	Biopolymers and biomedical polymers – polylactic acid polyglycolic acid polymers

<u>UNIT-II:</u> ELECTROCHEMICAL CELLS AND CORROSION **12 HRS**

Single electrode potential - Electrochemical series and uses of series - Standard hydrogen electrode, calomel electrode, concentration cell, construction of glass electrode, Batteries: Dry cell, Ni-Cd cells, Ni-Metal hydride cells, Li-ion battery, Zinc air cells, Fuel cells-H_2 –O_2, CH_3OH-O_2, phosphoric acid, molten carbonate.

Corrosion*:* Definition - theories of corrosion (chemical and electrochemical)-galvanic corrosion, differential aeration corrosion, stress corrosion, water-line corrosion- passivity of metals-galvanic series-factors influencing rate of corrosion-corrosion control: (proper designing, cathodic protection)-protective coatings: cathodic and anodic coatings, electroplating, electroless plating (nickel), paints (constituents and its functions).

Unit	Module	Micro content
Introduction	Single electrode potential	Oxidation potential
		Reduction potential
Concentration cells	Electrode concentration cell and electrolyte concentration cell	Electrode concentration cell and electrolyte concentration cell
Electro chemical series	Electro chemical series	Definition – Electro chemical series
		Significances of Electro chemical series
		Differences between Electro chemical series and galvanic series

Reference electrodes	Standard Hydrogen Electrode	Working Principle and Construction of a – Standard Hydrogen Electrode – Calomel Electrode – Glass Electrode
	Calomel Electrode	
	Glass Electrode	
Corrosion	Introduction	Definition – Corrosion
	Theories of Corrosion	Chemical Theory of Corrosion / Dry Corrosion Electro Chemical Theory of Corrosion / Wet Corrosion
	Types of Corrosion	Galvanic corrosion, Differential aeration corrosion, Stress corrosion, Water-line corrosion
	Passivity of metals	Passivity, Examples for passive metals
Factors affecting rate of Corrosion	(a) Nature of metal	*(a) Nature of metal:* (i) Position of metal in the Galvanic series (ii) Purity of metal (iii) Relative surface area of anodic and cathodic metal (iv) Nature of oxide film (v) Physical state of metal (vi) Solubility and volatility of corrosion products
	(b) Nature of environment	*(b) Nature of environment:* (i) Temperature (ii) Humidity (iii) pH of the medium (iv) Establishment of oxygen concentration cell (v) Impurities of the atmosphere (vi) Polarization of electrodes
Corrosion control methods	Cathodic protection	Sacrificial anodic protection, impressed cathodic current
	|Cathodic and Anodic coatings	Galvanizing and Tinning
	Electroplating	Electroplating with example
	Electroless plating	Nickel Electroless plating
	Paints	Constituents of paints and its functions

<u>UNIT-III:</u> CHEMISTRY OF MATERIALS **12 HRS**

Nano materials*:* Introduction, sol-gel method, characterization by BET, SEM and TEM methods, applications of graphene- carbon nanotubes and fullerenes: Types, preparation of carbon nanomaterials by carbon-arc, laser ablation method, and applications.
Refractories: Definition , classification, properties (refractoriness, refractoriness under load, porosity and thermal spalling), failure of refractories.
Lubricants: Definition, mechanism of lubricants and properties (definition and importance).
Cement: Constituents, manufacturing, parameters to characterize the Clinker formation: lime saturation factor (LSF), silica ratio (SR), and alumina ratio (AR). Chemistry of setting and hardening, deterioration of cement.

Unit	Module	Micro content

Nano materials	Introduction, Sol-gel method, BET, TEM and SEM Methods	Introduction, sol-gel method, characterization by BET, SEM and TEM methods, applications of graphene-carbon nanotubes and fullerenes: Types, preparation of carbon nanomaterials by carbon-arc, laser ablation method, and applications.
Refractories	Definition, Classification of Refractories, Failure of Refractories	Definition , classification, properties (refractoriness, refractoriness under load, porosity and thermal spalling), failure of refractories.
Lubricants	Definition, Mechanism of Lubrication	Definition, mechanism of lubricants and properties (definition and importance).
Cement	Constituents of Portland cement, clinker formation, lime saturation factor, setting and hardening of cement, deterioration of cement	Constituents, manufacturing, parameters to characterize the Clinker formation: lime saturation factor (LSF), silica ratio (SR), and alumina ratio (AR). Chemistry of setting and hardening, deterioration of cement.

UNIT-IV: FUELS **12 HRS**

Introduction - calorific value - HCV and LCV – problems using Dulong's formula – proximate and ultimate analysis of coal sample – significance of these analysis – problems – petroleum (refining – cracking) – synthetic petrol (Fischer-Tropsch & Bergius) – petrol knocking, diesel knocking – octane and cetane rating – anti-knocking agents – introduction to alternative fuels (bio-diesel, ethanol, methanol, natural gas, LPG, CNG) – Flue gas analysis by Orsat apparatus – rocket fuels.

Unit	Module	Micro content
Introduction	Introduction to fuels	Calorific Value – Higher Calorific Value – Lower Calorific Value
		Problems using Dulong's formula
	Coal Analysis	Proximate analysis of coal and Significances
		Ultimate analysis of coal and Significances
Crude oil or Petroleum	Refining of Petroleum	Refining of Petroleum with schematic diagram,
		Cracking of Petroleum
Synthetic petrol	Fischer-Tropsch and Bergius methods	Fischer-Tropsch & Bergius methods with schematic diagram
Knocking of petrol and diesel	Knocking of petrol and diesel	Petrol knocking, diesel knocking – octane and cetane rating – anti-knocking agents
Alternative fuels	Introduction, biodiesel, ethanol, natural gas, LPG, CNG	Introduction to alternative fuels (bio-diesel, ethanol, methanol, natural gas, LPG, CNG), rocket fuels.
Flue Gas	Flue Gas Analysis	Flue gas analysis by Orsat apparatus

UNIT-V: WATER TECHNOLOGY **12 HRS**

Hardness of water – determination of hardness by complexometric method – boiler troubles (priming and foaming, scale formation, boiler corrosion, caustic embrittlement) – internal treatments – softening of hard water (zeolite process and ion exchange process) – treatment of industrial waste water – potable water and its specifications – steps involved in purification of water – chlorination, break point chlorination – reverse osmosis and electro dialysis.

Unit	Module	Micro content
Hardness of water	Introduction, Determination of Hardness	Temporary hardness, Permanent hardness and Total hardness
		Determination of Hardness by complexometry
Boiler troubles	Boiler troubles	Priming and foaming, scale formation, boiler corrosion, caustic embrittlement
Internal treatments	Softening of hard water	Zeolite process and ion exchange process
		Treatment of industrial waste water
Potable water	Potable water and its specifications	Potable water and its specifications
Purification of water	Purification of water, Reverse osmosis and Electro dialysis.	Steps involved in purification of water – chlorination, break point chlorination – reverse osmosis and electro dialysis.

I-Year-II Semester		L T P C
ES1201	BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING	3 1* 0 3

Course objectives:

The main objectives are

1. To introduce basics of electric circuits and to teach DC and AC electrical circuit analysis.
2. To explain the working principles DC machines and speed control of various DC motors.
3. To explain the working principles of transformers and AC machines and its applications.
4. To introduce the basics of semiconductor physics and operation and applications of Diodes.
5. To introduce the basics of transistors and explain the transistor configurations

Unit 1 DC & AC Circuits: **14 HOURS**

DC Circuits:

Electrical circuit elements (R - L and C) – Kirchhoff's laws -Voltage and Current division rules-series, parallel circuits and star-delta and delta-star transformations- [Elementary treatment only]

AC Circuits:

Representation of sinusoidal waveforms - Peak and RMS values - phasor representation - real power - reactive power - apparent power - power factor.[Elementary treatment only]

Unit 2 DC Machines: **13 HOURS**

DC Generator:

Construction-Principle and operation of DC Generator - EMF equation -Types– Applications [Elementary treatment only]

DC Motor:

Principle and operation of DC Motor – types-Torque equation - Speed control of DC Motor-Brake test- Swinburne's test-Applications. [Elementary treatment only]

Unit 3 AC Machines: 13 HOURS **Single Phase Transformer:** Construction, Principle and operation of Single-Phase Transformer –EMF Equation-Losses-Efficiency. [Elementary treatment only] **Three Phase Induction Motor**: Construction- Principle and operation of three phase Induction Motor-Types- Applications. [Elementary treatment only]
Unit 4 Semiconductor Devices: 13 HOURS Semiconductor Physics, PN Junction Diode & Zener Diode-characteristics- Applications: Rectifiers (Half Wave Rectifier & Full Wave Rectifier) [Elementary treatment only], Clippers and Clampers.
Unit 5 Bipolar Junction Transistors: 12 HOURS Construction and working of bipolar junction transistor, CB, CE and CC Configurations and characteristics. [Elementary treatment only], Transistors as amplifiers, op-amp basics.

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

CO1	Apply concepts of KVL/KCL in solving DC circuits. (Apply, Find, Solve)
CO2	Choose correct machine for a specific application. (Understand, Apply)
CO3	Illustrate working principles of DC and AC Machines. (Understand, Apply)
CO4	Describe working principles of diodes and transistors. (Understand, Apply)
CO5	Understand the applications of diodes and transistors. (Understand, Analyze)

Text books:

1. D. P. Kothari and I. J. Nagrath- "Basic Electrical Engineering" - Tata McGraw Hill - 2010.
1. Electronic Devices and Circuits, R. L. Boylestad and Louis Nashelsky, 9th edition, PEI/PHI 2006.

Reference books:

1. L. S. Bobrow- "Fundamentals of Electrical Engineering" - Oxford University Press - 2011.
2. E. Hughes - "Electrical and Electronics Technology" - Pearson - 2010.

Micro-Syllabus of Basics of Electrical & Electronics Engineering

UNIT-I: DC & AC Circuits:

DC Circuits:

Electrical circuit elements (R - L and C) – Kirchhoff's laws -Voltage and Current division rules-series, parallel circuits and star-delta and delta-star transformations- [Elementary treatment only]

AC Circuits:

Representation of sinusoidal waveforms - Peak and RMS values - phasor representation - real power - reactive power - apparent power - power factor. [Elementary treatment only]

Unit	Module	Micro content
1.a DC Circuits	Definitions & circuit elements	Definitions of Voltage, Current, Power & Energy
		Types and Classification of circuit elements: R, L, C elements Active, Passive; unilateral, bilateral; linear, nonlinear; lumped, distributed elements
	Ohm's law, KCL, KVL, Voltage & Current Division rules	Ohm's Law. Active elements -Representation of Voltage and current sources in ideal and Practical cases and Passive elements –Voltage & Current relationship of R - L and C elements
		Kirchhoff's Voltage and current laws –series and parallel circuits of R, L & C elements, Voltage and Current division rules for resistive circuit only
	S T A R - D E L T A transformation	star-delta and delta-star transformations of resistive circuit only [Elementary treatment only]
1.b AC Circuits	Phasor representation & AC fundamentals	Representation of sinusoidal waveforms –Phase difference and phasor representation of sinusoidal waveforms
		Peak, Average and RMS values for sinusoidal waveforms only

	AC circuits & Power	Definitions of reactance and Impedance, real power - reactive power - apparent power - power factor. [Elementary treatment only]

UNIT-II: DC Machines:

DC Generator:

Construction-Principle and operation of DC Generator - EMF equation -Types– Applications [Elementary treatment only]

DC Motor:

Principle and operation of DC Motor – types-Torque equation - Speed control of DC Motor-Brake test- Swinburne's test-Applications. [Elementary treatment only]

Unit	Module	Micro content
2.a DC generators	DC generator principle of operation & applications	Construction details of dc generator-Field System, Armature
		Principle and operation of DC generator
		derivation of generated EMF-Simple problems on generated EMF
		Types of dc generators- Separately and Self excited (Shunt and series generators equivalent circuit [Elementary treatment only]) and applications.
2.b DC Motors	DC Motor principle of operation & Back EMF	Principle operation of DC Motor
		Significance of Back EMF-Simple problems on Back EMF
		Derivation of Torque Equation-Simple problems on Torque Equation Torque equation of DC motor
	Types of DC motors & Applications	Types of DC Motors (Shunt and series motors equivalent circuit) and Applications
	DC motor Speed control techniques	speed control (armature and field control methods)

	Testing of DC machines	Brake test procedure-Swinburne's test procedure [Elementary treatment only]

UNIT-III: AC Machines:

Single Phase Transformer:

Construction, Principle and operation of Single-Phase Transformer –EMF Equation-Losses-Efficiency. [Elementary treatment only]

Three Phase Induction Motor: Construction- Principle and operation of three phase Induction Motor-Types- Applications. [Elementary treatment only].

Unit	Module	Micro content
3.a Single Phase transformer	Basics of transformer	Construction, principle of operation of single-phase transformer, Types of single-phase transformer
	EMF equation & Phasor diagram	EMF Equation of a transformer and simple problems on EMF equation of single-phase transformer
		Ideal Transformer on NO load with phasor diagram
	Transformer performance	Losses, Efficiency. [Elementary treatment only]
3.b. Three Phase Induction Motor	Basics of 3-phase induction motor	Construction and principles of 3-phase induction motor
	Types and applications	Types (Squirrel Cage and slip ring induction motor construction)- Applications

UNIT – IV: Semiconductor Devices

Semiconductor Physics, PN Junction Diode & Zener Diode-characteristics- Applications: Rectifiers (Half Wave Rectifier & Full Wave Rectifier) [Elementary treatment only], Clippers and Clampers.

Unit	Module	Micro content
	Semiconductor Physics	Classification of materials based on energy band diagram
		Current density in conductor, Intrinsic semiconductor & properties of silicon and germanium

4 . a . Semiconductor physics & Diodes	Semiconductor Physics	Extrinsic semiconductor: P-type and N-type, Conductivity of extrinsic semiconductor and law of mass action, Diffusion & Drift currents-N junction formation.
	PN Junction Diode & Zener Diode	Working principle of PN junction diode: forward bias, reverse bias
		Diode current equation (Expression only), Basic problems on usage of diode current equation.
		Diode circuit models: Ideal Diode Model, Ideal Diode Model with $V_{\gamma,}$. Reverse breakdown phenomena, Zener diode characteristics
4 . b Diode Applications	Voltage regulator	Zener Diode as Voltage Regulator
	Diode Rectifier Circuits	PN junction Diode Rectifiers (Working principle, Input and Output Waveforms and Expressions of output DC voltage for each) PN junction Diode Rectifiers (Working principle, Input and Output Waveforms and Expressions of output DC voltage for each)
	Clipper circuits	Bridge. Basics of Clippers: Series Positive, Series negative, Shunt Positive, Shunt negative, Dual clipping (without bias voltage).

UNIT V: Bipolar Junction Transistors

Construction and working of bipolar junction transistor, CB, CE and CC Configurations and characteristics.[Elementary treatment only], Transistors as amplifiers, op-amp basics.

Unit	**Module**	**Micro content**
5 a BJT	BJT construction & working	Periodic functions Construction, Configuration and models
		Working of BJT, Definitions of α, β and γ

5.a BJT	B J T C B , C E characteristics	CB characteristics: Input, output characteristics , current relation, dynamic input and output resistances and base-width modulation
		CE characteristics: Input, output characteristics , current relation, dynamic input and output resistances
	BJT Amplifier	Transistor as an amplifier
5.b OP-Amp basic	Basics of OP-amp & characteristics	Block diagram of OP-AMP (Qualitative treatment)
		Ideal characteristics of OP-AMP
	Basic OP-amp circuits	Inverting amplifier circuit
		Non-inverting amplifier circuit

I-Year-II Semester		L T P C
ES1202	MATERIALS SCIENCE	3 1* 0 3

Pre-Requisites :

- Engineering Chemistry
- Engineering Physics

Course objectives: The student should be able To understand the basic fundamentals of Material science and Physical metallurgy. The basic concepts to be taught will help for the improvement, proper selection and effective utilization of materials which is essential to satisfy the ever increasing demands of the society.

Unit No	Contents
I	Introduction, Crystallography, Miller's indices, Packing Efficiency, Density calculations, Grains and Grain Boundaries, Effect of grain size on the properties, Determination of grain size by different methods, Constitution of Alloys: Necessity of alloying, Types of solid solutions, Hume - Rothery rules, Intermediate alloy phases.***Crystal Defects***
II	Introduction, phase diagrams, Phase rule, Lever rule, Binary phase Diagrams, Isomorphous transformations with examples, Eutectic transformations with examples, Eutectoid transformations with examples
III	Introduction, Steels, Iron-Carbon Phase Diagram, Heat Treatment, Study of Fe- Fe3C phase diagram., Construction of TTT diagrams, Annealing, Normalizing, Hardening and Tempering of steels, Hardenability of Alloy steels.

IV	Introduction - Cast Irons, Structure and properties of White Cast iron, Malleable Cast iron, Grey cast iron, Non-ferrous Metals and Alloys, Structure and properties of copper and its alloys, Aluminium and its alloys, Al-Cu phase diagram, Titanium and its alloys.***Super Alloys, Shape Memory Alloys***
V	Introduction to Ceramics, Polymers, Composites, Crystalline ceramics structure, properties & Applications, Glasses, cermets structure, properties & applications, Classification, properties & applications of composites, Classification, Properties and Applications of Polymers. ***Nano Composites***

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

C O 1: Able to know the basic concepts of bonds in metals and alloys. To understand the basicrequirements for the formation of solid solutions and other compounds.

C O 2: Able to understand the regions of stability of the phases that can occur in an alloy system in order to solve the problems in practical metallurgy.

CO3 : Able to study the basic concepts of steels, their properties and practical applications. And the affect of various alloying elements on iron-iron carbide system. And to understand the various heat treatment and strengthening processes used in practical applications.

C O 4: Able to study the basic concepts of castiron, non-ferrous metals and alloys, their properties

and practical applications.

C O 5: Able to study the properties and applications of ceramic, composite and other advanced materials so as to use the suitable material for practical applications.

Text books:

1. Material Science and Metallurgy/ Kodgire
2. Essentials of Materials Science and engineering / Donald R.Askeland / Thomson

Reference books:

1. Elements of Material science / V. Rahghavan
2. Engineering Material and Metallurgy – Er Amandeep Singh Wadhva
3. Materials Science and engineering / William and callister.
4. Introduction to Physical Metallurgy by Sidney H Avner, McGraw-Hill Publishers.

e- Resources & other digital material:

1. http://nptel.ac.in/courses/113105024/
2. http://nptel.ac.in/courses/113105024/1
3. http://nptel.ac.in/courses/113105024/2
4. http://nptel.ac.in/courses/113105024/3
5. http://nptel.ac.in/courses/113105024/4
6. http://nptel.ac.in/courses/113105024/5
7. http://nptel.ac.in/courses/113105024/6

NPTEL VIDEO COURSES

8. https://www.youtube.com/watch?v=PVnftOMxl6w&list=PLbMVogVj5nJQbjE_u2KZhUm CypfLunj G4

MICRO-SYLLABUS

Unit-1:

Introduction, Crystallography, Miller's indices, Packing Efficiency, Density calculations, Grains and Grain Boundaries, Effect of grain size on the properties, Determination of grain size by different methods,Constitution of Alloys: Necessity of alloying, Types of solid solutions, Hume - Rothery rules,Intermediate alloy phases

Unit	Module	Micro content
1. a or 2 a Crystallography	Crystallography	Crystallography,
	Crystallography	Miller's indices,
		Packing Efficiency, Grains and Grain Boundaries
Crystallography		Density calculations

1.b.or 2.b Constitution ofAlloys	Constitution of Alloys	Effect of grain size on the properties
		Determination of grain size by different methods,
		Necessity of alloying, Types of solid solutions
		Hume - Rothery rules
		Intermediate alloy phases

Unit-2:

Introduction, phase diagrams, Phase rule, Lever rule, Binary phase Diagrams, Isomorphous transformations with examples, Eutectic transformations with examples, Eutectoid transformations with examples

Unit	**Module**	**Micro content**
3. a or 4.a Phase diagrams	phase diagrams	phase diagrams.
		Phase rule
		Lever rule
		Binary phase Diagrams
3.b or 4.b Transformations	Transformations at different stages	Isomorphism transformations with examples
		Eutectic transformations with examples
		Eutectoid transformations with examples

Unit-3:

Introduction, Steels, Iron-Carbon Phase Diagram, Heat Treatment, Study of Fe-Fe3C phase diagram. Construction of TTT diagrams, Annealing, Normalizing, Hardening and Tempering of steels, Harden ability of Alloy steels.

Unit	**Module**	**Micro content**
5.a or 6.aSteels Heat Treatment	Different types of Steelsand Cast-iron	Composition, Application
	TTT diagrams	Construction of TTT diagrams
		Annealing

	Heat Treatment	Normalizing
		Hardening and Tempering of steels
		Harden ability of Alloy steels
5.b or 6.b **Iron-Carbon Phase Diagram**	**Iron-Carbon Phase Diagram**	Construction of phase diagram.
		Temperature, composition.
		Phase changes, Micro content
Unit-4: **Introduction** - Cast Irons, Structure and properties of White Cast iron, Malleable Cast iron, Grey cast iron, Non-ferrous Metals and Alloys, Structure and properties of copper and its alloys, Aluminium and its alloys, Al-Cu phase diagram, Titanium and its alloys		
Unit	**Module**	Malleable Cast iron
7.a.or 8.a Cast Irons	Types of Cast Irons	Grey cast iron.
		Structure and properties of copper and its alloys
		Aluminum and its alloys
7.b.or 8.b **Non-ferrous Metals and Alloys**	Types of Non-ferrous Metals and Alloys	Al-Cu phase diagram
		Titanium and its alloys
		Titanium and its alloys
		Micro content
UNIT-5 **Introduction** to Ceramics, Polymers, Composites, Crystalline ceramics structure, properties & Applications, Glasses, cermets structure, properties & applications, Classification, properties & applications of composites, Classification, Properties and Applications of Polymers.		
Unit	**Module**	properties & Applications
9.a. or 10.a **Ceramics,Polymers**	Types of Ceramics,	Glasses, cermets structure, properties & applications, Classification

	Polymers	properties & applications of composites
9.b.or 10.b **Glasses, Composites**	**Types of Glasses, Composites**	Classification, Properties and Applications ofPolymers

I-Year-II Semester		L T P C
ES1203	ENGINEERING MECHANICS	3 1* 0 3

Course objectives:

The main objectives are

1. To understand the resolution of forces, equilibrium of force systems
2. To learn the analysis of forces in the structures and also the basic concepts of friction and its Applications to simple systems.
3. To understand the concepts of centroid, moment of inertia, centre of gravity and mass moment of inertia.
4. To understand the basic concepts of kinematics and kinetics.
5. To learn the concepts of work energy method and impulse momentum

UNIT- I: INTRODUCTION TO ENGINEERING MECHANICS 13 HOURS
Force systems: Basic Concepts, Resultant of coplanar concurrent forces, Components of force in space, Moment of force and its applications, couples and resultant of force systems, Equilibrium of Force Systems, Free body diagram, Equations of equilibrium, Equilibrium of planar and spatial system.
UNIT-II: ANALYSIS OF STRUCTURES AND FRICTION 11 HOURS
Trusses: Introduction, Analysis of trusses by method of joints, method of sections; ***Friction:*** Introduction to Friction, Laws of friction, Application to simple systems and connected systems.

UNIT-III: CENTROID AND CENTRE OF GRAVITY, AREA MOMENT OF INERTIA AND MASS MOMENT INERTIA 14 HOURS ***Centroid:*** Centroid of simple figures from basic principles, centroid of composite sections; ***Centre of Gravity:*** Center of gravity of simple body from basic principles, Center of gravity of composite bodies, Pappus theorems. ***Area moments of Inertia:*** Definition – Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of Composite Figures. ***Mass Moment of Inertia:*** Introduction of Mass Moment of Inertia, mass moment of inertia of composite bodies
UNIT IV: INTRODUCTION TO KINEMATICS AND KINETICS 14 HOURS ***Kinematics:*** Rectilinear and Curvilinear motions – Velocity and Acceleration – Motion of Rigid Body – Types and their Analysis in Planar Motion. ***Kinetics:*** Analysis as a Particle and Analysis as a Rigid Body in Translation – Central Force Motion – Equations of Plane Motion – Fixed Axis Rotation – Rolling Bodies.
UNIT – V: WORK -ENERGY METHOD 13 HOURS ***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 successful completion of the course, the student will be able to

CO1	Compute the resultant and moment of a force system and apply the equations of equilibrium for a generalized force system **(Apply)**
CO2	Solve the forces in trusses, frames and also friction in various mechanical devices. **(Apply)**
CO3	Interpret the centroids, centers of gravity and moments of inertia of simple geometric shapes and understand the physical applications of these properties. (**Apply**)
CO4	Apply the basic concepts of dynamics to solve problems of engineering applications (**Apply**)
CO5	Solve problems using work energy equations for translation, fixed axis rotation and plane motion. (**Apply**)

Text books:

1. Reddy Vijay Kumar K. and K. Suresh Kumar (2010), Singer's Engineering Mechanics. 2.S.P. Timoshenko and D.H. Young, Engineering Mechanics, McGraw-Hill International Edition,1983. 3. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications
Reference books:
1. Engineering Mechanics statics and dynamics – R.C. Hibbeler, 11th Edn – Pearson Publ. 2. Mechanics for Engineers, statics - F.P. Beer & E.R. Johnston – 5th Edn Mc Graw Hill Publ. 3. Engineering Mechanics statics and dynamics, A Nelson, Mc Graw Hill publications

Micro-Syllabus of ENGINEERING MECHANICS

UNIT- I: INTRODUCTION TO ENGINEERING MECHANICS

Force systems: Basic Concepts, Resultant of coplanar concurrent forces, Components of force in space, Moment of force and its applications, couples and resultant of force systems, Equilibrium of Force Systems, Free body diagram, Equations of equilibrium, Equilibrium of planar and spatial system.

Unit	Module	Micro content
1a. *Force systems*	INTRODUCTION	Basic Concepts
		Resolving forces into rectangular components
		Classification of force system
	Resultant of forces	Resultant of coplanar concurrent forces. Parallelogram law of method **(Simple problems on analytical method only)**
		Components of force in space **(Simple problems using vector method for finding resultant)**

		Moment of force & couples Varignon's theorem **(Simple problems on analytical method only)**
		resultant of force systems
1b. Equilibrium	Equilibrium of Force Systems	Defining constraint, Types of supports and reaction forces
		Free body diagram
		Equilibrium of Force Systems
		Equations of equilibrium
		Equilibrium of planar system **(Simple problems using analytical method only)**
		Equilibrium of spatial system **(Simple problems on vector method)**

UNIT-II: ANALYSIS OF STRUCTURES AND FRICTION

Trusses: Introduction, Analysis of trusses by method of joints, method of sections;

Friction: Introduction to Friction, Laws of friction, Application to simple systems and connected systems.

Unit	**Module**	**Micro content**
2.a. ANALYSIS OF STRUCTURES	***Trusses***	Introduction, Analysis of trusses
		Analysis of trusses by method of joints **(Simple problems on 2D Truss only)**
		Analysis of trusses by method of sections **(Simple problems on 2D Truss only)**
2.b. Friction	***Friction***	Introduction, Applications of Friction
		Laws of friction
		Cone of friction
		Simple 2D problems on Friction

UNIT-III:

CENTROID AND CENTRE OF GRAVITY, AREA MOMENT OF INERTIA AND MASS MOMENT INERTIA

Centroid: Centroid of simple figures from basic principles, centroid of composite sections;

Centre of Gravity: Center of gravity of simple body from basic principles, Center of gravity of composite bodies, Pappus theorems.

Area moments of Inertia: Definition – Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of Composite Figures.

Mass Moment of Inertia: Introduction of Mass Moment of Inertia, mass moment of inertia of composite bodies

Unit	Module	Micro content
3. CENTRE OF GRAVITY & MOMENT OF INERTIA	***Centroid***	Derivation of Centroid for simple figures such as Triangle, sector and semi circle from basic principles
		Centroid of composite sections
		Simple problems on *Centroid* of composite sections
	Centre of Gravity	Derivation of Center of gravity for simple body such as cylinder and cone from the basic principles
		Pappus theorems
	Area moments of Inertia	Definition, Parallel axis theorem and Perpendicular axis theorem
		Simple problems on *Area moments of Inertia*
	Mass Moment of Inertia	Mass Moment of Inertia importance and its Derivation for simple bodies such as cylinder and cone

<table>
<tr><td colspan="3">UNIT IV: INTRODUCTION TO KINEMATICS AND KINETICS

Kinematics: Rectilinear and Curvilinear motions – Velocity and Acceleration – Motion of Rigid Body – Types and their Analysis in Planar Motion.

Kinetics: Analysis as a Particle and Analysis as a Rigid Body in Translation – Central Force Motion – Equations of Plane Motion – Fixed Axis Rotation – Rolling Bodies.</td></tr>
<tr><td>Unit</td><td>Module</td><td>Micro content</td></tr>
<tr><td rowspan="4">4a. Kinematics</td><td rowspan="2">Rectilinear motion</td><td>Equations of motion in linear motion
Simple problems on linear motion</td></tr>
<tr><td>Projectile motion
Simple problems on Rectilinear motion</td></tr>
<tr><td rowspan="2">Curvilinear motion</td><td>Equations of motion in Curvilinear motion</td></tr>
<tr><td>Relation between Linear and curvilinear moton (Simple problems)</td></tr>
<tr><td></td><td>Motion of Rigid Body</td><td>Types and their Analysis in Planar Motion. (Finding Instantaneous center)</td></tr>
<tr><td rowspan="5">4b.
Kinetics</td><td rowspan="2">Analysis as a Particle</td><td>D Alembert’s principle</td></tr>
<tr><td>Simple problems on Translatory motion using D Alembert’s principle</td></tr>
<tr><td rowspan="3">Analysis as a Rigid Body</td><td>Central Force Motion</td></tr>
<tr><td>Equations of Plane Motion – Fixed Axis Rotation</td></tr>
<tr><td>Rolling Bodies
Simple problems on Rolling Bodies</td></tr>
<tr><td colspan="3">UNIT – V: WORK -ENERGY METHOD

Work – Energy Method: Equations for Translation, Work-Energy Applications to Particle Motion, Connected System-Fixed Axis Rotation and Plane Motion. Impulse momentum method.</td></tr>
<tr><td>Unit</td><td>Module</td><td>Micro content</td></tr>
<tr><td></td><td></td><td>Derivation of work energy method</td></tr>
</table>

5. WORK - ENERGY METHOD	Work-Energy Applications to Particle Motion	**Simple problems on Translation using work energy method**
		Simple problems on Connected System using work energy method
	Impulse momentum method	**Simple problems using Impulse momentum method**
		Simple problems on Connected System using Impulse momentum method

I-Year-II Semester		L T P	C
BS1202L	ENGINEERING CHEMISTRY LAB	0 0 3	1.5

Course objectives:

The main objectives are

1. To furnish the students with a solid foundation in Chemistry Laboratory required to solve the Engineering problems.
2. To expose the students in practical aspects of the theoritical concepts like pH, hardness of water etc.
3. To guide the students on how to handle the instruments like UV-visible spectrophotometer, potentiometer and conductometer.

List of Experiments: (Any 10 of the following listed 16 experiments)

1. Determination of HCl using standard Na_2CO_3 solution.
2. Determination of alkalinity of a sample containing Na_2CO_3 and NaOH.
3. Determination of Mn (II) using standard oxalic acid solution.
4. Determination of ferrous iron using standard $K_2Cr_2O_7$ solution.
5. Determination of Copper (II) using standard EDTA solution.
6. Determination of temporary and permanent hardness of water using standard EDTA solution.
7. Determination of Iron (III) by colorimetric method.
8. Determination of the concentration of acetic acid using sodium hydroxide (pH-metric method).
9. Determination of concentration of strong acid vs strong base (by conductometric method).
10. Determination of strong acid vs strong base (by potentiometric method).
11. Determination of Mg^{+2} present in an antacid.
12. Determination of $CaCO_3$ presence in an egg shell.
13. Estimation of vitamin- C.
14. Determination of phosphoric content in soft drinks.
15. Adsorption of acetic acid by charcoal.

16. Prepatation of nylon-6, 6 and Bakelite (demonstration only)

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

CO1	To estimate the amount of metal ions present in different solutions (L4 & L3)
CO2	To analyze the quality parameters of water (L4)
CO3	To determine the strength of different solutions by using different instrumentation techniques (L3)

I-Year-II Semester		L T P	C
ES1203L	BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING LAB	0 0 3	1.5

Course objectives:

The main objectives are

1. To Verify Kirchhoff's laws, Voltage and Current division rules.
2. To learn speed control and testing of DC Shunt Motor.
3. To learn and understand the operation of induction motor.
4. To learn applications of diodes and transistors.

List of Experiments: -

1. Verification of Kirchhoff laws.
2. Verification of Voltage division rule and current division rule.
3. Speed control of DC Shunt Motor.
4. Perform Brake test on DC Shunt Motor.
5. Conduct Swinburne's test on DC Shunt Motor.
6. Brake test on 3-phase Induction Motor.
7. Draw the V-I characteristics of P-N Junction Diode.
8. Draw the V-I characteristics of zener Diode.
9. Half wave rectifier and Full wave rectifier operations using diodes.
10. Draw the BJT-CB Configuration characteristics.
11. Draw the BJT-CE Configuration characteristics.
12. Draw the BJT-CC Configuration characteristics.
13. Study of circuit simulation software (any one- TINA-PRO/ PSPICE/ CIRCUIT MAKER/ GPSIM/ SAPWIN etc).

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

CO1	Analyze the performance of AC and DC Machines by testing
CO2	Perform speed control of DC shunt motor.
CO3	Perform the half wave and full wave rectifier

I-Year-II Semester		L T P	C
ES1204L	WORKSHOP PRACTICE LAB	0 0 3	1.5

Course Objective:

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

Wood Working:

Familiarity with different types of woods and tools used in wood working and make following joints

a) Half – Lap joint
b) Dovetail joint
c) Bridle joint

Sheet Metal Working:

Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from GI sheets

a) Tapered tray b) Conical funnel c) Elbow pipe d) Brazing

Fitting:

Familiarity with different types of tools used in fitting and do the following fitting exercises

a) V-fit b) Dovetail fit c) square fit d) Semi-circular fit
e) Two Wheeler tyre puncture and change of two wheeler tyre

Electrical Wiring:

Familiarities with different types of basic electrical circuits and make the following connections

a) Parallel and series b) Two way switch c) Godown lighting d) Tube light
e) Three phase motor f) Soldering of wires

Course Outcomes:

After completion of this lab the student will be able to

1. Apply wood working skills in real world applications. (L3)
2. Build different parts with metal sheets in real world applications. (L3)
3. Apply fitting operations in various applications. (L3)
4. Apply different types of basic electric circuit connections. (L3)
5. Demonstrate soldering and brazing. (L2)

I-Year-II Semester	ENVIRONMENTAL STUDIES	L T P 2 0 0	C 0

MC1201

Course objectives:

The main objective is

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

UNIT – I: MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES

13 HOURS

Definition, Scope and Importance – Need for Public Awareness.

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

UNIT – II: Ecosystems, Biodiversity, and its Conservation **13 HOURS**

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

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

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

UNIT – III: Environmental Pollution and Solid Waste Management **12 HOURS**

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

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

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

UNIT – IV: Social Issues and the Environment **14 HOURS** **Social Issues and the Environment:** From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns. Case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies – Wasteland reclamation. – Consumerism and waste products. – Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.
UNIT – V: Human Population and the Environment **13 HOURS** **Human Population and the Environment:** Population growth, variation among nations. Population explosion – Family Welfare Programmed. – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of information Technology in Environment and human health – Case studies. **Field Work:** Visit to a local area to document environmental assets River/forest grassland/hill/ mountain – Visit to a local polluted site-Urban/Rural/Industrial/Agricultural Study of common plants, insects, and birds – river, hill slopes, etc.

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

CO1	Able to U**nderstand** The concepts of the ecosystem
CO2	Able to U**nderstand** The natural resources and their importance
CO3	Able to learn The biodiversity of India and the threats to biodiversity ,and **Apply** conservation practices
CO4	Able to learn Various attributes of the pollution and their impacts
CO5	Able to U**nderstand** Social issues both rural and urban environment. And able to U**nderstand** About environmental Impact assessment and **Evaluate** the stages involved in EIA

Text books:

1. Text book of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission, Universities Press.
2. Environmental Studies by Palaniswamy – Pearson education
3. Environmental Studies by Dr.S.Azeem Unnisa, Academic Publishing Company

Reference books:

1. Textbook of Environmental Science by Deeksha Dave and E.Sai Baba Reddy, Cengage Publications.
2. Text book of Environmental Sciences and Technology by M.Anji Reddy, BS Publication.
3. Comprehensive Environmental studies by J.P.Sharma, Laxmi publications.
4. Environmental sciences and engineering – J. Glynn Henry and Gary W. Heinke – Prentice hall of India Private limited.
5. A Text Book of Environmental Studies by G.R.Chatwal, Himalaya Publishing House.

II-Year-I Semester		L T P	C
BS2101	**MATHEMATICS-III** **(Linear Algebra, Vector Calculus and PDE)**	3 1* 0	3

Pre-Requisites:

1) Basics of Matrix Algebra
2) Partial Differentiation
2) Multiple Integrals
4) Ordinary Differential Equations

Course Objectives: To learn

1. The concept of rank of a matrix which is used to know the consistency of system of linear equations and also to find the eigen vectors of a given matrix.
2. Cayley-Hamilton theorem to find the inverse and power of a matrix and determine the nature of the quadratic form.
3. The gradient of a scalar function, divergence and curl of a vector function
4. To evaluate line, surface and volume integrals and construct relation between line, surface and volume integrals using vector integral theorems.
5. To familiarize the techniques in solutions of partial differential equations.

Unit No	Contents

I	**Solving system of linear equations, Eigenvalues and Eigen vectors:** Rank of a matrix by Echelon form and normal form–solving system of homogeneous and non-homogeneous linear equations–Gauss elimination, Gauss Jordan for solving system of equations- Eigenvalues and Eigen vectors and their properties. **(12 hrs)**
II	**Cayley-Hamilton theorem and quadratic forms:** Cayley-Hamilton theorem (without proof)–Finding inverse and power of a matrix by Cayley-Hamilton theorem–Reduction to Diagonal form–Quadratic forms and nature of the quadratic forms–Reduction of quadratic form to canonical forms by orthogonal transformation.**Application:** Free vibration of two mass systems. **(12 hrs)**
III	**Vector Differentiation:** Scalar and Vector point functions-Vector Differential operator-Gradient – Directional derivatives – Divergence – Curl – Laplacian second order operator-Vector identities- Scalar Potential. **(10 hrs)**
IV	**Vector Integration:** Line integral – Work done – Circulation- Surface integral- Volume integral **Vector integral theorems (without proof):** Green's theorem in a plane- Stoke's theorem-Gauss Divergence theorem. **(12 hrs)**
V	**Solutions of Partial differential Equations:** Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solutions of first order linear (Lagrange) equation and nonlinear (standard types) equations.**Second order PDE:** Solutions of linear partial differential equations with constant coefficients – RHS term of the type e^{ax+by}, $\sin(ax+by)$, $\cos(ax+by)$, $x^m y^n$. **(14 hrs)**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Analyze** the solution of the system of linear equations and to find the Eigenvalues and Eigen vectors of a matrix. (L4)

CO2	**Apply** Cayley-Hamilton theorem to determine inverse and power of a matrix and **identify** the nature of the quadratic form (L3)
CO3	**Interpret** the physical meaning of different operators such as gradient, curl and divergence. (L5)
CO4	**Determine** line, surface and volume integrals. **Apply** Green's, Stoke's and Gauss divergence theorems to calculate line, surface and volume integrals. (L5 & L3)
CO5	**Identify** the solution methods for partial differential equation that model physical processes. (L3)

Text books:

1. **B.S. Grewal,** Higher Engineering Mathematics, 44th Edition, Khanna Publishers.
2. **B.V. Ramana,** Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference books

1. **Erwin Kreyszig,** Advanced Engineering Mathematics, 10th Edition, Wiley-India.
2. **H. K. Das,** Advanced Engineering Mathematics, 22nd Edition,S. Chand & Company Ltd.
3. **David Poole**, Linear Algebra- A modern introduction, 4th edition, Cengage.
4. **Peter O' Neil**, Advanced Engineering Mathematics, Cengage
5. **Srimantha Pal, S C Bhunia**, Engineering Mathematics, Oxford University Press.

e- Resources & other digital material

1. https://www.youtube.com/watch?v=LJ-LoJhbBA4&list=PLbMVogVj5nJQ2vsW_hmyvVfO4GYWaaPp7
   (For Unit-I, Mod1 :1-7 lectures, Mod 6: 25th lecture, Mod 6: 26th lecture & For Unit-II Mod 7: 25th -27th lectures)

1. https://www.youtube.com/watch?v=9MCjyQSRmR8&list=PLFW6lRTa1g80fZ1giRbqbe_XdXPdkkyqY&ab_channel=NPTEL-NOCIITMNPTEL-NOCIITM
   (For Unit-I 1-17 lectures)

1. https://www.youtube.com/watch?v=ksS_yOK1vtk&list=PLbRMhDVUMngfIrZCNOyPZwHUU1pP66vQW&ab_channel=IITKharagpurJuly2018IITKharagpurJuly2018 (For Unit-III 33-52 lectures, For Unit-IV 53-56 lectures)
1. http://www.infocobuild.com/education/audio-video-courses/mathematics/Mathematics-III-IIT-Roorkee/lecture-16.html (For Unit-V lectures: 30-32)
1. https://www.youtube.com/watch?v=PDUHeFyq6sA&list=PLoVRJrAl0FT0oYJJQbchL1hiAUjlJ4y4O&index=42&ab_channel=AKTUDigitalEducationAKTUDigitalEducation (For Unit-V lectures: 41-44)

Micro-Syllabus of Mathematics-III

Unit-1: Solving system of linear equations, Eigen values and Eigen Vectors:

Rank of a matrix by Echelon form and normal form–solving system of homogeneous and non-homogeneous linear equations–Gauss elimination, Gauss Jordan for solving system of equations-Eigen values and Eigen vectors and their properties.

Unit	Module	Micro content
1a. & 2a. Rank of a matrix & Solving system of linear equations	Rank of a matrix	Echelon form
		Normal form
		Normal form by reducing it into PAQ form
	Solutions to the system of linear equations	Homogeneous Linear system
		Non homogeneous linear system
		Gauss elimination method
		Gauss Jordan method
1b. & 2b. Eigen values and	Eigen values and Eigen vectors of a matrix	Eigen Values and Eigen vectors

Eigen vectors of a matrix & Properties	Properties	Properties of Eigen values and Eigen vectors

Unit-2: Cayley-Hamilton theorem and quadratic forms:

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

Application: Free vibration of two mass systems.

Unit	Module	Micro content
3.Cayley-Hamilton theorem & Applications	Cayley-Hamilton theorem	Verification of Cayley-Hamilton theorem
		Find the inverse of a matrix using Cayley-Hamilton theorem
		Find the higher powers of a matrix using Cayley-Hamilton theorem
	Free vibration of two mass systems	Find the natural frequencies and normal modes using Free vibration of two mass systems
4. Diagonalization of a matrix & Reduction of the quadratic forms into canonical form	Diagonalization of a matrix, Rank, index, nature, signature, nature of the Quadratic forms	Diagonalization of a matrix
		Reduction of the quadratic forms into canonical form by orthogonal transformation

Unit-3: Vector Differentiation:

Scalar and Vector point functions-Vector Differential operator- Gradient – Directional derivatives – Divergence – Curl – Laplacian second order operator- Vector identities- Scalar Potential.

Unit	Module	Micro content
5a. & 6a.		Unit normal vector
		Angle between the two surfaces

Del applied to scalar and vector point functions	Gradient, Divergence and Curl	Directional derivatives
		Divergence of a vector-Solenoidal
		Curl of a vector-Irrotational
5b. & 6b. **Scalar potential, Del applied twice to point functions.**	Scalar potential functions, Laplacian operators, Vector identities	Scalar potential function
		Problems on Laplacian operator
		Vector identities

Unit-4: Vector Integration:

Line integral – Work done – Circulation- Surface integral- Volume integral

Vector integral theorems (without proof): Green's theorem in a plane- Stoke's theorem- Gauss Divergence theorem.

Unit	Module	Micro content
7a. & 8a. **Integration of vectors**	Line, surface and volume integrals	Work done by the force
		Surface integral
		Volume integral
7b. & 8b. **Vector integral theorems**	Relations between line, surface and volume integrals.	Green's theorem in the plane
		Stoke's theorem
		Gauss divergence theorem

Unit-5: Solutions of Partial differential Equations:

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solutions of first order linear (Lagrange) equation and nonlinear (standard types) equations.

Second order PDE: Solutions of linear partial differential equations with constant coefficients – RHS term of the type $e^{ax+by}, \sin(ax+by), \cos(ax+by), x^m y^n$.

Unit	Module	Micro content
9 a. & 9b. Formation of a partial differential equations and Solutions to the partial differential equations of first order	Formation of partial differential equations	Formation of partial differential equations by eliminating the arbitrary constants
		Formation of partial differential equations by eliminating the arbitrary functions
	Linear (Lagrange's) partial differential equations	Method of grouping
		Method of multipliers
	Non-linear partial differential equations	$f(p, q) = 0$
		$f(z, p, q) = 0$
		$f(x, p) = g(y, q)$
		$z = px + qy + f(p, q)$
10a. & 10b. Second order partial differential equations	Homogeneous partial differential equations of second order with constant coefficients	Finding the Complementary function
		Particular integral of the type $'e^{ax+by}'$
		Particular integral of the type $'\sin(ax+by)\ or\ \cos(ax+by)'$
		Particular integral of the type $'x^m y^n'$
	Non-homogeneous partial differential equations of	Finding the Complementary function
		Particular integral of the type $'e^{ax+by}'$

equations	second order with constant coefficients	Particular integral of the type $'\sin(ax+by)\ or\ \cos(ax+by)'$
		Particular integral of the type $'x^m y^n'$

II-Year-I Semester	**MECHANICS OF SOLIDS**	**L** **T** **P** **C** 3 1* 0 3

PC2101

Pre-Requisites:

1) Engineering Mathematics

2) Engineering Mechanics

Course objectives:

The students will acquire the knowledge to

1. Understand the stresses & deformations of a member due to axial loading under different conditions.
2. Determine the shear force and bending moment in beams under various loading conditions.
3. Understand the concepts of bending and torsion theories
4. Analyze principal stresses in uni-axial & bi-axial members and also design of thin & thick cylinders.
5. Analyze the deflections in beams and columns

Unit No	Contents
I	**SIMPLE STRESSES & STRAINS:** Elasticity and plasticity – Types of stresses & strains–Hooke's law – stress – strain diagram for different materials –Working stress– Factor of safety. Lateral strain, Poisson's ratio & volumetric strain – composite bars– Temperature stresses- Relation between elastic constants.

II	**SHEAR FORCE AND BENDING MOMENT:** Definition of beam – Types of beams – Concept of shear force and bending moment – Relation between S.F., B.M and rate of loading at a section of abeam.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.
III	**FLEXURAL STRESSES:** Theory of simple bending – Assumptions – Derivation of bending equation: M/ I = f/y = E/R Neutral axis – Determination bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I, T, Angle and Channel sections – Design of simple beam sections. **TORSION:** Introduction-Derivation- Torsion of Circular shafts -Pure Shear-Transmission of power by circular shafts, Shafts in series, Shafts in parallel.
IV	**PRINCIPAL STRESSES AND STRAINS** - Stresses on an inclined plane under different uniaxial and biaxial stress conditions - Principal planes and principal stresses - Mohr's circle. Stress strain analysis of 3-D element. **THIN CYLINDERS:** Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and Volumetric strains – changes in diameter, and volume of thin cylinders. **THICK CYLINDERS:** Lame's equation – cylinders subjected to inside & outside pressures.
V	**DEFLECTION OF BEAMS:** Bending into a circular arc – slope, deflection and radius of curvature – Differential equation for the elastic line of a beam – Determination of slope and deflection for cantilever and simply supported beams subjected to point loads, U.D.L, uniformly varying loads by Double integration method, Macaulay's method and moment area method. **COLUMNS:** Buckling and Stability, Columns with Pinned ends, Columns with other support Conditions, Limitations of Euler's Formula, Rankine's Formula.

Course outcomes:

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

1. Compute the stresses & deformations of a member due to axial loading under uniform and non-uniform conditions. **(Apply level, KL3)**
2. Solve the variation of SF & BM in determinate beams. **(Apply level, KL3)**
3. Examine the structural members subjected to flexural and torsion loads. **(Apply level, KL3)**
4. Determine the biaxial stresses developed at a point of stressed member and analyze the thin Pressure vessels. **(Apply level, KL3)**
5. Understand the concepts of deflections for statically determinate beams and buckling of Columns. **(Understand level, KL2)**

Text books

1. Mechanics of Materials-Gere and Timoshenko, Second edition CBS, Publications.
2. Strength of materials by R.K. Bansal, Laxmi Publications-Sixth edition.

References

1. Strength of materials by B.C. Punmia-lakshmi publications Pvt. Ltd, New Delhi.- Tenth edition
2. Strength of materials -GH Ryder- Mc Millan publishers,2002 India Ltd
3. Strength of Materials -By Jindal, Umesh Publications, 1 edition
4. Solid Mechanics, Egor P. Popov. Published by Pearson 1998.
5. Strength of materials by S. Ramamrutham-16/e- Dhanpat Rai Publishing Co Pvt. Ltd.

e- Resources & other digital material:

1. https://nptel.ac.in/courses/112/102/112102284/
2. https://nptel.ac.in/noc/courses/noc17/SEM2/noc17-ce17/
3. https://onlinecourses.nptel.ac.in/noc20_me84/preview
4. https://www.youtube.com/watch?v=kpAnsW-WB58

Micro Syllabus

UNIT-I

SIMPLE STRESSES & STRAINS: Elasticity and plasticity – Types of stresses & strains–Hooke's law – stress – strain diagram for different materials –Working stress–Factor of safety. Lateral strain, Poisson's ratio & volumetric strain – composite bars–Temperature stresses- Relation between elastic constants.

Unit	Module	Micro content
1.a. or 2.a	Simple stresses & Strains	Types of stresses & strains, Hooke's law and stress-strain diagram for different materials, Factor of safety, Lateral strain, Poisson's ratio & volumetric strain **(Theory and associated problems)**
1.b. or 2.b	Simple stresses & Strains	Composite bars, temperature stresses & relation between elastic constants. **(Theory and associated problems)**

UNIT II

SHEAR FORCE AND BENDING MOMENT: Definition of beam – Types of beams – Concept of shear force and bending moment – Relation between S.F., B.M and rate of loading at a section of abeam. 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.

Unit	Module	Micro content
3.a. or 4. a	Shear force & Bending moment	Types of beams, Concept of shear force and bending moment & relation between S.F., B.M **(Only theory)**
		S.F and B.M diagrams for cantilever beam subjected to point loads, UDL & uniformly varying loads **(Theory and associated problems)**

3.b. or 4. b	Shear force & Bending moment	S.F and B.M diagrams for simply supported beam subjected to point loads, UDL & uniformly varying loads **(Only problems)**
		S.F and B.M diagrams for overhanging beam subjected to point loads, UDL & uniformly varying loads **(Only problems)**

UNIT III

FLEXURAL STRESSES:

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

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

Unit	Module	Micro content
5.a. or 6. a	Flexural stresses	Derivation of bending equation **(Only theory)**
		Determination bending stresses & section modulus for beams with different cross sections such as rectangular and circular sections, I, T, Angle and Channel sections **(Only numericals)**
5.b. or 6. b	Torsion	Derivation of torsion equation **(Only theory)**
		Torsion and power transmission of circular shafts, shafts in series & shafts in parallel **(Only problems)**

Unit-IV

PRINCIPAL STRESSES AND STRAINS - Stresses on an inclined plane under different uniaxial and biaxial stress conditions - Principal planes and principal stresses - Mohr's circle. Stress strain analysis of 3-D element.

THIN CYLINDERS: Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and Volumetric strains – changes in diameter, and volume of thin cylinders.

THICK CYLINDERS: Lame's equation – cylinders subjected to inside & outside pressures.

Unit	Module	Micro content
7.a. or 8.a	Principal stresses & strains	Stresses on an inclined plane under different uniaxial and biaxial stress conditions, Principal planes and principal stresses & Mohr's circle **(Theory & associated numericals)**
7.b. or 8.b	Thin & Thick cylinders	Longitudinal and circumferential stresses for thin cylinders **(Derivation and associated numericals)**
		Lame's equation & cylinders subjected to inside & outside pressures. **(Theory and associated numericals)**

Unit-V

DEFLECTION OF BEAMS: Bending into a circular arc – slope, deflection and radius of curvature – Differential equation for the elastic line of a beam – Determination of slope and deflection for cantilever and simply supported beams subjected to point loads, U.D.L, uniformly varying loads by Double integration method, Macaulay's method and moment area method.

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

Unit	Module	Micro content

9.a. or 10.a	Deflection of beams	Determination of slope and deflection for cantilever beam subjected to point loads & U.D.L **(Theory & associate numericals)**
		Determination of slope and deflection for simply supported beams subjected to point loads & U.D.L **(Theory & associate numericals)**
9.b. or 10.b	Columns	Euler's equation for columns with various end conditions **(Theory & associate numericals)**
		Rankine's formula for columns **(Theory & associate numericals)**

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II-Year-I Semester	**KINEMATICS OF MACHINERY**	3 1* 0	3

PC2102

Pre-Requisites:

1. Engineering Mathematics
2. Engineering Mechanics

Course objectives: The main objective of this course is to identify the basic components & layout of mechanisms and understand the kinematics of linkages in the machines.

Unit No	Contents
I	**MECHANISMS**: Elements or Links – Classification – Rigid Link, flexible and fluid link – Types of kinematic pairs – sliding, turning, rolling, screw and spherical pairs – lower and higher pairs – closed and open pairs – constrained motion – completely, partially or successfully constrained and incompletely constrained. Grubler's criterion, Grashoff's law, Degrees of freedom, Kutzbach criterion for planar mechanisms, Mechanism and machines – kinematic chain – inversion of mechanism – inversions of quadric cycle, chain – single and double slider crank chains. Kinematic structure of robot. **LOWER PAIR MECHANISM**: Exact and approximate copiers and generated types – Peaucellier, Hart and Scott Russel – Grasshopper – Watt T. Chebicheff and Robert Mechanisms and straight-line motion, Pantograph. Conditions for correct steering – Davis Steering gear, Ackermans steering gear mechanism.

II	**KINEMATICS**: Velocity and acceleration – Motion of a link in machine – Determination of Velocity and acceleration diagrams – Graphical method – Application of relative velocity method four bar chain. Velocity and acceleration analysis of for a given mechanism, Kleins construction, Coriolis acceleration, determination of Coriolis component of acceleration.
III	**CAMS:** Definitions of cam and followers – their uses – Types of followers and cams – Terminology –Types of follower motion- Knife edge, Roller and Flat faced followers during Uniform velocity, Simple harmonic motion and uniform acceleration and retardation. Maximum velocity and maximum acceleration during outward and return strokes in the above 3 cases. Analysis of motion of followers.
IV	**BELT, ROPE AND CHAIN DRIVES**: Introduction - Selection of belt drive- Types of belt drives- materials-Velocity Ratio-Slip-Creep-Tensions for flat belt drives & V-belt drive-Angle of contact- Centrifugal tension- Maximum tension – Rope drives. Terminology of Chain drives.
V	**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. **GEAR TRAINS**: Introduction to gear Trains, Train value, Types – Simple and reverted wheel train – Epicyclic gear Train. Methods of finding train value or velocity ratio – Epicyclic gear trains. Selection of gear box-Differential gear for an automobile.

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

CO1: Distinguish different mechanisms with their applications**. (Apply level, KL3)**

CO2: Determine the velocities and accelerations of links in mechanisms. **(Apply level, KL3)**

CO3: Construct cam profiles for different types of follower motions. **(Apply level, KL3)**

CO4: Construct belt and rope drives for the rated conditions of the machines. **(Apply level, KL3)**

CO5: Illustrate the kinematic analysis of gears and gear trains. **(Understand level, KL2)**

Text books:

1. AmbekarA.G. Mechanism and Machine Theory, Prentice Hall of India, NewDelhi, 2009.
2. Rattan S.S, Theory of Machines, 3rdEdition, Tata McGraw Hill Publishing Company Ltd., NewDelhi, 2011.

Reference books:

1. Shigley J. E. And UickerJ.J."Theory of Machines and Mechanisms", 2nd Edition ,McGraw-Hill, Inc., 1995
2. RaoJ.S and Dukkipati R.V, Mechanism and Machine Theory, 2nd Edition, New Age International, New Delhi, 2007.
3. Sadhu Singh—Theory of Machines,13rd Edition , Pearson Education, 1997.
4. Ballaney.P.L—Theory of Machines, 20th Edition, Khanna Publishers, 1996.

Thomas Bevan," Theory of Machines", 3rdEdition, CBS Publishers and Distributors, 2013.

e- Resources & other digital material:

1. https://swayam.gov.in/nd1_noc20_ce50/preview
2. https://www.youtube.com/watch?v=MJeRFzs4oRU&list=PLBEA57F7E7560C8E8
3. https://www.youtube.com/watch?v=yDEJxYGAoso&list=PLbRMhDVUngdCkMipemSKP_dCgZLLfOe8

Micro Syllabus

UNIT-I

MECHANISMS: Elements or Links – Classification – Rigid Link, flexible and fluid link – Types of kinematic pairs – sliding, turning, rolling, screw and spherical pairs – lower and higher pairs – closed and open pairs – constrained motion – completely, partially or successfully constrained and incompletely constrained. Grubler's criterion, Grashoff's law, Degrees of freedom, Kutzbach criterion for planar mechanisms, Mechanism and machines – kinematic chain – inversion of mechanism – inversions of quadric cycle, chain – single and double slider crank chains. Kinematic structure of robot

LOWER PAIR MECHANISM: Exact and approximate copiers and generated types – Peaucellier, Hart and Scott Russel – Grasshopper – Watt T. Chebicheff and Robert Mechanisms and straight line motion, Pantograph. Conditions for correct steering – Davis Steering gear, Ackermans steering gear mechanism.

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Unit	Module	Micro content
1.a. or 2.a	Mechanisms	Fundamentals of mechanisms **(Only theory)**
		Inversions of mechanisms **(Only theory)**
		Mobility of Mechanisms
1.b. or 2.b	Lower pair Mechanisms	Straight line motion mechanisms **(Only theory)**
		Steering gear mechanisms **(Only theory)**

UNIT-II

KINEMATICS: Velocity and acceleration – Motion of a link in machine – Determination of Velocity and acceleration diagrams – Graphical method – Application of relative velocity method four bar chain. Velocity and acceleration analysis of for a given mechanism, Kleins construction, Coriolis acceleration, determination of Coriolis component of acceleration.

Unit	Module	Micro content

3. a or 4.a	Kinematics	Velocity & acceleration diagrams **(Graphical methods)**
		Application of relative velocity method (Four bar chain) **(Theory & numericals)**
3.b or 4.b	Kinematics	Kleins construction, Coriolis acceleration, determination of Coriolis component of acceleration **(Theory & numericals)**

UNIT-III

CAMS: Definitions of cam and followers – their uses – Types of followers and cams – Terminology –Types of follower motion- Knife edge, Roller and Flat faced followers during Uniform velocity, Simple harmonic motion and uniform acceleration and retardation. Maximum velocity and maximum acceleration during outward and return strokes in the above 3 cases. Analysis of motion of followers

Unit	Module	Micro content
5.a or 6.a	Introduction to cam & followers	Definitions of cams & followers and types of follower motion **(Only theory)**
		Knife edge, Roller and Flat faced followers during Uniform velocity **(Theory & numericals)**
5.b or 6.b	Different types of follower motion	Knife edge, Roller and Flat faced followers during Simple harmonic motion, uniform acceleration and retardation **(Numericals)**

Unit-IV

BELT, ROPE AND CHAIN DRIVES: Introduction - Selection of belt drive- Types of belt drives-materials-Velocity ratio-Slip-Creep-Tensions for flat belt drives & V-belt drive-Angle of contact-Centrifugal tension- Maximum tension – Rope drives. Terminology of Chain drives.

Unit	Module	Micro content

7.a. or 8.a	Belt drives	Velocity ratio, slip, creep, centrifugal tension, maximum tensions in belt drives**(Theory & associated numericals)**
7.b. or 8.b	Rope & Chain drives	Velocity ratio, slip, creep, centrifugal tension, maximum tensions in rope drive **(Theory & associated numericals)**
		Terminology of Chain drives **(Only theory)**

Unit-V

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

GEAR TRAINS: Introduction to gear Trains, Train value, Types – Simple and reverted wheel train – Epicyclic gear Train. Methods of finding train value or velocity ratio – Epicyclic gear trains. Selection of gear box-Differential gear for an automobile

Unit	**Module**	**Micro content**
9.a. or 10.a	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 **(Theory & associated problems)**

9.b. or 10.b	Gear Trains	Introduction to gear Trains, Train value, Types – Simple and reverted wheel train – Epicyclic gear Train. Methods of finding train value or velocity ratio – Epicyclic gear trains **(Theory and associated problems)**

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II-Year-I Semester	**PRODUCTION TECHNOLOGY**	3 1* 0 3

PC2103

Pre-Requisites: Fundamentals of Engineering Chemistry-Metals & Non Metals

Course objectives: The student should be able

1. To impart basic knowledge and understanding about basic casting processes.
2. To impart basic knowledge and understanding about metal forming processes such as rolling, forging and extrusion.
3. To impart basic knowledge and understanding about Sheet metal forming operations.
4. To impart basic knowledge and understanding about various metal joining processes.
5. To impart basic knowledge and understanding about powder metallurgy and high energy rate forming processes.

Unit No	Contents

I	**METAL CASTING PROCESSES** **Introduction:** Definition of casting, steps involved in making a casting, advantages, limitations, applications Casting Terms, Sand Mould making process (i) Single piece pattern (ii) Split -piece pattern **Patterns:** Definition, Pattern Allowances, Type of Patterns, Pattern materials, Pattern colour code **Moulds:** Definition, Types of moulds based on mould material, Properties required for a moulding material, Testing sand properties, Moulding machines **Cores:** Definition, Desired characteristics, Types of cores, Core prints. **Chaplets:** Definition, Types of Chaplets, Materials for chaplets. Special casting process (i) Die casting, (ii) Investment casting, (iii) Centrifugal casting, (iv) Continuous casting process. Casting defects & Remedies. **(12Hrs)**
II	**METAL FORMING PROCESSES :** Definition, Types of metal forming, Nature of plastic deformation, Hot working, Cold working **Rolling:** Principle, Roll stand arrangements, Roll passes, Tube making-Rollpiercing, Plugmill, Threadrolling **Forging:** Principle , Forging operations , Types of forging , Forging defects, FORGING DIE DESIGN-parting plane, draft, Fillet & Corner radii, Shrinkage Allowance, Die wear Allowance, Finish Allowance, Cavities, Flash, Gutter, Stock. **Extrusion: Principle**, Types of Extrusion Wire drawing, Rod & Tube drawing, swaging. **(12Hrs)**

III	**SHEET METAL FORMING :** Principle, Effect of clearance on shearing load and edge characteristics, Classification of Press tool operations based on types of stress introduce into the component, Types of sheet metal cutting operations. Drawing, Spinning, Bending, Stretch forming, Embossing, Coining, Ironing. **Shear** - Effect of shear on maximum load on punch, Effect of shear on punch with resultant distortion of slug. Press tool and its terminology **Stock strip layout :**Scrap-strip Terminology, Scrap-strip layout for (i) Contoured blanks (ii)Parallel blank edges **Centre line of pressure**.**(13Hrs)**

IV	**METAL JOINING PROCESSES :** Classification of joining processes, Define Autogenous, Heterogeneous and homogeneous joining processes. Principles of solid phase welding .liquid phase welding (fusion) Types of joints, Types of welding positions, Butt-joint edge preparation methods, Weld terminology. **Gas welding :**Principle, Characteristics of different fuels, Oxy- Acetylene welding equipment, Acetylene generator, Different types of flames, Fore hand and back hand welding techniques, Gas cutting . **Electric-Arc welding: Principle**, Types of Arc welding equipment (AC, DC), Characteristic curves of (i) Constant current (ii) Constant voltage arc welding machine.Weld penetration as affected by the polarity of workpiece (DCSP/ DCEN ,DCRP/DCEP) Specification of arc welding machines- max rated open circuit voltage, rated current in ampere, Duty cycle **Electrodes:** Consumable and Non-consumable electrodes. Purpose of coatings on electrodes. Arc blow in DC Arc welding. Modes of metal transfer in Arc welding. **Different types of Arc welding :**(i) Gas Metal Arc Welding (GMAW) (ii) TIG Welding, (iii) MIG Welding, (iv) Submerged Arc welding (SAW) **Resistance Welding :**Principle, Heat balance, electrodes, Types of Resistance Welding Electro slag welding, Thermit welding, Electron beam welding, laser beam welding, forge welding, Friction welding, Friction stir welding, Explosion welding, Brazing, Braze welding, Soldering, Advantages and Disadvantages**(15Hrs)**

V	**POWDER METALLURGY :**Definition, Flow diagram indicating various operations involved in powder metallurgy processing, Production of metallic powder, Mixing, Blending, compacting - Single level component, Two level component Sintering, Pre sintering **Secondary operations:** Re pressing, Sizing, Coining, Heat treatment, Infiltration, Impregnation, Finishing operations. **HIGH ENERGY RATE FORMING:** Principles of explosive forming, Electromagnetic forming, Electro hydraulic forming, Rubber pad forming, Advantages and limitations, **(12Hrs)**
Advanced Topics in This Course:*Forging Die Design*	

Course Outcomes: Upon successful completion of the course, the student will be able to	
CO1:	**Understand** various steps, elements involved in sand casting process and various types of casting processes.**{Understand level, KL2}**
CO2:	**Understand** principles involved in Different types of Metal Forming Processes. **{Understand level, KL2}**
CO3:	**Understand** principles of different types of Sheet Metal Forming processes. **{Understand level, KL2}**
CO4:	**Apply** the principles involved in Gas welding and Arc Welding in preparation of various types of joints and various types of welding technique and various defects in welding. **{Apply level, KL3}**
CO5:	**Understand** principles of different types high energy rate forming processes and powder metallurgy techniques**{Understand level, KL2}**
Text books:	
1.	Manufacturing Technology-P.N.Rao- Tata McGraw-Hill Education-Volume1-5e, 2018.
2.	Manufacturing Science-Ghosh & Mallik-2nd edition,2012, East-West Press Pvt. Ltd
Reference books:	
1.	Process and Materials of Manufacturing- Roy A Lindberg- Pearson,2015; 4e edition

3.	Production Technology - P.C .Sharma -S.Chand & Co,8th edition, 2014
4.	Manufacturing Processes for Engineering Materials - Kalpakjian.S& S.R Schmid-Pearson Publications,6th edition,2018.
5.	Production Technology -R.K Jain –Khanna Publications, 10th edition,1997.
e- Resources & other digital material:	
1.	https://swayam.gov.in/nd1_noc20_me35
2.	https://onlinecourses.nptel.ac.in/noc20_me67
3.	https://nptel.ac.in/courses/112/106/112106153/
4.	https://onlinecourses.nptel.ac.in/noc20_me23
5.	https://nptel.ac.in/courses/112/107/112107144/

Micro-Syllabus

Unit-1: METAL CASTING PROCESSES

Introduction: Definition of casting, steps involved in making a casting, advantages, limitations, applications Casting Terms, Sand Mould making process

(i) Single piece pattern

(ii) Split -piece pattern

Patterns: Definition, Pattern Allowances, Type of Patterns, Pattern materials, Pattern color code

Moulds: Definition, Types of moulds based on mould material, Properties required for a moulding material, Testing sand properties, Moulding machines

Cores: Definition, Desired characteristics, Types of cores, Core prints.

Chaplets: Definition, Types of Chaplets, Materials for chaplets. Special casting process (i) Die casting, (ii) Investment casting, (iii) Centrifugal casting, (iv) Continuous casting process.

Casting defects & Remedies.

Unit	Module	
		Introduction to casting, steps involved in casting

1a. & 2a.Introduction to casting, Patterns& Moulds	Introduction to casting	limitations, applications Casting Terms
		Sand Mould making process and different types of patterns
	Patterns& Moulds	Definition, Pattern Allowances, Pattern color code
		Definition, Types of moulds based on mould material
		Properties required for a moulding material, Testing sand properties,
		Moulding machines
1b. & 2b. Cores, Chaplets, Special Casting Process, Casting Defects	Cores	Definition, Desired characteristics, Types of cores, Core prints
	Chaplets	Definition, Types of Chaplets, Materials for chaplets. Special casting process
	Special Casting Process	(i) Die casting, (ii) Investment casting, casting process, (iii) Centrifugal casting, (iv) Continuous casting process
	Casting Defects	Various Casting defects
		Remedies of casting defects

Unit-2: METAL FORMING PROCESSES

Definition, Types of metal forming, Nature of plastic deformation, Hot working, Cold working

Rolling: Principle, Roll stand arrangements, Roll passes, Tube making-Roll piercing, Plug mill, Thread rolling

Forging: Principle , Forging operations , Types of forging , Forging defects, FORGING DIE DESIGN-parting plane, draft, Fillet & Corner radii, Shrinkage Allowance, Die wear Allowance, Finish Allowance, Cavities, Flash, Gutter, Stock.

Extrusion: Principle, Types of Extrusion Wire drawing, Rod & Tube drawing, swaging

Unit	Module	Micro content

3a. & 4a. Introduction to Metal forming Process, Rolling Process	Introduction to Metal forming Process, Rolling Process	Definition, Types of metal forming, Nature of plastic deformation
		Hot working, Cold working
		Principle, Roll stand arrangements, Roll passes
		Tube making-Roll piercing
		Plug mill, Thread rolling
3b. & 4b. Forging & Extrusion Process	Forging Process	Principle , Forging operations , Types of forging , Forging defects
		FORGING DIE DESIGN-parting plane, draft, Fillet & Corner radii
	Extrusion Process	Shrinkage Allowance, Die wear Allowance, Finish Allowance, Cavities, Flash, Gutter, Stock
		Types of Extrusion : Forward , Backward , Impact and Hydro static Extrusion

Unit-3: SHEET METAL FORMING

Principle, Effect of clearance on shearing load and edge characteristics, Classification of Press tool operations based on types of stress introduce into the component, Types of sheet metal cutting operations.

Drawing, Spinning, Bending, Stretch forming, Embossing, Coining, Ironing.

Shear - Effect of shear on maximum load on punch, Effect of shear on punch with resultant distortion of slug.

Press tool and its terminology

Stock strip layout: Scrap-strip Terminology, Scrap-strip layout for (i) Contoured blanks (ii) Parallel blank edges

Unit	Module	Micro content
5a. & 6a.	Introduction	Principle, Effect of clearance on shearing load and edge characteristics

Introduction to sheet Metal Operations	to sheet Metal Operations	Classification of Press tool operations based on types of stress introduce into the component
		Types of sheet metal cutting operations
5b. & 6b. Shear, Press tool and its terminology & Stock strip layout	Shear	Effect of shear on maximum load on punch
		Effect of shear on punch with resultant distortion of slug.
	Press tool and its terminology	Different Types of Press tools and terminology
	Stock strip layout	Scrap-strip Terminology
		Scrap-strip layout for (i) Contoured blanks (ii)Parallel blank edges

Unit-4: METAL JOINING PROCESSES

Classification of joining processes, Define Autogenous, Heterogeneous and homogeneous joining processes. Principles of solid phase welding .liquid phase welding (fusion) Types of joints, Types of welding positions, Butt-joint edge preparation methods, Weld terminology.

Gas welding : Principle, Characteristics of different fuels, Oxy- Acetylene welding equipment, Acetylene generator, Different types of flames, Fore hand and back hand welding techniques, Gas cutting .

Electric-Arc welding: Principle, Types of Arc welding equipment (AC, DC), Characteristic curves of (i) Constant current (ii) Constant voltage arc welding machine.

Weld penetration as affected by the polarity of work piece (DCSP/DCEN ,DCRP/DCEP)

Specification of arc welding machines- max rated open circuit voltage, rated current in ampere, Duty cycle

Electrodes: Consumable and Non-consumable electrodes. Purpose of coatings on electrodes. Arc blow in DC Arc welding. Modes of metal transfer in Arc welding.

Different types of Arc welding :(i) Gas Metal Arc Welding (GMAW)

(ii) TIG Welding, (iii) MIG Welding, (iv) Submerged Arc welding (SAW)

Resistance Welding : Principle, Heat balance, electrodes, Types of Resistance Welding

Electro slag welding, Thermit welding, Electron beam welding, laser beam welding, forge welding, Friction welding, Friction stir welding, Explosion welding, Brazing, Braze welding, Soldering, Advantages and Disadvantages

Unit	Module	Micro content
7a. & 8a. Introduction on Welding, Gas Welding, Gas Welding Flames, Electric-Arc welding: Principle	Introduction on Welding	Classification of joining processes, Define Autogenous, Heterogeneous and homogeneous joining processes. Principles of solid phase welding.
		liquid phase welding (fusion) Types of joints, Types of welding positions, Butt-joint edge preparation methods, Weld terminology
	Gas Welding	Principle, Characteristics of different fuels, Oxy- Acetylene welding equipment, Acetylene generator
	Gas Welding Flames	Different types of flames, Fore hand and back hand welding techniques, Gas cutting
	Electric-Arc welding: Principle	Types of Arc welding equipment (AC, DC), Characteristic curves of (i) Constant current (ii) Constant voltage arc welding machine.
		Weld penetration as affected by the polarity of work piece (DCSP/ DCEN ,DCRP/DCEP)
		Specification of arc welding machines- max rated open circuit voltage, rated current in ampere, Duty cycle

7b. & 8b. Electrodes,Types of arc welding, Resistance Welding & Types of Welding Process	Electrodes	Consumable and Non-consumable electrodes.
		Purpose of coatings on electrodes.
	Types of arc welding	Arc blow in DC Arc welding. Modes of metal transfer in Arc welding
		i) Gas Metal Arc Welding (GMAW)
		ii) TIG Welding, iii) MIG Welding
		iv) Submerged Arc welding (SAW)
	Resistance Welding	Principle, Heat balance, electrodes
		Types of Resistance Welding
	Types of Welding Process	Electro slag welding
		Thermit welding, Electron beam welding, laser beam welding, forge welding
		Friction welding, Friction stir welding, Explosion welding,
		Brazing, Braze welding Soldering, Advantages and Disadvantages

Unit-5: POWDER METALLURGY : Definition, Flow diagram indicating various operations involved in powder metallurgy processing, Production of metallic powder, Mixing, Blending, compacting - Single level component, Two level component Sintering, Pre sintering

Secondary operations: Re pressing, Sizing, Coining, Heat treatment, Infiltration, Impregnation, Finishing operations.

High energy rate forming: Principles of explosive forming, Electromagnetic forming, Electro hydraulic forming, Rubber pad forming, Advantages and limitations

Unit	**Module**	**Micro content**

9a. & 10a. Introduction on Powder Metallurgy	Introduction on Powder Metallurgy	Definition, Flow diagram indicating various operations involved in powder metallurgy processing
		Production of metallic powder, Mixing, Blending, compacting - Single level component, Two level component Sintering, Pre sintering
9b. & 10b. Secondary operations & High energy rate forming	Secondary operations	Re pressing, Sizing, Coining, Heat treatment, Infiltration, Impregnation, Finishing operations
	High energy rate forming	Principles of explosive forming, Electromagnetic forming,
		Electro hydraulic forming, Rubber pad forming, Advantages and limitations

		L T P	C
II-Year-I Semester	**MACHINE DRAWING**	1 0 2	1.5

PC2104

PRE-REQUISITES : Engineering Graphics / Drawing, Advanced 3d Modeling Tools Fits & Tolerances

Course objectives:

The student should be able to

1. The student will acquire knowledge of usage CAD Tools for Ex: CATIA / CREO / Solid Edge / Siemens PLM software / IRON CAD /Auto- CAD
2. The student will acquire knowledge of drawing conventions as per IS.
3. To provide basic understanding and drawing practice of various joints / fastening arrangements simple mechanical parts.
4. The student will be able to draw the assembly from the individual part drawing.
5. The student also is enabled to prepare the assembly of various machine or engine components and miscellaneous machine components.

Unit No	**Contents**

I	**Machine Drawing Conventions:** Need for drawing conventions – introduction to IS conventions a) Conventional representation of materials, common machine elements and parts such as screws, nuts, bolts, keys, gears, webs, ribs. b) Types of sections – selection of section planes and drawing of sections and auxiliary sectional views. Parts not usually sectioned. c) Methods of dimensioning, general rules for sizes and placement of dimensions for holes, centers, curved and tapered features. d) Title boxes, their size, location and details - common abbreviations & their liberal usage. e) Types of Drawings – working drawings for machine parts **(2 Sessions)**
II	**Drawing of Machine Elements and simple parts:** Selection of Views, additional views for the following machine elements and parts with every drawing Proportions. a) Popular forms of Screw threads, bolts, nuts, stud bolts, tap bolts, set screws. b) Keys, cotter joints and knuckle joint. c) Riveted joints for plates d) Shaft coupling, spigot and socket pipe joint. e) Journal, pivot and collar and foot step bearings **(4 Sessions)**
III	**Assembly Drawing I:** Drawings of assembled views for the part drawings of the following using conventions and easy drawing Proportions. Engine parts: a) Gear pump. b) Fuel pump. c) Petrol Engine connecting rod. f) Piston assembly. **(4 Sessions)**

IV	**Assembly Drawings II:** Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportions. Other machine parts: a) Screws jacks. b) Machine Vices. c) Plummer block. d) Tailstock. **(4 Sessions)**
V	**Assembly Drawings III:** Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportions. Valves: a) Spring loaded safety valve. b) Feed check valve. c) Air cock. d) Control valves **(4 Sessions)**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Gain the knowledge in advanced modeling concepts using CAD tools such as CATIA / CREO / Solid Edge / Siemens PLM software / IRON CAD /Auto- CAD
CO2	understand product symbols, weld symbols, pipe joints
CO3	Draw the detailed assembly drawings of various machine or engine components and miscellaneous machine components.
CO4	To motivate students to develop new innovative methods for measuring product Characteristics.
CO5	Improving skills to adopt modern methods in mechanical engineering as continuous improvement.

Learning Resources
Text books:

1. Machine Drawing – N.Siddeswar, K.Kannaiah & V.V.S.Sastry - TMH 2. Machine Drawing –K.L.Narayana, P.Kannaiah & K. Venkata Reddy / New Age/ Publishers
Reference books
1. Machine Drawing – P.S.Gill. 2. Machine Drawing – Luzzader 3. Machine Drawing – Rajput 4. Machine Drawing – N.D. Junnarkar, Pearson 5. Machine Drawing – Ajeeth Singh, McGraw Hill 6. Machine Drawing – KC John, PHI 7. Machine Drawing – B Battacharya, Oxford 8. Manuals & Tutorials on CAD/CAE packages like Pro/Engineer, Pro/Mechanica, ANSYS, etc latest available in the lab. 9. Kelley David S., Pro/ENGINEER Wildfire 5.0 Instructor, Tata McGraw Hill (2011). 10. Toogood Roger Ph.D., P. Eng., Zecher Jack P.E., Creo Parametric 1.0 Tutorial and MultiMedia DVD, SDC Publications, USA (2012), ISBN: 978-1-58503-692-9, ISBN (Book + Software on Disk): 978-1-58503-730-8

e- Resources & other digital material
1. http://www.maruf.ca/files/catiahelp/CATIA_P3_default.htm
2. https://www.youtube.com/playlist?list=PLkMYhICFMsGbYCvbGrrygtqGiBGguIzbf
3. http://www.staff.city.ac.uk/~ra600/Presentations/CATIA%20V5%20Lectures.pdf
4. https://www.scribd.com/doc/12516072/eBook-Catia-Tutorial-PDF
5. http://www.maruf.ca/files/catiahelp/CATIA_P3_default.htm
6. https://www.youtube.com/playlist?list=PLkMYhICFMsGbYCvbGrrygtqGiBGguIzbf

		L T P	C
II-Year-I Semester	**THERMODYNAMICS**	3 1* 0	3

ES2101

Pre-Requisites :

1) Engineering Mathematics
   I. Calculus
   II.Differential Equations
2) Engineering Chemistry
3) Engineering Physics

Course objectives: The student should be able to

1. Identify the unique vocabulary associated with thermodynamics through the precise definition of basic concepts to form a sound foundation for the development of the principles thermodynamics and also review concepts of temperature and temperature scales.

2. Introduce the concept of energy, define its various forms and solve energy balance problems for closed (fixed mass) and open (fixed volume) systems that involve heat and work interactions for general pure substances, ideal gases, and incompressible substances.

3. Apply the second law of thermodynamics to cycles, cyclic devices, develop the absolute thermodynamic temperature scale and also establish the increase of entropy principle.

4. Illustrate the P-v, T-v, and P-T property diagrams and P-v-T surfaces of pure substances, demonstrate the procedures for determining thermodynamic properties of pure substances from tables of property data and also relate the specific heat with internal energy and enthalpy of an ideal gas.

5. Predict the P-v-T behavior of gas mixtures based on Dalton's law of additive pressures and Amagat's law of additive volumes; use the psychrometric chart as a tool to determine the properties of atmospheric air.

Unit No	Contents

I	**BASIC CONCEPTS AND DEFINITIONS:** Macroscopic and Microscopic viewpoints, Thermodynamic System, Surrounding, Boundary, Universe, Control Volume, Control Surface, Classes of Systems, State, Thermodynamic Properties, Process and Cycles, Thermodynamic Equilibrium, Reversibility, Quasi static Process, Concept of Continuum, Specific heat at constant volume, Enthalpy, Specific heat at constant pressure. **(05 hrs)** **ZEROTH LAW OF THERMODYNAMICS:** Concept of Temperature, Measurement of temperature, Scales of Temperature, Constant Volume Gas Thermometer, Advantages of gas thermometers over liquid thermometers. **(02 hrs)** **WORK AND HEAT TRANSFER:** Work transfer, P-dv work, Path and Point Functions, P-dv work in various Quasi-Static Processes, Types of Work Transfer, Free expansion with zero work transfer, Heat Transfer-a path function, specific heat and Latent heat. **(03hrs)**
II	**FIRST LAW OF THERMODYNAMICS:** First law for a closed system undergoing a cycle(Joule's experiment) and a change of state, Energy- a property of the system, Energy in Stored and in Transition, Different forms of stored energy, limitations of the first law, PMMI. **(05hr)** **THERMODYNAMIC ANALYSIS OF CONTROL VOLUME:** Conservation of Energy Principle-Flow work, The Steady Flow Process-Steady Flow Energy Equation, Steady Flow Engineering Devices-Nozzles, Diffuser, Turbine, Throttling Valves and Heat Exchangers **(05hrs)**
III	**SECOND LAW OF THERMODYNAMICS:** Introduction, Thermal Energy, Reservoirs, Heat Engines, Refrigerators, Heat Pumps, Kelvin-Planck & Clausius Statements of Second law of Thermodynamics, Equivalence of Kelvin-Plank and Clausius Statements, PMM II, Differences between reversible and Irreversible Process, Carnot Cycle and its specialties, Carnot Theorem, Corollary of Carnot's theorem, Thermodynamic scale of Temperature.**(07hrs)** **ENTROPY:** Clausius Inequality, Entropy - Principle of Entropy Increase, Entropy Change for Ideal gases, Availability and Irreversibility(only definitions), Elementary Treatment of the Third Law of Thermodynamics. Second-law analysis of heat engines, Refrigerators and heat pumps. **(03hrs)**

IV	**PROPERTIES OF PURE SUBSTANCES:** Pure Substances, Phases of Pure Substance, Properties of steam, p-v, p-T, T-s and h-s diagrams, P-V-T- surfaces, Dryness Fraction, Steam tables, Measurement of Steam Quality. **(05 hrs)** **PERFECT GAS LAWS:** Avogadro's law, Equation of State of a ideal gas, specific heats, Internal energy and Enthalpy of an ideal gas, Reversible Adiabatic Process, Reversible Isothermal process, Polytropic Process, entropy change of an ideal gas, Deviations from perfect Gas Model, Compressibility factor, Vander walls Equation of state ,Compressibility charts.**(05 hrs)**
V	**MIXTURES OF PERFECT GASES:** Composition of a gas mixture: Mass and Mole Fraction, Gravimetric and volumetric Analysis, Dalton's Law of partial pressure, Amagat`s Laws of additive volumes, Equivalent Gas constant and molecular Internal Energy, Enthalpy, Specific heats and Entropy of mixture of perfect Gases. **(05 hrs)** **PSYCHROMETRY:** 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.**(05 hrs)**

Content Beyond the Syllabus: ***Second-law analysis of heat engines, Refrigerators and heat pumps***

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

CO 1: **Explain** the fundamental concepts of Thermodynamics, energy transfer by heat, work including various forms of work and also review concepts of temperature and temperature scales.**{Understand level, KL2}**

CO 2: **State** and **explain** laws of thermodynamics and also **solve** energy balance problems for closed (fixed mass) and open (fixed volume) systems that involve heat and work interactions for general pure substances, ideal gases, and incompressible substances. **{Apply level, KL3}**

CO 3: **Apply** the second law of thermodynamics to cycles, cyclic devices, develop the absolute thermodynamic temperature scale and also establish the increase of entropy principle. **{Apply level, KL3}**

CO 4: **Analyze** the thermodynamic properties of pure substances from tables of property data and also **relate** the specific heat with internal energy and enthalpy of an ideal gas. **{Analyze level, KL4}**

CO 5: **Envisage** the P-v-T behavior of gas mixtures based on Dalton's law of additive pressures and Amagat's law of additive volumes; use the psychrometric chart as a tool to **Compute** the properties of atmospheric air. **{Apply level, KL3}**

Text books:

1. P.K.Nag, Engineering Thermodynamics, 5/e, Tata McGraw Hill, 2013.
2. Yunus A. Cengel, Michaela A. Boles, Thermodynamics, 7/e, Tata McGraw Hill, 2011.

Reference books:

1. J.P.Holman, Thermodynamics, McGraw Hill Publications -2003.
2. Richard E.Sonntag,Claus Borgnakke,Gordon J.Van Wylen,Fundamentals of Thermodynamics, Six Edition, Wiley-India Edition.
3. E.Rathakrishnan, Fundamentals of Engineering Thermodynamics‖, PHI, 2nd Edition, 2010.
4. Prasanna Kumar ,Thermodynamics, First Edition, Pearson Publications.
5. R.K. Rajput, S.Chand& Co., Thermal Engineering, 6/e, Laxmi publications, 2010

e- Resources & other digital material:

1. https://nptel.ac.in/courses/112/105/112105266/
2. https://nptel.ac.in/courses/103/103/103103144/
3. https://nptel.ac.in/courses/112/105/112105220/
4. https://nptel.ac.in/courses/101/104/101104067/
5. https://nptel.ac.in/courses/101/104/101104063/
6. https://nptel.ac.in/courses/103/104/103104151/

Data books to be allowed in examinations:

1. S.C. Jain, Steam Tables, Birla Publications Pvt. Ltd – 2011

2. R.S. Khurmi & N. Khurmi, Steam Tables, S.Chand Publications – 2014

Micro-Syllabus of Thermodynamics

Unit-1:

Basic Concepts and Definitions: Macroscopic and Microscopic viewpoints, Thermodynamic System, Surrounding, Boundary, Universe, Control Volume, Control Surface, Classes of Systems, State, Thermodynamic Properties, Process and Cycles, Thermodynamic Equilibrium, Reversibility, Quasi static Process, Concept of Continuum, Specific heat at constant volume, Enthalpy, Specific heat at constant pressure.

Zeroth Law of Thermodynamics: Concept of Temperature, Measurement of temperature, Scales of Temperature, Constant Volume Gas Thermometer, Advantages of gas thermometers over liquid thermometers.

Work and Heat Transfer: Work transfer, P-dv work, Path and Point Functions, P-dv work in various Quasi-Static Processes, Types of Work Transfer, Free expansion with zero work transfer, Heat Transfer-a path function, specific heat and Latent heat-simple problems on work transfer.

Unit	**Module**	**Micro content**
1a. Basic Concepts and Definitions	Macroscopic and Microscopic viewpoints	General structure of matter
		Events occurring at molecular level
		Concept of Continuum
	Thermodynamic System, types and its vocabulary	System, Surrounding, Boundary, Universe,
		Control Volume, Control Surface,
		Classes of Systems, State
	Description of State of the System, System undergone by Process and Cycle.	Thermodynamic Properties, Process and Cycles, Thermodynamic Equilibrium
		Reversibility, Quasi static Process
	Concept of specific heats under various process.	Specific heat at constant volume
		Enthalpy, Specific heat at constant pressure

1b.Zeroth Law of Thermodynamics	Concept of Temperature, scales and its measurement	Scales of Temperature
		Constant Volume Gas Thermometer and advantages of gas thermometers over liquid thermometer.
1c. Work and Heat transfer	Concept of Work in various process, its types	Path and Point Functions ,Constant Volume, pressure, temperature, entropy, Polytropic Process and types of work transfer.
		Free expansion with zero work transfer
	Concept of heat transfer	Heat , sensible and latent heat

Unit-2:

First Law of Thermodynamics: First law for a closed system undergoing a cycle(Joule's experiment) and a change of state, Energy- a property of the system, Energy in Stored and in Transition, Different forms of stored energy, limitations of the first law, PMM I.

Thermodynamic Analysis of Control Volume: Conservation of Energy Principle-Flow work, The Steady Flow Process-Steady Flow Energy Equation, Steady Flow Engineering Devices-Nozzles, Diffuser, Turbine, Throttling Valves and Heat Exchangers.

Unit	**Module**	**Micro content**
2. a First Law of Thermodynamics	First law for a closed system.	Joule's experiment
		First law for closed system
		First law for various process
		Limitations of First Law
		PMM1
	Concept of Energy	Energy- a property of a system
		Stored energy and types
		Transition energy and types
2 . b Thermodynamic	First law for a open system	Conservation of Energy Principle,Flow work
		Steady Flow process, Steady Flow Energy

Analysis of Control Volume	First law for a open system	S.F.E. equation for Nozzles, Diffuser, Turbine, Throttling Valves and Heat Exchangers.

Unit-3:

Second Law of Thermodynamics: Introduction, Thermal Energy, Reservoirs, Heat Engines, Refrigerators, Heat Pumps, Kelvin-Planck & Clausius Statements of Second law of Thermodynamics, Equivalence of Kelvin-Plank and Clausius Statements, PMM II, Differences between reversible and Irreversible Process, Carnot Cycle and its specialties, Carnot Theorem, Corollary of Carnot's theorem, Thermodynamic scale of Temperature.

Entropy: Clausius Inequality, Entropy - Principle of Entropy Increase, Entropy Change for Ideal gases, Availability and Irreversibility(only definitions), Elementary Treatment of the Third Law of Thermodynamics.

Unit	Module	Micro content
3.a Second Law of Thermodynamics	ThermalEnergy Reservoirs	Energy source and sink
	Second law of Thermodynamics	Kelvin-Planck & Clausius Statements
		Heat engine – line diagram
		Heat Pump – line diagram
		Refrigerator – line diagram
		Equivalence of Kelvin-Plank and Clausius Statements
		PMM II
	Carnot Cycle	Carnot Cycle and its specialties,
		Carnot Theorem, Corollary of Carnot's theorem
		Thermodynamic scale of Temperature.
3.b Entropy	Entropy	Entropy and its introduction
		Clausius Inequality
		Entropy - Principle of Entropy Increase
		Entropy - Change for Ideal gases

Entropy		Elementary Treatment of the Third Law of Thermodynamics
	Concepts of available energy	Availability and Irreversibility

Unit-4:

Properties of Pure Substances: Pure Substances, Phases of Pure Substance, Properties of steam, p-v, p-T, T-s and h-s diagrams, P-V-T- surfaces, Dryness Fraction, Steam tables, Measurement of Steam Quality. **Perfect Gas Laws:** Avogadro's law, Equation of State of a ideal gas, specific heats, Internal energy and Enthalpy of an ideal gas, Reversible Adiabatic Process, Reversible Isothermal process, Polytropic Process, entropy change of an ideal gas, Deviations from perfect Gas Model, Compressibility factor, Van der walls Equation of state, Compressibility charts.

Unit	**Module**	**Micro content**
4a. Properties of Pure Substances	Pure substance	Pure Substances and its Phases
		p-v, p-T, T-s and h-s diagrams
		Properties of steam
		Dryness fraction, Measurement of Steam Quality and Steam tables.
4b.Perfect Gas Laws	Properties of ideal gas	Avogadro's law
		Equation of State of a ideal gas
		specific heats, Internal energy and Enthalpy of an ideal gas
	Deviations from perfect Gas Model	Compressibility factor
		Vander walls Equation of state
		Compressibility charts

Unit-5:

Mixtures of Perfect Gases: Composition of a gas mixture: Mass and Mole Fraction, Gravimetric and volumetric Analysis, Dalton's Law of partial pressure, Amagat`s Laws of additive volumes, Equivalent Gas constant and molecular Internal Energy, Enthalpy, Specific heats and Entropy of mixture of perfect Gases.

Psychrometry: 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	Module	Micro content
5. a Mixtures of Perfect Gases	Composition of a gas mixture	Mass and Mole Fraction
		Gravimetric and volumetric Analysis
		Dalton's Law of partial pressure
		Amagat`s Laws of additive volumes
		Equivalent Gas constant and molecular Internal Energy, Enthalpy, Specific heats and Entropy of mixture of perfect Gases
5. b Psychrometry	Properties of Atmospheric Air	DBT, WBT,DPT,TWBT, Specific humidity, relative humidity,Saturated Air Vapour pressure, Degree of saturation – Adiabatic Saturation
		Carrier's Equation
		Psychrometric chart.

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

PC2103L

Pre-Requisites :

1) Engineering Workshop

Course objectives: To impart hands-on practical exposure on manufacturing processes and equipment.

LIST OF EXPERIMENTS: At least 10 Experiments are required to be conducted

I. METAL CASTING:

1. Testing of moulding sand Properties (Permeability, Hardness, Moisture, Strength)
2. Pattern Design and making - single piece, split piece
3. Mould Preparation- Single piece, split piece

Theory includes **"Study of Melting Practices, Gating System ".**

II.WELDING:

1. Gas Welding
2. Gas Cutting (Profile Cutting)
3. Manual metal arc welding - Lap & Butt joints.
4. TIG Welding (T-Joint)
5. Resistance Welding

III. METAL FORMING

1. Blanking and punching operations and study of simple, compound and progressive dies (Washer preparation)

IV PROCESSING OF PLASTICS

1. Injection moulding
2. Blow moulding

II-Year-I SemesterMECHANICS OF SOLIDS & METALLURGY LAB

L	T	P	C
0	0	1.5	3

PC2101L

Course objectives: The student should be able to

1. To impart practical exposure on the microstructures of various materials and their hardness evaluation.

2.To impart practical knowledge on the evaluation of material properties through various destructive testing procedures.

Experiments:

NOTE: Any 6 experiments from each section A and B

(A)MECHANICS OF SOLIDS LAB

1. Determination of strength of ductile materials under tensile load by using UTM and to study stress strain characteristics.
2. Determination of shear strength of materials by using UTM.
3. Determination of stiffness and modulus of rigidity by conducting compression tests on springs.
4. Determination of hardness number by using Brinell Hardness Tester.
5. Determination of hardness number by using Rockwell Hardness Tester.
6. Determination of Impact strength on Izod Impact Testing Machine.
7. Determination of Impact strength on Charpy Impact Testing Machine.
8. Determination of Rigidity Modulus by conducting Torsion test on circular shafts.
9. Determination of Young's Modulus for materials on simply supported beam.
10. Determination of Young's Modulus for materials on Cantilever beam.

(B)METALLURGY LAB:

1. Preparation and study of the Micro Structure of pure metals like Iron, Cu andAl.

II-Year-I Semester		L T P C
MC2101	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	2 0 0 0

Pre-Requisites :

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

1. The course aim of the importing basic principle of third process reasoning and inference sustainability is at the course of Indian traditional knowledge system
2. To understand the legal framework and traditional knowledge and biological diversity act 2002 and geographical indication act 2003.
3. The courses focus on traditional knowledge and intellectual property mechanism of traditional knowledge and protection.
4. To know the student traditional knowledge in different sector.

Unit No	Contents
I	Introduction to traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-à-vis formal knowledge

II	Protection of traditional knowledge: the need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.
III	Legal framework and TK: A: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmers Rights Act, 2001 (PPVFR Act);B:The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016. Geographical indications act 2003.
IV	Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional Knowledge.
V	Traditional knowledge in different sectors: Traditional knowledge and engineering, Traditional medicine system, TK and biotechnology, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK

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

CO1: understand the concept of Traditional knowledge and its importance

CO2: know the need and importance of protecting traditional knowledge

CO3: Know the various enactments related to the protection of traditional knowledge.

CO4: understand the concepts of Intellectual property to protect the traditional knowledge

Text books:

1. V. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material, Bharatiya Vidya Bhavan, Mumbai, 5th Edition,2014
2. SwamiJitatmanand,ModernPhysicsandVedant,BharatiyaVidyaBhavan
3. Fritzof Capra, Tao ofPhysics
4. Fritzof Capra, The wave ofLife

5. VNJha(Eng.Trans,),TarkasangrahaofAnnamBhatta,InernationalChinmayFoundation,Velli arnad, Amaku,am
6. YogaSutraofPatanjali,RamakrishnaMission,Kolkatta
7. G N J h a (E n g . T r a n s .) E d . R N J h a , Y o g a - darshanamwithVyasaBhashya,VidyanidhiPrakasham,Delhi, 2016
8. RNJha,ScienceofConsciousnessPsychotherapyandYogaPractices,VidyanidhiPrakasham, Delhi,2016
9. PRSharma(Englishtranslation),ShodashangHridayam
10. Traditional Knowledge System in India, by Amit Jha, 2009.
11. Traditional Knowledge System and Technology in India by Basanta Kumar Mohanta and Vipin Kumar Singh, Pratibha Prakashan 2012.
12. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002
13 "Knowledge Traditions and Practices of India" Kapil Kapoor, Michel Danino

e- Resources & other digital material:

1. https://www.youtube.com/watch?v=LZP1StpYEPM
2. http://nptel.ac.in/courses/121106003/

II-Year-II Semester	**Complex Variables and Statistical Methods**	**L** **T** **P** **C** 3 1* 0 3

BS2201

Pre-Requisites:

3) Calculus

4) Partial Differentiation

3) Multiple Integrals

4) Basics of Probability

Course objectives: To learn

1. Differentiation and integration of complex functions.
2. Expansion of complex functions using Taylor's and Laurent's series and residue of complex functions.
3. The ideas of probability and random variables and various discrete and continuous probability distributions and their properties.
4. The statistical methods of studying data samples using test of hypothesis.
5. The basic ideas of statistical measures like correlation and regression.

Unit No	**Contents**

I	**Functions of complex variable and complex integration:** Introduction – Continuity – Differentiability – Analyticity – Properties – Cauchy-Riemann equations in cartesian and polar coordinates – Harmonic and conjugate harmonic functions – Milne-Thompson method. **(05 hrs)** Complex integration: Line integral – Cauchy's integral theorem – Cauchy's integral formula (all without proofs). **(05 hrs)**
II	**Series expansions and Residue Theorem:** Radius of convergence –Expansion in Taylor's series, Maclaurin's series - Laurent's series. **(05 hrs)** Types of singularities: Isolated – pole of order m – Essential – Residues – Residue theorem (without proof). **(05 hrs)**
III	**Probability, Distributions and Sampling Theory:** Probability-Baye's theorem-Random variables-Discrete and Continuous random variables-Distribution function-Mathematical Expectation and Variance- **Application approach:** Binomial, Poisson and Normal distributions. **(07 hrs)** Population and samples-Sampling distribution of Means -Point and Interval estimations. **Applications: Maximum error of estimate Bayesian estimate.** **(07 hrs)**
IV	**Test of Hypothesis:** Introduction–Hypothesis-Null and Alternative Hypothesis-Type I and Type II errors-Level of significance-One tail and two-tail tests-Tests concerning one mean and two means (Large and Small samples)-Tests on proportions. **Applications: Chi-square test and F-test on small samples.** **(14 hrs)**

V	**Curve fitting and Correlation:** Method of least squares-Straight line-Parabola-Exponential-Power curves-Correlation-Correlation coefficient-Rank correlation-Regression coefficient and properties-Regression lines-**Multiple regression.** **(12 hrs)**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Apply** Cauchy-Riemann equations to complex function in order to determine whether a given continuous function is analytic. (L3)
CO2	**Find** the differentiation, integration of complex functions used in engineering problems and make use of Cauchy residue theorem to evaluate certain integrals. (L3)
CO3	**Apply** discrete and continuous probability distributions and **Design** the components of a classical hypothesis test. (L3 &L6)
CO4	**Infer** the statistical inferential methods (hypothesis testing) based on small and large sampling tests. (L4)
CO5	**Interpret** the association of characteristics and through correlation and regression tools. (L4)
Text books:	
3. **B.S. Grewal,** Higher Engineering Mathematics, 44th Edition, Khanna Publishers. 4. **S. C. Gupta and V. K. Kapoor,** Fundamentals of Mathematical Statistics, 11/e (Reprint) 2019, Sultan Chand & Sons Publications. 5. **B.V. Ramana,** Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.	
Reference books	

1. **Miller and Freund's,** Probability and Statistics for Engineers, 7/e, Pearson, 2008.
2. **T. K. V. Iyenger**, Probability and Statistics, S. Chand & Company Ltd, 2015.
3. **Jay I. Devore,** Probability and Statistics for Engineering and the Sciences, 8th Edition, Cengage.
4. **Erwin Kreyszig,** Advanced Engineering Mathematics, 10th Edition, Wiley-India.
5. **H. K. Das,** Advanced Engineering Mathematics, 22nd Edition, S. Chand & Company Ltd.

e- Resources & other digital material

1. https://www.youtube.com/watch?v=Mwpz1zjPlzI&list=PLbMVogVj5nJS_i8vfVWJG16mPcoEKMuWT (For Complex Variables)

1. https://www.youtube.com/playlist?list=PLiUVvsKxTUr66oLF6Pzirc1EgSstMbRZR
(For Complex Variables from 1-13)

1. https://www.youtube.com/watch?v=COI0BUmNHT8&list=PLyqSpQzTE6M_JcleDbrVyPnE0PixKs2JE
(For Probability and Statistics)

1. https://www.youtube.com/watch?v=VVYLpmKRfQ8&list=PL6C92B335BD4238AB
(For Probability and Statistics)

1. https://www.mathsisfun.com/data/standard-normal-distribution-table.html
(Information about Normal distribution)

1. https://www.statisticshowto.com/tables/t-distribution-table/
(Information about T- distribution)

Statistical Tables to be allowed in examinations:

1. Normal distribution table
2. T- distribution table

Micro-Syllabus of Complex Variables and Statistical Methods

Unit-1: Functions of a complex variable and complex integration

Introduction – Continuity – Differentiability – Analyticity – Properties – Cauchy-Riemann equations in Cartesian and polar coordinates – Harmonic and conjugate harmonic functions – Milne-Thompson method.

Complex integration: Line integral – Cauchy's integral theorem – Cauchy's integral formula. (all without proofs).

Unit	Module	Micro content
1a. & 2a. Analytic functions	Introduction of Analytic function	Cauchy-Riemann equations in cartesian form.
		Cauchy-Riemann equation in Polar form.
		Verify the given function is analytic or not.
	Harmonic function	Prove that real and imaginary parts of analytic function are harmonic.
		Finding conjugate harmonic function for given part of analytic function.
	Orthogonal trajectory	Prove that real and imaginary parts of analytic function are Orthogonal.
		Find orthogonal trajectory of given function.
	Finding analytic function	Using Milne-Thomson method find analytic function whose real or imaginary are known.
1b. & 2b. Complex integration	Introduction of Complex integration	Evaluation of Complex Integration Using line integral along the given curve.
	Cauchy's Integration	Verification of Cauchy's integral theorem.
		Evaluation of Complex integration using Cauchy's integral theorem.
		Evaluation of Complex integration using Cauchy's integral formula.

Unit-2: Series expansions and Residue Theorem

Radius of convergence – Expansion in Taylor's series, Maclaurin's series - Laurent's series.

Types of singularities: Isolated – pole of order m – Essential – Residues – Residue theorem (without proof)

Unit	Module	Micro content
3a. & 4a. Series Expansion of Complex function	Taylor's Expansion	Expand given function as Taylor's series about z = a.
		Expand given function as Taylor's series in powers of z.
	Laurent's Expansion	Expand given function as Laurent series about z = a.
		Expand given function as Laurent series in powers of z.
3b. & 4b. Residue theorem	Evaluation of integration using residue theorem	Find poles and residue at each pole of f(z).
		Evaluate integral of f(z) using residue theorem.

Unit-3: Probability, Distributions and Sampling Theory

Probability-Baye's theorem-Random Variables-Discrete and Continuous random variables-Distribution Function-Mathematical Expectation and Variance-Binomial, Poisson and Normal distributions.

Population and samples-Sampling distribution of Means -Point and Interval estimations -Maximum error of estimate.

Unit	Module	Micro content
5. Probability Distributions	Probability	Find probability using Baye'e theorem.
		Write probability distribution for given random variable. And find mean, variance and S.D. of random variable.

6. Random variables and Sampling Theory	Probability distributions	Mean and variance of Binomial, Poisson and normal distributions.
		Find probability of Binomial event.
		Find probability of Poisson event.
		Find probability of Normal event.
	Sampling theory	Write sampling distribution of sample mean. And find mean of sampling distribution and S.D. of sampling distribution.

Unit 4: Test of Hypothesis

Introduction–Hypothesis-Null and Alternative Hypothesis-Type I and Type II Errors-Level of significance-One tail and two-tail tests-Tests concerning one mean and two means (Large and Small samples)-Tests on proportions.

Unit	Module	Micro content
7a. & 8a. Test of Hypothesis	Test significance of large samples	Test significance of single mean or proportions.
		Test significance of two means or proportions.
7b. & 8b. Test of hypothesis	Test significance of small samples	Test significance of single mean.
		Test significance of two means.
		Test significance of variances.

Unit 5: Curve fitting and Correlation

Method of least squares-Straight line -Parabola-Exponential-Power curves -Correlation-Correlation coefficient -Rank correlation -Regression coefficient and properties-Regression lines.

Unit	Module	Micro content
		Fit the data in to line equation.

9a. & 10a. Curve fitting	By least square approximation method fit the data in to given curve	Fit the data into a second-degree polynomial or parabola.
		Fit the data into power curve $y = a x^b$
		Fit the data into power curve $y = a b^x$
		Fit the data into power curve $y = a e^{bx}$
9b. & 10b. Correlation and regression	Correlation	Find correlation coefficient.
		Find Karl Pearson's coefficient of correlation.
	Regression	Find regression coefficient and lines.

II-Year-II Semester	**APPLIED THERMODYNAMICS-I**	**L T P C** 3 1* 0 3

PC2201

PRE-REQUISITES : Engineering Thermodynamics, Engineering Physics, Engineering Chemistry.

Course objectives:

(1) To make the student learn and understand the reasons and affects of various losses that occurs in the actual engine operation.

(2) To familiarize the student with the various engine systems along with their function and necessity.

(3) To learn about normal combustion phenomenon and knocking in S.I. and C.I. Engines and to find the several engine operating parameters that affect the smooth engine operation.

(4) To make the student learn to perform testing on S.I and C.I Engines for the calculations of performance and emission parameters.

(5) To make students learn about different types of compressors ,calculate the power and efficiency of air compressors.

Unit No	Contents
I	**Air Standard Cycles:** Otto, Diesel and Dual cycles, its comparisons. **(02 hrs)** **Actual Cycles and their Analysis:** Introduction, Comparison of Air Standard and Actual Cycles, Time Loss Factor, Heat Loss Factor, Exhaust Blow down-Loss due to Gas exchange process, Volumetric Efficiency. Loss due to Rubbing Friction, Actual and Fuel-Air Cycles of CI Engines**. (08 hrs)**

II	**I. C. Engines :** Classification - Working principles, Valve and Port Timing Diagrams, - Engine systems – Fuel, Carburettor, Fuel Injection System, Ignition, Cooling and Lubrication, principle of Wankle engine, principles of supercharging and turbo charging. **(10 hrs)**
III	**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 knocking (explanation of) – Fuel requirements and fuel rating, anti knock additives – combustion chamber – requirements, types**.** **(05 hrs)** **Combustion in C.I. Engines :** Four stages of combustion – Delay period and its importance – Effect of engine variables – Diesel Knock– Need for air movement, suction, compression and combustion induced turbulence – open and divided combustion chambers and nozzles used – fuel requirements and fuel rating. **(05 hrs)**
IV	**Measurement, 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**.** **(10 hrs)**
V	**COMPRESSORS** – Classification, Reciprocating, Principle of operation, work required, Isothermal efficiency, volumetric efficiency and effect of clearance, multi stage compression, undercooling, saving of work, minimum work condition for two stage compression. **(04hrs)** **ROTARY (POSITIVE DISPLACEMENT TYPE):** Roots Blower, vane type compressor, mechanical details and principle of working, efficiency considerations. **(02hrs)** **DYNAMIC COMPRESSORS:** Centrifugal compressors, mechanical details and principle of operation, velocity and pressure variation, Energy transfer, velocity diagrams, Axial Flow Compressors, Mechanical details and principle of operation – velocity triangles and energy transfer per stage per degree of reaction. **(04hrs)**

Course Outcomes

Upon successful completion of the course, the student will be able to	
CO1	**Identify** the reasons behind deviation of actual cycles from air standard cycles and also **understand** the various losses occurring in the operation of IC engines. **{Understand level, KL2}**
CO2	**Understand** about the IC Engines systems like fuel supply, cooling, lubricant and ignition. **{Understand level, KL2}**
CO3	**Understand** the normal and abnormal combustion phenomenon and also knowing about the fuel requirements and ratings. **{Understand level, KL2}**
CO4	**Understand** about measurement of Parameters of performance and also **Compute** the performance of IC Engines **{Apply level, KL3}**
CO5	**Compute** the performance of air compressors. **{Apply level,KL3}**

Learning Resources
Text books:
1. I.C. Engines / V. Ganesan- Tata McGraw- Hill,4th edition.
2. Thermal Engineering by Mahesh Rathore, Tata McGraw- Hill,2010.
Reference books
1.Thermal Engineering / RK Rajput/ Lakshmi Publications,2010.
2.Thermal Engineering by Sadhu Singh, Sukumar Pati, Pearson Publications,First edition,2018.
3. IC Engines – M.L.Mathur &R.P.Sharma – Dhanpath Rai & Sons,2001.
4. I.C.Engines–AppliedThermosciences–C.R.Ferguson&A.T.Kirkpatrick-2ndEdition-Wiley Publ
5. I.C. Engines - J.B.Heywood /McGraw- Hill,2017.
6. Thermal Engineering – R.S.Khurmi & J.S.Gupta- S.chand Publications,1997.
7. Thermal Engineering / PL Ballaney, Khanna Publishers

e- Resources & other digital material
1. https://nptel.ac.in/courses/112/103/112103262/
2. https://nptel.ac.in/courses/112/104/112104033
3. http://nptel.ac.in/courses/112105123/

Micro-Syllabus

<table>
<tr><td colspan="3">Unit-1:
AIR STANDARD CYCLES: Otto, Diesel and Dual cycles, its comparisons.
Actual Cycles and their Analysis: Introduction, Comparison of Air Standard and Actual Cycles, Time Loss Factor, Heat Loss Factor, Exhaust Blow down-Loss due to Gas exchange process, Volumetric Efficiency. Loss due to Rubbing Friction, Actual and Fuel-Air Cycles of CI Engines.</td></tr>
<tr><td>Unit</td><td>Module</td><td>Micro content</td></tr>
<tr><td rowspan="3">1.a.or 2.a AIR STANDARD CYCLES & Actual Cycles and their Analysis</td><td>Air Standard Cycles</td><td>Otto, Diesel and Dual cycles, its comparisons. (Theory, derivations and simple Problems only)</td></tr>
<tr><td rowspan="2">Actual Cycles and their Analysis</td><td>Introduction.</td></tr>
<tr><td>Comparison of Air Standard and Actual Cycles.</td></tr>
<tr><td rowspan="6">1.b.or 2.b Actual Cycles and their Analysis</td><td rowspan="6">Actual Cycles and their Analysis</td><td>Time Loss Factor.</td></tr>
<tr><td>Heat Loss Factor.</td></tr>
<tr><td>Exhaust Blow down-Loss due to Gas exchange process,.</td></tr>
<tr><td>Volumetric Efficiency.</td></tr>
<tr><td>Loss due to Rubbing Friction.</td></tr>
<tr><td>Actual and Fuel-Air Cycles of CI Engines</td></tr>
<tr><td colspan="3">Unit-2:
I. C. Engines : Classification - Working principles, Valve and Port Timing Diagrams, - Engine systems – Fuel, Carburettor, Fuel Injection System, Ignition, Cooling and Lubrication, principle of Wankle engine, principles of supercharging and turbo charging.</td></tr>
<tr><td>Unit</td><td>Module</td><td>Micro content</td></tr>
<tr><td rowspan="3">3. a or 4.a Fundamentals of I.C.Engines</td><td rowspan="3">Fundamentals of I.C.Engines</td><td>Classification.</td></tr>
<tr><td>Working principles.</td></tr>
<tr><td>Valve and Port Timing Diagrams.</td></tr>
</table>

3.b or 4.b I.C.Engines Systems	I.C.Engines Systems	Fuel Supply Systems in SI and CI Engines.
		Ignition Systems.
		Cooling Systems.
		Lubrication Systems.
		Principle of Wankle engine.
		Principles of Supercharging and Turbo charging.

Unit-3:

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 knocking (explanation of) – Fuel requirements and fuel rating, anti knock additives – combustion chamber – requirements, types**.**

Combustion in C.I. Engines : Four stages of combustion – Delay period and its importance – Effect of engine variables – Diesel Knock– Need for air movement, suction, compression and combustion induced turbulence – open and divided combustion chambers and nozzles used – fuel requirements and fuel rating

Unit	**Module**	**Micro content**
5.a or 6.a Combustion in S.I. Engines	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 knocking.
		Fuel requirements and fuel rating.
		Anti knock additives
		combustion chamber – requirements, types
5.b or 6.b Combustion in C.I. Engines	Combustion in C.I.	Four stages of combustion
		Delay period and its importance.
		Effect of engine variables
		Diesel Knock

	Combustion in C.I. Engines	Need for air movement, suction, compression and combustion induced turbulence.
		open and divided combustion chambers and nozzles used.
		fuel requirements and fuel rating.

Unit-4:

Measurement, 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	Module	Micro content
7.a.or 8.a Measurement of Performance Parameters of IC Engines	Measurement of Performance Parameters of IC Engines	Parameters of performance.
		Measurement of cylinder pressure **(Theory, derivations and associated simple Problems)**
		Measurement of fuel consumption **(Theory, derivations and associated simple Problems)**
		Measurement of air intake **(Theory, derivations and associated simple Problems)**
		Measurement of exhaust gas composition.
		Measurement of Brake power **(Theory, derivations and associated simple Problems)**
7.b.or 8.b Performance Testing of IC Engines	Performance Testing of IC Engines	Determination of frictional losses and indicated power**(Theory, derivations and associated simple Problems**
		Performance test – Heat balance sheet and chart **(Theory and associated simple Problems)**

Unit-5:

COMPRESSORS – Classification, Reciprocating, Principle of operation, work required, Isothermal efficiency, volumetric efficiency and effect of clearance, multi stage compression, undercooling, saving of work, minimum work condition for two stage compression.

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

DYNAMIC COMPRESSORS: Centrifugal compressors, mechanical details and principle of operation, velocity and pressure variation, Energy transfer, velocity diagrams, Axial Flow Compressors, Mechanical details and principle of operation – velocity triangles and energy transfer per stage degree of reaction.

Unit	Module	Micro content
9.a. or 10.a A I R COMPRESSORS	Reciprocating Type	Classification.
		Principle of operation.
		Work required- Isothermal efficiency.
		Volumetric efficiency**(Theory, derivation and simple Problems)**
		Effect of clearance**(Theory, derivation and simple Problems)**
		Multi stage compression- under cooling- saving of work**(Theory, derivation and simple Problems)**
		Minimum work condition for two stage compression**(Theory, derivation and simple Problems)**
	Rotary Positive Displacement Type	Mechanical details and principle of working, efficiency considerations of Roots Blower Compressor **(Theory, derivation and simple Problems)**

9.b.or 10.b Rotary Positive Displacement Type & Dynamic Type	Displacement Type	Mechanical details and principle of working, efficiency considerations of vane type compressor. **(Theory, derivation and simple Problems)**
	Dynamic Type	Centrifugal compressors- mechanical details and principle of operation.
		Velocity and pressure variation.
		Energy transfer.
		Velocity diagrams **(Theory Only)**
		Axial Flow Compressors- Mechanical details and principle of operation
		Velocity triangles and energy transfer per stage degree of reaction **(Theory Only)**

II-Year-II Semester	FLUID MECHANICS & HYDRAULIC MACHINES	L T P 3 1* 0	C 3

PC2202

PRE-REQUISITES: Engineering Physics, Engineering Mathematics

Course objectives: The student should be able to

- ➢ Describe briefly the concepts of different fluid properties, present numerous examples related to variation of pressure in a fluid and measurement of pressure and illustrate the flow field.
- ➢ Formulate and Analyze simple problems related to Bernoulli's equation, different flow measuring devices and pipe flows.
- ➢ Understand the concept of boundary layer flow, determine the lift and drag on different geometrical bodies and also analyze simple problems related to impact of jets.
- ➢ Describe briefly hydraulic turbines and its performance characteristic curves.
- ➢ Formulate and Analyze simple problems related to centrifugal and reciprocating pumps.

Unit No	Contents

I	**FLUID STATICS:** Definition of fluid, differences between a solid and fluids, physical properties of fluids- specific gravity, viscosity , surface tension, capillarity, vapor pressure, Pascal's law for pressure at a point, pressure variation in a fluid at rest, Absolute, gauge, Atmospheric and vacuum pressures, measurement of pressure, Manometers- Piezometer, U-tube, inverted and differential manometers **(05hrs)** **FLUID KINEMATICS:** Introduction, classification of flows, steady & un steady, uniform & non uniform, laminar & turbulent, rotational & irrotational flows, equation of continuity for one dimensional flow, Stream line, path line, streak lines and stream tube, Stream function ,velocity potential function, differences and relation between them, condition for irrotational flow. **(05hrs)**
II	**FLUID DYNAMICS:** Surface & body forces, Euler's & Bernoulli's equations for flow along a stream line, momentum equation and its applications on force on pipe bend, Measurement of flow: pitot tube, venture meter and orifice meter, flow nozzle. **(05hrs)** **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, power transmission through pipes. **(05hrs)**
III	**BOUNDARY LAYER CONCEPTS:** Definition, thicknesses, characteristics along thin plate, Definition of displacement, momentum, energy thickness, separation of boundary layers, Fluid flow around submerged objects, concepts of drag and lift, expression for drag and lift, types of drag, Streamlined body and bluff body. **(05hrs)** **Impact of Jets:** hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes. **(05hrs)**

IV	**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. **(05hrs)** **Performance of hydraulic turbines:** Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer. **(05hrs)**
V	**Centrifugal pumps:** classification, working principle, work done, different heads in a pumping system, different efficiencies of a centrifugal pump, specific speed, pumps in series and parallel, performance characteristic curves, cavitation , NPSH. **(05hrs)** **Reciprocating pumps:** Working principle, types, Discharge and power requirement, slip, coefficient of discharge, effect of acceleration on indicator diagram. **(05hrs)**

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Depict** briefly the concepts of different fluid properties, **Understand** the variation of pressure in a fluid, measurement of pressure and also **illustrate** the flow field. **{Understand level, KL2}**
CO2	**Apply** the Bernoulli's equation for various flow measurement devices and also **compute** the losses in pipe flows. **{Apply level, KL3}**
CO3	**Estimate** the lift and drag on different geometrical bodies and also **compute** the force exerted by jet on vanes. **{Apply level, KL3}**
CO4	**Compute** the performance of Hydraulic turbines. **{ Apply level, KL3}**
CO5	**Analyze** the performance of centrifugal and reciprocating pumps. **{Analyze level, KL4}**

Learning Resources
Text books:

1. Hydraulics and Fluid mechanics including Hydraulic machinery MODI and SETH, Standard Book house publications. 2. Fluid Mechanics: Fundamentals and Applications by Y.A. Cengel & J.M.Cimbala, 6th Edn, McGrawHill
Reference books
1.Fluid Mechanics and Hydraulic Machines by R.K.Rajput,S.Chand Publications, Sixth Edition. 2. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria & Sons, Nineth Edition 3. Fluid Mechanics and Machinery by D. Rama Durgaiah, New Age International,2007. 4. Hydraulic Machines by Banga & Sharma, Khanna Publishers,Eighth Edition. 5. Fluid Mechanics & Turbo machinery by Dixon, 7th Edn, Elesvier 6. Fluid Mechanics and Hydraulic Machines by Domkundwar & Domkundwar, Dhanpatrai & Co
e- Resources & other digital material
1. https://nptel.ac.in/courses/112/105/112105171/
1. https://nptel.ac.in/courses/112/105/112105183/
1. https://nptel.ac.in/courses/105/101/105101082/
1. https://nptel.ac.in/courses/105/103/105103095/

MICRO-SYLLABUS:

Unit-1:

FLUID STATICS: Definition of fluid, differences between a solid and fluids, physical properties of fluids- specific gravity, viscosity , surface tension, capillarity, vapor pressure, Pascal's law for pressure at a point, pressure variation in a fluid at rest, Absolute, gauge, Atmospheric and vacuum pressures, measurement of pressure, Manometers- Piezometer, U-tube, inverted and differential manometers

FLUID KINEMATICS: Introduction, classification of flows, steady & un steady, uniform & non uniform, laminar & turbulent, rotational & irrotational flows, equation of continuity for one dimensional flow, Stream line, path line, streak lines and stream tube, Stream function ,velocity potential function, differences and relation between them, condition for irrotational flow.

Unit	Module	Micro content

1.a.or 2.a FLUID STATICS	Fluid and its Properties	Definition of fluid.
		Differences between a solid and fluids.
		Physical properties of fluids- specific gravity, viscosity , surface tension, capillarity, vapor pressure**(Theory, derivations and associated simple Problems)**
	Fluid Statics	Pascal's law for pressure at a point. **(Theory, derivation and associated simple Problems)**
		Pressure variation in a fluid at rest. **(Theory, derivation and associated simple Problems)**
	Fluid Pressure	Absolute, gauge, Atmospheric and vacuum pressures **(Simple Problems)**
1.b or 2.b. Fluid Pressure measurement & Fluid Kinematics	Fluid Pressure measurement	Measurement of pressure, Manometers- Piezometer, U-tube, inverted and differential manometers . **(Theory, derivations and associated simple Problems)**
	Fluid Kinematics	Classification of flows, Steady & Unsteady, Uniform & Nonuniform, Laminar & Turbulent, Rotational & Irrotational flows
		Equation of continuity for one dimensional flow.
		Stream line, Path line, Streak lines and Stream tube.
		Stream function, Velocity potential function, differences and relation between them. **(Theory, derivations and associated simple Problems)**
		Condition for irrotational flow **(Simple Problems)**

Unit-2:

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

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, power transmission through pipes.

Unit	Module	Micro content
3. a or 4.a Fluid Dynamics	Fluid Dynamics	Surface & body forces.
		Euler's & Bernoulli's equations for flow along a stream line, **(Theory, derivations and associated simple Problems)**
		Momentum equation and its applications on force on pipe bend **(Theory, derivations and associated simple Problems)**
	Measurement of flow	Pitot tube, Venture meter ,Orifice meter and Flow nozzle.**(Theory, derivations and associated simple Problems)**
3.b or 4.b. Closed Conduit Flow	Flow through Pipes	Reynold's experiment.
		Darcy Weisbach equation.**(Theory, derivation and associated simple Problems)**
		Minor losses in pipes.**(Theory, derivation and associated simple Problems)**
		Pipes in series and pipes in parallel. **(Theory, derivations and associated simple Problems)**
		Total energy line-hydraulic gradient line.**(Theory, derivations and associated simple Problems)**.
		Power transmission through pipes.**(Simple Problems)**

Unit-3:

BOUNDARY LAYER CONCEPTS: Definition, thicknesses, characteristics along thin plate, Definition of displacement, momentum, energy thickness, separation of boundary layers, Fluid flow around submerged objects, concepts of drag and lift, expression for drag and lift, types of drag, Streamlined body and bluff body.

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

Unit	Module	Micro content
5.a or 6.a Boundary Layer Concepts	Boundary Layer Concepts	Definition.
		Characteristics along thin plate.
		Definition of displacement, momentum and energy thickness.
		Separation of boundary layers. **(simple Problems)**
	Flow over bodies	Fluid flow around submerged objects.
		Concepts of drag and lift.
		Expression for drag and lift.**(Simple Problems)**
		Types of drag.
		Streamlined body and bluff body.
5.b or 6.b Impact of Jets	Impact of Jets	Hydrodynamic force of jets on stationary flat, inclined, and curved vanes, jet striking centrally and at tip.
		Velocity diagrams, work done and efficiency. **(Theory, derivations and associated simple Problems)**
		Hydrodynamic force of jets on moving flat, inclined, and curved vanes, jet striking centrally and at tip.

		Velocity diagrams, work done and efficiency. **(Theory, derivations and associated simple Problems)**
		Flow over radial vanes. **(Theory, derivation and associated simple Problems)**

Unit-4:

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: Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer.

Unit	Module	Micro content
7.a.or 8.a Hydraulic Turbines	Hydraulic Turbines	Classification.
		Impulse Turbine (Pelton wheel)- working proportions- work done- efficiencies- hydraulic design. (**Theory, derivation and simple Problems)**
		Reaction Turbines(Francis and Kaplan)- working proportions- work done- efficiencies- hydraulic design **(Theory, derivation and simple Problems)**
		Draft tube- theory functions and efficiency. **(Theory, derivation and simple Problems)**
7.b.or 8.b Performance of hydraulic	Performance of hydraulic turbines	Unit and Specific quantities**.(Simple Problems)**
		Characteristic curves.
		Governing of turbines.
		Selection of type of turbine

hydraulic turbines	turbines	Cavitation.
		Surge tank.
		Water hammer.

Unit-5:

Centrifugal pumps: classification, working principle, work done, different heads in a pumping system, different efficiencies of a centrifugal pump, specific speed, pumps in series and parallel, performance characteristic curves, cavitation , NPSH.

Reciprocating pumps: Working principle, types, Discharge and power requirement, slip, coefficient of discharge, effect of acceleration on indicator diagram.

Unit	**Module**	**Micro content**
9.a or 10.a Centrifugal pumps	Centrifugal pumps	Classification.
		Principle of operation.
		Work done.
		Different heads in a pumping system
		Different efficiencies of a centrifugal pump **(Theory, derivation and simple Problems)**
		Specific speed. **(Theory, derivation and simple Problems)**
		Pumps in series and parallel. **(Theory, derivation and simple Problems)**
		Performance characteristic curves.
		Cavitation.
		NPSH**(Simple Problems)**
9.b or 10.b Reciprocating pumps:	Reciprocating pumps	Working principle.
		Types.
		Discharge and Power requirement. **(Theory, derivation and simple Problems)**
		Slip, coefficient of discharge. **(Simple Problems)**

		Effect of acceleration on indicator diagram. **(Theory only)**

II-Year-II Semester	DYNAMICS OF MACHINERY	L T P 3 1* 0	C 3

PC2203

Course Objectives: The Students will acquire the knowledge

1. To solve frictional losses, torque transmission of mechanical systems.
2. To analyze dynamic forces of slider crank mechanism and design of flywheel
3. To analyze stabilization of sea vehicles, aircrafts and automobile vehicles and understand the working of various governors.
4. To understand the methods of balancing reciprocating and rotary masses.
5. To understand the concept of vibrations and its significance on engineering design.

Unit No	Contents
I	**FRICTION:** **BEARINGS:** Pivot and collar bearings, uniform pressure, uniform wear, friction circle and friction axis: lubricated surfaces, boundary friction, 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, bandbrake of vehicle. General description and operation of dynamometers: Prony, Rope brake, Epicyclic, Bevis Gibson and belt transmission.

II	Static and dynamic force analysis of planar mechanisms. **TURNING MOMENT DIAGRAMS:** Dynamic force analysis of slider crank mechanism, inertia torque, angular velocity and acceleration of connecting rod, crank effort and turning moment diagrams – fluctuation of energy – fly wheels and their design.
III	**PRECESSION:** Gyroscopes, effect of precession motion on the stability of moving vehicles such as motor car, motor cycle, aero planes and ships, **GOVERNERS:** Watt, porter and proell governors, spring loaded governors – Hartnell and Hartung-sensitiveness, isochronism and hunting.
IV	**BALANCING:** Balancing of rotating masses single and multiple – single and different planes, use analytical and graphical methods. 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 effort.
V	**VIBRATIONS:** Free Vibration of spring mass system –Natural frequency-types of damping– damped free vibration, Simple problems on forced damped vibration-critical speeds-torsional vibrations.

Text Books:

1. Theory of Machines / S.S Rattan/ Mc. Graw Hill

2. Mechanism and machine theory /Ashok G. Ambedkar/PHI Publications.

References:

1. Mechanism and Machine Theory / JS Rao and RV Dukkipati / New Age

2. Theory of Machines / Shigley / MGH

3. Theory of Machines / Thomas Bevan / CBS Publishers

4. Theory of machines / Khurmi/S.Chand.

Course outcomes:

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

1. Solve frictional losses, torque transmission of mechanical systems (KL-3)
2. Determine dynamic forces of slider crank mechanism and design of flywheel (KL-3)
3. Judge the stabilization of sea vehicles, aircrafts and automobile vehicles and illustrate the working of various governors (KL-3)
4. Execute the methods of balancing reciprocating and rotary masses (KL-3)
5. Illustrate the concept of vibrations and its significance on engineering design (KL-2)

Micro Syllabus

UNIT-I

BEARINGS: Pivot and collar bearings, uniform pressure, uniform wear, friction circle and friction axis: lubricated surfaces, boundary friction, 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, bandbrake of vehicle. General description and operation of dynamometers: Prony, Rope brake, Epicyclic, Bevis Gibson and belt transmission.

Unit	Module	Micro content
1.a. or 2.a	Bearings & Clutches	Uniform pressure and uniform wear conditions **(Only theory)**
		Problems on bearings & clutches
1.b. or 2.b	Brakes & dynamometers	Numericals On Brakes
		Explanation on dynamometers **(Only theory)**

UNIT-II

Static and dynamic force analysis of planar mechanisms.

TURNING MOMENT DIAGRAMS:

Dynamic force analysis of slider crank mechanism, inertia torque, angular velocity and acceleration of connecting rod, crank effort and turning moment diagrams – fluctuation of energy – fly wheels and their design.

Unit	Module	Micro content
3. a or 4.a	Static & dynamic force analysis	Static and dynamic force analysis of planar mechanisms **(Only theory)**
		dynamic force analysis of slider crank mechanism **(Simple numericals)**
3.b or 4.b	Turning Moment Diagrams & fly wheels	Different turning moment diagrams **(Theory & numericals)**
		Numericals on fly wheels

UNIT-III

PRECESSION:

Gyroscopes, effect of precession motion on the stability of moving vehicles such as motor car, motor cycle, aero planes and ships,

GOVERNERS:

Watt, porter and proell governors, spring loaded governors – Hartnell and Hartung- sensitiveness, isochronism and hunting.

Unit	Module	Micro content
5.a or 6.a	Precession	Stability of aeroplanes & ships **(Numericals)**
		Stability of two-wheelers & four-wheelers **(Numericals)**

5.b or 6.b	Governers	Porter and proell governors **(Only problems)**
		Hartnell and Hartung governors **(Only problems)**
		sensitiveness, isochronism and hunting of a governer **(Only theory)**

Unit-IV

BALANCING:

Balancing of rotating masses single and multiple – single and different planes, use analytical and graphical methods. 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 effort.

Unit	**Module**	**Micro content**
7.a. or 8.a	Balancing of rotating masses	Balancing of rotating masses **(Analytical & graphical methods)**
7.b. or 8.b	Balancing of reciprocating masses	Primary & secondary balancing, examination of v-multi cylinder inline and radial engines **(Only numericals)**
		Locomotive balancing: hammer blow, swaying couple, variation of tractive effort. **(Only theory)**

Unit-V

VIBRATIONS:

Free Vibration of spring mass system –Natural frequency-types of damping– damped free vibration, Simple problems on forced damped vibration-critical speeds-torsional vibrations.

Unit	Module	Micro content
9.a. or 10.a	Free vibration	Free Vibration of spring mass system **(Theory & problems)**
		Types of damping, damped free vibrations **(Theory and associated problems)**
9.b. or 10.b	Forced vibration	Simple problems on forced damped vibration
		Critical speed & torsional vibrations **(Theory and associated problems)**

II-Year-II Semester	**DESIGN OF MACHINE MEMBERS-I**	**L** **T** **P** **C** 3 1* 0 3

PC2204

Pre-Requisites:

1. Engineering Mathematics
2. Mechanics of Solids
3. Engineering Mechanics
4. Material Science

Course objectives: The student should be able to

1. To introduce the fundamental knowledge of design, this deals about the shape, size and material of particular machine elements.
2. To implement the failure theory in designing and predicting the behavior of machine components.
3. To introduce the basic principles for design of some machine elements such as riveted joints, welded joints, bolted joints, cotter join and springs.

Unit No	Contents

I	**DESIGN FOR STATIC STRENGTH:** Basic Procedure of Machine Design, Classifications of Machine design, Factors to be considered in Machine Design, Preferred numbers and significance. **(3hrs)** Simple Stresses - stresses - Torsion and Bending stresses - stress strain relations, Theories of elastic failure – Maximum Principal stress theory, maximum shear stress theory, Distortion energy theory. **(7hrs)**
II	**DESIGN FOR FATIGUE STRENGTH:** Variable Stresses, Fatigue Failure, Fatigue strength, Endurance limit - Approximate estimation. Design for variable stresses – Gerber's Method, Goodman's Method, Soderberg's Method**. (7hrs)** Stress concentration –stress concentration factors – Reduction of Stress Concentration. Cumulative damage in fatigue **(3hrs)**
III	**RIVETED JOINTS:** Types of riveted joints, Modes of Failure, efficiency of riveted joint, Design of Joints for boiler Shell. **(5hrs)** **WELDED JOINTS:** Types of welded joints, Strength of Parallel Fillet welds, Strength of Transverse Fillet welds, Axially Loaded unsymmetrical welded Joints**. (4hrs)** **BOLTED JOINTS:** Stresses in bolts due to initial tightening, external loading and combined loading, eccentrically loaded bolted joints in shear, Eccentric load perpendicular to axes of bolts**. (4hrs)**
IV	**SHAFTS:** Transmission shafts- Shaft design on strength basis- Shaft design on torsional rigidity basis-ASME code for shaft design-Design of hollow shaft on strength and torsional rigidity basis. **(5hrs)** **KEYS & COUPLINGS:** Types of keys- Design of square and flat keys - Requirements – Rigid Couplings-Muff Coupling-Clamp coupling Flange Coupling-Bushed pin flexible coupling. **(5hrs)**
V	**COTTER JOINTS:** cotter joints-spigot and socket, sleeve and cotter, jib and cotter joints- **SPRINGS:** Types of springs, Terminology of Helical Springs, End conditions, Stress and Deflection equations, Series and parallel Connections, Design of Helical springs. Introduction to Leaf springs, nipping of Leaf Spring. (**7hrs)**

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

CO1: Sketch the design Procedure and determine the dimensions of simple mechanical components subjected to static loads considering static theories of failure. KL-3

CO2: Apply the knowledge in designing mechanical components subjected to stress concentration and Fatigue loads considering fatigue theories of failure. KL-3

CO3: Design and analyze permanent joints such as riveted and welded joints under different loading conditions. KL-4

CO4: Design and analyze temporary joints such as bolted and cotter joints under different loading conditions. KL-4

CO5: Design and analyze springs for the given loading. KL-4

Text books:

1. Design of Machine Elements, (3rd Edition) by V.B. Bhandari, Tata McGraw Hill Publishers, New Delhi, 2014.
2. Machine Design an Integrated Approach, (5th Edition) Robert L. Norton, Pearson Education Limited, New Delhi, 2013.

Reference books:

1. A Textbook of Machine Design (SI Units) (12th Edition) by P. C. Sharma, Dr. D. K. Aggarwal, S. K. Kataria& Sons, New Delhi, 2012.
2. Mechanical Engineering Design, (8th Edition) by Joseph Shigley, Charles R Mischke, Tata McGraw Hill Publishers, New Delhi, 2008.
3. Design of Machine Elements, by C. S. Sharma, Kamlesh Purohit, Prentice Hall of India Private Limited (PHI), New Delhi, 2009.
4. A Textbook of Machine Design by R S Khurmi, J K Guptha, S Chand & Company Ltd., New Delhi., (25th Edition), 2005.
5. Design of Machine Elements, (2ndEdition) by P. Kannaiah, Scitech Publications India Private Limited, Chennai, 2009.

e- Resources & other digital material:

1. https://swayam.gov.in/nd1_noc20_me46/preview
2. https://swayam.gov.in/nd1_noc20_ce50/preview

3. https://www.youtube.com/watch?v=-rZPnpzHutE&t=32s
4. https://www.youtube.com/watch?v=oBGzuZXBoQY&list=PLbjTnjt5GklgyqPw1ULGpWPPpvXWKioU

Micro-Syllabus

UNIT-I **DESIGN FOR STATIC STRENGTH:** Basic Procedure of Machine Design, Classifications of Machine design, Factors to be considered in Machine Design, Preferred numbers and significance. Simple Stresses - stresses - Torsion and Bending stresses - stress strain relations, Theories of elastic failure – Maximum Principal stress theory, maximum shear stress theory, Distortion energy theory.		
Unit	**Module**	**Micro content**
1.a.or 2.a Introduction to Machine Design	Introduction to Machine Design	Basic Procedure of Machine Design**,** Classifications of Machine design, Factors to be considered in Machine Design, Preferred numbers & their significance **(only theory)**
1.b.or 2.b Theories of elastic failure	Theories of elastic failure	Types of stresses **(only theory)**
		Factor of safety **(Definition & concepts)**
		Maximum Principal stress theory, maximum shear stress theory & distortion energy theory (**Definitions & simple problems)**

UNIT-II

Variable Stresses, Fatigue Failure, Fatigue strength, Endurance limit - Approximate estimation. Design for variable stresses – Gerber's Method, Goodman's Method, Soderberg's Method

Stress concentration –stress concentration factors – Reduction of Stress Concentration. Cumulative damage in fatigue

Unit	Module	Micro content
3. a or 4.a Design for variable stresses	Design for variable stresses	Variable Stresses, Fatigue Failure, Fatigue strength, Endurance limit **(Definitions & concepts)**
		Design for variable stresses by Gerber's method **(simple problems)**
		Design for variable stresses by Goodman's method **(simple problems)**
		Design for variable stresses by Soderberg's method **(simple problems)**
3.b or 4.b Cumulative damage in fatigue	Stress concentration & cumulative damage in fatigue	Stress concentration and stress concentration factors **(only theory)**
		Methods of reducing stress concentration **(only theory)**
		Cumulative damage in fatigue **(simple problems)**

Unit-III

RIVETED JOINTS: Types of riveted joints, Modes of Failure, efficiency of riveted joint, Design of Joints for boiler Shell

WELDED JOINTS: Types of welded joints, Strength of Parallel Fillet welds, Strength of Transverse Fillet welds, Axially Loaded unsymmetrical welded Joints**.**

BOLTED JOINTS: Stresses in bolts due to initial tightening, external loading and combined loading, eccentrically loaded bolted joints in shear, Eccentric load perpendicular to axes of bolts

Unit	Module	Micro content
5.a or 6.a Design of Riveted & welded joints	Design of riveted joints	Types of riveted joints **(only theory)**
		Modes of failure and Efficiency of riveted joint **(Theory and associated problems)**
		Design of joints for boiler shell **(simple problems)**
	Design of welded joints	Types of welded joints **(only theory)**
		Strength of parallel fillet and transverse fillet welds **(Concepts & simple problems)**
5.b or 6.b Design of welded & bolted joints	Design of welded joints	Axially Loaded unsymmetrical welded Joints **(Associated problems)**
	Design of bolted joints	Stresses in bolts due to initial tightening, external loading and combined loading. **(Definitions & concepts)**
		Eccentrically loaded bolted joints in shear **(Simple problems)**
		Eccentric load perpendicular to axes of bolts **(Associated Problems)**

Unit-IV

SHAFTS: Transmission shafts- Shaft design on strength basis- Shaft design on torsional rigidity basis-ASME code for shaft design-Design of hollow shaft on strength and torsional rigidity basis.

KEYS & COUPLINGS:

Types of keys- Design of square and flat keys - Requirements – Rigid couplings-Muff coupling-Clamp coupling Flange coupling-Bushed pin flexible coupling

Unit	Module	Micro content
7.a.or 8.a Design of shafts	Design of shafts	Torsion equation in shafts **(Derivation)**
		Shaft design on strength basis **(Simple problems)**
		Shaft design on torsional regidity basis **(Simple problems)**
		Design of hollow shaft on strength and torsional rigidity basis **(Associated numericals)**
7.b.or 8.b Keys & Couplings	Design of keys	Types of keys (Only theory)
		Design of square key **(Associated problems)**
		Design of flat key **(Simple problems)**
	Design of Couplings	Design of flange coupling (Simple problems)
		Design of muff coupling **(Associated simple problems)**

Unit-V

COTTER JOINTS: cotter joints-spigot and socket, sleeve and cotter, jib and cotter joints

SPRINGS: Types of springs, Terminology of Helical Springs, End conditions, Stress and Deflection equations, Series and parallel Connections, Design of Helical springs. Introduction to Leaf springs, nipping of Leaf Spring.

Unit	Module	Micro content
9.a. or 10.a Cotter joints	Design of Cotter joints	Design procedures of Spigot and Socket joint, Sleeve and Cotter joint, Jib and Cotter joint **(Design procedures and associated simple problems)**
9.b.or 10.b Design of Springs	Design of Springs	Types and Terminology of Springs **(Only theory)**
		Stress and deflection equations of helical springs **(Associated simple problems)**
		Springs in series and parallel connections (**Simple problems)**
		Design of helical springs **(Design procedure and simple problems)**

		L T P	C
II-Year-II Semester	**THERMAL ENGINEERING LAB**	0 0 3	1.5

PC2201L

Pre-Requisites : Nil

Course objectives: The main objective of this course is to familiarize the principles and its evaluation of various performance parameters of mechanical systems and its impact on global environment.

LIST OF EXPERIMENTS:

(At least 10 Experiments are required to be conducted)

1. I.C. Engines valve / port timing diagrams.
2. Testing of Fuels – Viscosity, flash point/fire point, carbon residue, calorific value.
3. I.C. Engines performance test on 4 -stroke diesel engine
4. I.C. Engines performance test on 2-stroke petrol engine
5. Evaluation of engine friction by conducting Morse test on 4-stroke multi cylinder petrol engine.
6. Determination of FP by retardation and motoring test on IC engine.
7. I.C. Engines heat balance at different loads and show the heat distribution curve.
8. Economical speed test of an IC engine
9. Performance test on variable compression ratio engines
10. Performance test on reciprocating air compressor unit.
11. Dis-assembly / assembly of different parts of two wheelers. 3 wheelers & 4 wheelers. Tractor & Heavy duty engines covering 2-stroke and 4 stroke, SI and CI engines.
12. Study of Boilers.

II-Year-II Semester	FLUID MECHANICS & HYDRAULIC MACHINES LAB	L T P 0 0 3	C 1.5

PC2202L

Pre-Requisites : Nil

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

LIST OF EXPERIMENTS:

(At least 10 Experiments are required to be conducted)

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

REFERENCE: Lab Manual

		L T P	C
II-Year-II Semester	**PYTHON PROGRAMMING LAB**	0 0 3	1.5

ESL2201L

Pre-Requisites : Problem solving using any programming language

Course objectives:

1) Experiment with scripting language
2) Evaluate expression evaluation, control statements
3) Use Data structures
4) Model Functions, Modules and packages
5) Outline OOP through Python and Exception Handling
6) Select required Python Standard library and Testing

LIST OF EXPERIMENTS:

Exercise 1 - Basics

a) Running instructions in Interactive interpreter and a Python Script
b) Write a program to purposefully raise Indentation Error and Correct it

Exercise 2 - Operations

a) Write a program to compute distance between two points taking input from the user (Pythagorean Theorem)
b) Write a program add.py that takes 2 numbers as command line arguments and prints its sum.

Exercise - 3 Control Flow

a) Write a Program for checking whether the given number is an even number or not.
b) Using a for loop, write a program that prints out the decimal equivalents of 1/2, 1/3, 1/4, . . . , 1/10
c) Write a program using for loop that loops over a sequence. What is sequence?
d) Write a program using a while loop that asks the user for a number, and prints a countdown from that number to zero.

Exercise 4 - Control Flow - Continued

a) Find the sum of all the primes below two million.