VASIREDDY VENKATADRI INSTITUTE OF TECHNOLOGY

Namur (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)

VVIT

VASIREDDY VENKATADRI
INSTITUTE OF TECHNOLOGY

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.

About Department

The Mechanical engineering is one of the core engineering departments, which has potential to accommodate all efficient engineers. The Mechanical engineers serve all other branches of engineering directly or indirectly. The Mechanical engineers can find their place in Automobile engineering sector, Electrical Engineering sector, IT sector, manufacturing industries, design industries, Military, Naval and Air force, Defence research organizations, material research organizations etc.

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.

PEO4: To make graduates as Entrepreneurs by inculcating the qualities required for Entrepreneurship.

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 V^{th} 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 distinctionFor 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 courseof 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	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.

	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.	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	Student of the college expulsion from the

	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.	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

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	3	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	3	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	Indian Constitution	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	Engineering Mathematics – III	3	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	3	1*	0	3

		4. Nano Technology				
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	Environmental Science	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	Metrology and Instrumentation	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**	3	1*	0	3

		1. Green Engineering Systems 2. Robotics 3. Additive Manufacturing (3D printing) 4. Logistics and supply chain management				
6	PC3201L	Heat Transfer Lab	0	0	3	1.5
7	PC3202L	Metrology and Instrumentation 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**
OpenElective 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**	3	1*	0	3

		1. CAD/CAM 2. Product Design 3. Renewable Energy Sources 4. Production Planning Control				
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: PLM & Robotics Lab	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 2. Materials Management 3. Industrial Robotics 4. Advanced Mechanics of Solids	1. Finite Element Methods 2. Power Plant Engineering 3. Total Quality Management 4. Mechatronics	1. Industrial Engineering and Management 2. Composites and Nano Materials 3. Solar and Photo Voltaic systems 4. Design for Manufacturing

Professional Elective- IV	**Professional Elective- V**
1. CAD/CAM 2. Product Design 3. Renewable Energy Sources 4. Production Planning Control	1. Condition Monitoring 2. Optimization Techniques 3. Automobile Engineering 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	III-II
10	Power Plant Engineering	Thermodynamics	4	0	0	4	
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	4	0	0	4

		Members II				
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	Communicative English	L	T	P	C
HS1101		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:

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:

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:

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:

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:

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

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

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)**

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 BS1101	Mathematics-I	L	T	P	C
		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:

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:

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:

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:

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

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.

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.

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.

I-Year-I Semester BS1102	ENGINEERING PHYSICS	L	T	P	C
		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:

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

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

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

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

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.

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.

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

I-Year-I Semester ES1102	Problem Solving using C	L	T	P	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

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

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

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

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

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.

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

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.

I-Year-I Semester ES1101	ENGINEERING GRAPHICS	L	T	P	C
		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:

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:

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:

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

Conversion of isometric views to orthographic views, drawing of isometric views - simple Solids, Conversion of orthographic views to isometric views of simple Drawings

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

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}

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

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

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)

I-Year-I Semester BS1102L	ENGINEERING PHYSICS AND VIRTUAL LAB	L	T	P	C
		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 ES1103L	PROBLEM SOLVING USING C LAB	L	T	P	C
		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	MATHEMATICS-II	L	T	P	C
BS1201		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

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

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

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:

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:

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.

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.

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)

I-Year-II Semester BS1202	ENGINEERING CHEMISTRY	L	T	P	C
		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

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

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.

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.

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.

I-Year-II Semester ES1201	BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING	L	T	P	C
		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:

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:

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:

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:

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

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.

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)

I-Year-II Semester ES1202	MATERIALS SCIENCE	L	T	P	C
		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'sindices,PackingEfficiency,Densitycalculations, Grains and Grain Boundaries, Effect of grain size on the properties,Determinationofgrainsizebydifferentmethods,Constitution of Alloys: Necessity of alloying, Types of solid solutions, Hume -Rotheryrules,Intermediatealloy phases.***CrystalDefects***
II	Introduction,phasediagrams,Phaserule,Leverrule,BinaryphaseDiagrams,Isomorphoustransformationswithexamples,Eutectictransformationswith examples,Eutectoidtransformationswithexamples
III	Introduction,Steels,Iron-CarbonPhaseDiagram,HeatTreatment,StudyofFe-Fe3Cphasediagram.,ConstructionofTTTdiagrams,Annealing,Normalizing, HardeningandTemperingofsteels,HardenabilityofAlloysteels.
IV	Introduction - Cast Irons, Structure and properties of White Cast iron, MalleableCastiron,Greycastiron,Non-ferrousMetalsandAlloys,Structureandpropertiesofcopperandits alloys,Aluminiumandits alloys,Al-Cuphasediagram,Titaniumanditsalloys.***SuperAlloys, ShapeMemoryAlloys***
V	Introduction to Ceramics, Polymers, Composites, Crystalline ceramics structure,properties & Applications, Glasses, cermets structure, properties & applications,Classification, properties & applications of composites, Classification, PropertiesandApplicationsofPolymers.***NanoComposites***

CourseOutcomes: Uponsuccessfulcompletionofthecourse,thestudentwillbeableto

CO1: Abletoknowthebasicconceptsofbondsinmetalsandalloys.Tounderstandthebasicrequirements fortheformationofsolidsolutionsandothercompounds.

CO2: Able to understand the regions of stability of the phases that can occur in an alloy system inorder to solve the problems in practical metallurgy.

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

CO4: Able to study the basic concepts of castiron, non-ferrous metals and alloys, their properties

and practical applications.

CO5: Able to study the properties and applications of ceramic, composite and other advanced materials so as to use the suitable material for practical applications.

Textbooks:

1. MaterialScienceandMetallurgy/Kodgire
2. EssentialsofMaterialsScienceandengineering/DonaldR.Askeland/Thomson

Referencebooks:

1. ElementsofMaterial science/ V.Rahghavan
2. EngineeringMaterialandMetallurgy–ErAmandeepSinghWadhva
3. MaterialsScienceandengineering/Williamandcallister.
4. IntroductiontoPhysicalMetallurgybySidneyHAvner,McGraw-HillPublishers.

I-Year-II Semester ES1203	ENGINEERING MECHANICS	L	T	P	C
		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

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

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

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

Work – Energy Method: Equations for Translation, Work-Energy Applications to Particle Motion, Connected System-Fixed Axis Rotation and Plane Motion. Impulse momentum method

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

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

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.

I-Year-II Semester BS1202L	ENGINEERING CHEMISTRY LAB	L	T	P	C
		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 ES1203L	BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING LAB	L	T	P	C
		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 ES1204L	WORKSHOP PRACTICE LAB	L	T	P	C
		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	INDIAN CONSTITUTION	L	T	P	C
MC1201		2	0	0	0

Course Objectives:

- To Enable the student to understand the importance of constitution
- To understand the structure of executive, legislature and judiciary
- To understand philosophy of fundamental rights and duties
- To understand the autonomous nature of constitutional bodies like Supreme Court and high court controller and auditor general of India and election commission of India.
- To understand the central and state relation financial and administrative.

UNIT-I

Introduction to Indian Constitution: Constitution' meaning of the term, Indian Constitution - Sources and constitutional history, Features - Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy.

LEARNING OUTCOMES:

After completion of this unit student will

- Understand the concept of Indian constitution
- Apply the knowledge on directive principle of state policy
- Analyze the History, features of Indian constitution
- Evaluate Preamble Fundamental Rights and Duties

UNIT-II

Union Government and its Administration Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha, The Supreme Court and High Court: Powers and Functions;

LEARNING OUTCOMES: - After completion of this unit student will

- Understand the structure of Indian government
- Differentiate between the state and central government
- Explain the role of President and Prime Minister
- Know the Structure of supreme court and High court

UNIT-III

State Government and its Administration Governor - Role and Position - CM and Council of ministers, State Secretariat: Organisation, Structure and Functions

LEARNING OUTCOMES: - After completion of this unit student will

- Understand the structure of state government
- Analyze the role Governor and Chief Minister
- Explain the role of state Secretariat
- Differentiate between structure and functions of state secretariate

UNIT-IV

Local Administration - District's Administration Head - Role and Importance, Municipalities - Mayor and role of Elected Representative - CEO of Municipal Corporation Panchayati: Functions PRI: Zila Panchayat, Elected officials and their roles, CEO Zila Panchayat: Block level Organizational Hierarchy - (Different departments), Village level - Role of Elected and Appointed officials - Importance of grass root democracy

LEARNING OUTCOMES: -After completion of this unit student will

- Understand the local Administration
- Compare and contrast district administration role and importance
- Analyze the role of Myer and elected representatives of Municipalities
- Evaluate Zilla panchayat block level organisation

UNIT-V

Election Commission: Election Commission- Role of Chief Election Commissioner and Election Commissionerate State Election Commission: Functions of Commissions for the welfare of SC/ST/OBC and women

LEARNING OUTCOMES: -After completion of this unit student will

- Know the role of Election Commission apply knowledge
- Contrast and compare the role of Chief Election commissioner and Commissionerate

- Analyze role of state election commission
- Evaluate various commissions of viz SC/ST/OBC and women

REFERENCES:

1. Durga Das Basu, Introduction to the Constitution of India, Prentice – Hall of India Pvt.Ltd.. New Delhi
2. Subash Kashyap, Indian Constitution, National Book Trust
3. J.A. Siwach, Dynamics of Indian Government & Politics
4. D.C. Gupta, Indian Government and Politics
5. H.M.Sreevai, Constitutional Law of India, 4th edition in 3 volumes (Universal Law Publication)
6. J.C. Johari, Indian Government and Politics Hans
7. J. Raj Indian Government and Politics
8. M.V. Pylee, Indian Constitution Durga Das Basu, Human Rights in Constitutional Law, Prentice – Hall of India Pvt.Ltd.. New Delhi
9. Noorani, A.G., (South Asia Human Rights Documentation Centre), Challenges to Civil Right), Challenges to Civil Rights Guarantees in India, Oxford University Press 2012

E-RESOURCES:

1. nptel.ac.in/courses/109104074/8
2. nptel.ac.in/courses/109104045/
3. nptel.ac.in/courses/101104065/
4. www.hss.iitb.ac.in/en/lecture-details
5. www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indian-constitution

Course Outcomes:

At the end of the semester/course, the student will be able to have a clear knowledge on the following:

- Understand historical background of the constitution making and its importance for building a democratic India.
- Understand the functioning of three wings of the government ie., executive, legislative and judiciary.
- Understand the value of the fundamental rights and duties for becoming good citizen of India.
- Analyze the decentralization of power between central, state and local self-government.

- Apply the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy

Course Outcomes:

CO-1 Know the sources, features and principles of Indian Constitution.

CO-2 Learn about Union Government, State government and its administration.

CO-3 Get acquainted with Local administration and Pachayati Raj.

CO-4 Be aware of basic concepts and developments of Human Rights.

CO-5 Gain knowledge on roles and functioning of Election Commission

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

Contents

UNIT-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.

UNIT-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.

UNIT-III

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

UNIT-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.

UNIT-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}, $\sin(ax+by)$, $\cos(ax+by)$, $x^m y^n$.

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.

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)

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. Understandthe 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

Contents

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-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-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-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-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.

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.

II-Year-I Semester | **KINEMATICS OF MACHINERY**

L	T	P	C
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.

Contents

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.

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-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-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-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.

Text books:

1. AmbekarA.G. Mechanismand Machine Theory, Prentice Hall of India, NewDelhi, 2009.
2. Rattan S.S, Theory of Machines,3rdEdition, TataMcGraw 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, NewAge 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.

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)**

II-Year-I Semester	PRODUCTION TECHNOLOGY	L	T	P	C
PC2103		3	1*	0	3

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.
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

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**.

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

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,

Advanced Topics in This Course:*Forging Die Design*

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.

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}**

Understand principles of different types high energy rate forming processes and powder metallurgy techniques**{Understand level, KL2}**

II-Year-I Semester | **MACHINE DRAWING**

L	T	P	C
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.

Contents

UNIT-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)**

UNIT-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

UNIT-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)**

UNIT-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)**

UNIT-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

II-Year-I Semester	THERMODYNAMICS	L	T	P	C
ES2101		3	1*	0	3

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.

Contents

UNIT-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.

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.

UNIT-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.

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-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.

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.

UNIT-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.

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

UNIT-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.

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.

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

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

CO1: **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}**

CO2: **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}**

CO3: **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}**

CO4: **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}**

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**

II-Year-I Semester	PRODUCTION TECHNOLOGY LAB	L	T	P	C
PC2103L		0	0	3	1.5

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
3. Theory includes " **Study of Different types of plastics and their characteristics** "

II-Year-I Semester	MECHANICS OF SOLIDS & METALLURGY LAB	L	T	P	C
PC2101L		0	0	3	1.5

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

Determination of strength of ductile materials under tensile load by using UTM and to study stress strain characteristics.

Determination of shear strength of materials by using UTM.

Determination of stiffness and modulus of rigidity by conducting compression tests on springs.

Determination of hardness number by using Brinell Hardness Tester.

Determination of hardness number by using Rockwell Hardness Tester.

Determination of Impact strength on Izod Impact Testing Machine.

Determination of Impact strength on Charpy Impact Testing Machine.

Determination of Rigidity Modulus by conducting Torsion test on circular shafts.

Determination of Young's Modulus for materials on simply supported beam.

Determination of Young's Modulus for materials on Cantilever beam.

(B)METALLURGY LAB:

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

Preparation and study of the Microstructure of Mild steels, low carbonsteels, high – Csteels.

Study of the Micro Structures of Cast Irons.

Study of the Micro Structures of Non-Ferrous alloys.

Study of the Micro structures of Heat treated steels.

Hardenability of steels by Jominy End QuenchTest.

To find out the hardness of various treated and untreated steels.

Course outcomes: The student should be able to

1. Practical exposure on the microstructures of various materials and their hardness evaluation was clearly understood.

2. Practical knowledge on the evaluation of material properties through various destructive testing procedures are analyzed and noted.

II-Year-I Semester	CAAED ESSENTIALS	L	T	P	C
		1	0	2	2

SOC2101

Pre-Requisites :

1) Engineering Graphics / Drawing

CAD Package: Siemens PLM software

Arduino simulator: Tinkercad

Course objectives: After successfully completing this course, student able to

1. Create various mechanical components.
2. Create and modify basic assembly structures.
3. Create and modify components imported from other CAD tools.
4. Create simple prototypes using 3D printer.
5. Create program for arduino for simple mechanical applications.

Contents

UNIT-I

3D Modeling: Introduction to coordinate systems, Impact of Coordinate Systems on Parts ,Creating datum geometry to support design intent

Sketch toolbar -Creating Parts with Sketch, Editing and manipulating sketches

Modeling tool bar - Sweeping geometry to create part features, Types of Geometric Constraints,Trimming a solid body ,Creating swept features with offset and draft,Copying and mirroring part segments , Pattern Features, Boolean Operations etc.

UNIT-II

Assembly: Types of assemblies 1. Top down assembly 2. Bottom down assembly, Various types of Assembly constraints,Loading and working with assemblies,Adding and positioning parts in an assembly.

UNIT-III

Synchronous Modeling and Parametric Design: Move Face, Delete face, offset areas, re-blend faces,

Replace face, Substitution modifications,Creating and manipulating shell features, importing Step, IGES, Para solid or other CAD models.
UNIT-IV **3D Printing:** Prototype Fundamentals,Rapid Prototyping Process Chain,Liquid-Based Rapid Prototyping Systems,Solid-Based Rapid Prototyping Systems,Powder-Based Rapid Prototyping Systems and Applications and Examples.Converting part file to STL file, Importing STL file into 3D printing Software, Conversion of STL file into axis codes.
UNIT-V **Arduino Programming :** Board description of an arduino UNO, different types of arduino, simple projects such as Fading LED, Traffic light controller, Temperature and humidity sensor , Pick and place robot and Detecting obstacles and warning.

Text books:

1. Parametric Modeling with Siemens NX, by Randy H. Shin
2. NX 11.0 for Designers, 10th Edition by Sham Tickoo, Purdue University Northwest, USA.
3. RAPID PROTOTYPING: PRINCIPLES AND APPLICATIONS, 2nd Edition,World Scientific Publishing Co. Pte. Ltd.
4. Getting Started With Arduino: The Ultimate Beginner's Guide,Steve Gold

Reference books:

1. Machine Drawing –K.L.Narayana, P.Kannaiah & K. Venkata Reddy / New Age/ Publishers
2. Programming Arduino: Getting Started with Sketches (Tab) 2nd Edition, Kindle Edition by Simon Monk
3. Manuals & Tutorials on CAD/CAE packages like Pro/Engineer, Pro/Mechanica, ANSYS, etc latest available in the lab.

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

CO1: **Gain** the knowledge in basic 2D sketches and modeling concepts for Engineering applications using CAD tools such as Siemens PLM software / CATIA **{Understand level, KL2}**

CO2: Create and modify basic assembly structures. **{Apply level, KL3}**

CO3: Creating and manipulating shell features for Copying and mirroring part segment**{Apply level, KL3}**

CO4: Create Proto type model with 3D Printer. **{Apply level, KL3}**

CO5: Create Arduino program for mechanical applications. **{Apply level, KL3}**

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

Contents

UNIT-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

UNIT-II

Protection of traditional knowledge: the need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

UNIT-III

Legal framework and TK: A: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmers 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.

UNIT-IV

Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional Knowledge.

UNIT-V

Traditional knowledge in different sectors: Traditional knowledge and engineering, Traditional medicine system, TK and biotechnology, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK

Text books:

1. V. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material, Bharatiya Vidya Bhavan, Mumbai, 5thEdition,2014
2. SwamiJitatmanand,ModernPhysicsandVedant,BharatiyaVidyaBhavan
3. Fritzof Capra, Tao ofPhysics
4. Fritzof Capra, The wave ofLife
5. VNJha(Eng.Trans,),TarkasangrahaofAnnamBhatta,InernationalChinmayFoundation,Velliar nad, Amaku,am
6. YogaSutraofPatanjali,RamakrishnaMission,Kolkatta
7. GNJha(Eng.Trans.)Ed.RNJha,Yoga-

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

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

II-Year-II Semester	Complex Variables and Statistical Methods	L	T	P	C
BS2201		3	1*	0	3

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.

Contents

UNIT-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.

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

UNIT-II

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).

Probability, Distributions and Sampling Theory:

Probability-Baye's theorem-Random variables-Discrete and Continuous random variables-Distribution function-Mathematical Expectation and Variance-

UNIT III

Application approach: Binomial, Poisson and Normal distributions.

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

Applications: Maximum error of estimate Bayesian estimate.

UNIT-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.

UNIT-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**

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.

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)

II-Year-II Semester | **APPLIED THERMODYNAMICS-I** | **PC2201**

L	T	P	C
3	1*	0	3

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.

Contents

UNIT-I

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**.**

UNIT-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.

UNIT-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**.**

UNIT-IV

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.

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)**

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

UNIT-V

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 per degree of reaction.

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

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 andalso **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 measurementof Parameters of performanceand also **Compute** the performance of IC Engines **{Apply level, KL3}**

CO5 **Compute** the performance of air compressors. **{Apply level,KL3**

II-Year-II Semester	FLUID MECHANICS & HYDRAULIC MACHINES	L	T	P	C
PC2202		3	1*	0	3

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.

Contents

UNIT-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

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-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.

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-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.

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-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.

Performance of hydraulic turbines: Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer.

UNIT-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.

Reciprocating pumps: Working principle, types, Discharge and power requirement, slip, coefficient of discharge, effect of acceleration on indicator diagram.

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

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}**

II-Year-II Semester | **DYNAMICS OF MACHINERY**

L	T	P	C
3	1*	0	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.

Contents

UNIT-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.

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-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-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-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)

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.

Contents

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-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**.**

Stress concentration –stress concentration factors – Reduction of Stress Concentration.Cumulative damage in fatigue

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-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-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.

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.

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

II-Year-II Semester	THERMAL ENGINEERING LAB	L	T	P	C
PC2201L		0	0	3	1.5

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	C
PC2202L		0	0	3	1.5

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

II-Year-II Semester	PYTHON PROGRAMMING LAB	L	T	P	C
ESL2201L		0	0	3	1.5

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.

Each new term in the Fibonacci sequence is generated by adding the previous two terms. By starting with 1 and 2, the first 10 terms will be:1, 2, 3, 5, 8, 13, 21, 34, 55, 89, ...

b) By considering the terms in the Fibonacci sequence whose values do not exceed four million, find the sum of the even-valued terms.

Exercise - 5 - DS

a) Write a program to count the numbers of characters in the string and store them in a dictionary data structure

b) Write a program to use split and join methods in the string and trace a birthday with a dictionary data structure.

Exercise - 6 DS - Continued

a) Write a program combine_lists that combines these lists into a dictionary.

b) Write a program to count frequency of characters in a given file. Can you use character frequency to tell whether the given file is a Python program file, C program file or a text file?

Exercise - 7 Files

a) Write a program to print each line of a file in reverse order.

b) Write a program to compute the number of characters, words and lines in a file.

Exercise - 8 Functions

a) Write a function ball_collide that takes two balls as parameters and computes if they are colliding. Your function should return a Boolean representing whether or not the balls are colliding.

Hint: Represent a ball on a plane as a tuple of (x, y, r), r being the radius

If (distance between two balls centers) <= (sum of their radii) then (they are colliding)

b) Find mean, median, mode for the given set of numbers in a list.

Exercise - 9 Functions - Continued

a) Write a function nearly_equal to test whether two strings are nearly equal. Two strings a and b are nearly equal when a can be generated by a single mutation on b.

b) Write a function dups to find all duplicates in the list.

c) Write a function unique to find all the unique elements of a list.

Exercise - 10 - Functions - Problem Solving

a) Write a function cumulative_product to compute cumulative product of a list of numbers.

b) Write a function reverse to reverse a list. Without using the reverse function.

c) Write function to compute gcd, lcm of two numbers. Each function shouldn't exceed one line.

Exercise 11 - Multi-D Lists

a) Write a program that defines a matrix and prints

b) Write a program to perform addition of two square matrices

c) Write a program to perform multiplication of two square matrices

Exercise - 12 - Modules

a) Install packages requests, flask and explore them. using (pip)

b) Write a script that imports requests and fetch content from the page. Eg. (Wiki)

c) Write a simple script that serves a simple HTTPResponse and a simple HTML Page

Exercise - 13 OOP

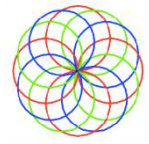
a) Class variables and instance variable and illustration of the self variable

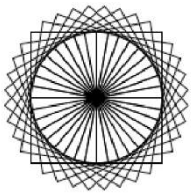
i) Robot

ii) ATM Machine

Exercise - 14 GUI, Graphics

1. Write a GUI for an Expression Calculator using tk
2. Write a program to implement the following figures using turtle





Exercise - 15 - Testing

a) Write a test-case to check the function even_numbers which return True on passing a list of all even numbers

b) Write a test-case to check the function reverse_string which returns the reversed string

Exercise - 16 - Advanced

a) Build any one classical data structure.

b) Write a program to solve knapsack problem.

Reference Books:

1. Python Programming: A Modern Approach, Vamsi Kurama, Pearson

2. Learning Python, Mark Lutz, Orielly

II-Year-II Semester	DIE DESIGN	L	T	P	C
SOC2201		1	0	2	2

Pre-Requisites :

1) Engineering Graphics / Drawing
2) Advanced 3d Modeling Tools
3) Fits & Tolerances

CAD Package:

Any one of the CAD Tool i.e. **Siemens PLM software / CATIA** isused to learn the above course.

Course objectives: After successfully completing this course, student able to

6. Learn various Sheet metal operations and blank development.
7. Create sheet metal components using basic operations.
8. Design a Press tool using Progressive wizard tools.
9. Create Pattern surface for various components.
10. Design a mold using Mold wizard tools.

Contents

UNIT – I

Introduction :

Classification of presses – – Various press tool operations -Location of clearance for regular and irregular shapes-Stock strip terms – Layouts – Economic utilization-Classification of dies viz. shearing, bending, drawing & forming. Design of dies –

Simple piercing/blanking – Inverted die – Compound die – Progressive dies – Rules for developing stock – Strip layouts for progressive diesLoad centre – Necessity – Analytical and graphical method to determine load centre (i.e. centre of pressure)

Bending dies – Blank development – Spring back effect – Methods of correction to overcome spring back – Forces in bending

Drawing Dies -Blank development for drawing operation,Drawing of rectangular components – Blank development

UNIT – II

Sheet Metal-part1:

Sheet Metal workflow

Establish basic part characteristics

Define the basic shape of the part

Constructing base features

Sheet Metal corners

Sheet Metal cut-outs

UNIT – III

Sheet Metal-part2:

Sheet Metal deform features

Flat Solid and Flat Pattern

Advanced Sheet Metal commands

Analyze Formability – One step

Aerospace Sheet Metal

UNIT – IV

Mold design-part1:

Initializing a mold design project, Shrinkage, Mold CSYS, Workpiece, Cavity layout, Family molds, Mold tools, Partings.

UNIT – V

Mold design-part2:

Mold Design Validation, Mold base, Standard Parts, Sub-insert Library, Gates and runners, Mold Cooling Tools, Electrode design, Creating pockets and Drawings.

Text books:

1. Fundamentals of Tool Design – ASTME, Prentice Hall, New Delhi, 1987
2. Ivana Suchy, Handbook of Die Design,2nd Edition –Mc Graw Hills, Newyork, 2006
3. NX 9 for Beginners - Part 5 (Sheet Metal Design) Kindle Editionby CADFolks

Reference books:

1. Die Design Handbook – AISME, Mc Graw Hills, Newyork, 1965
2. Eary & Reed, Shear Working of Metals, Prentice Hall, New Delhi, 1969
3. Basic Die Making & Advance Die Making – D. Eugene Ostergaard, Mc Graw Hill
4. Tool Design by Cyril Donaldson – Tata Mc Graw Hill, New Delhi
5. Machine Drawing –K.L.Narayana, P.Kannaiah & K. Venkata Reddy / New Age/ Publishers
6. Manuals & Tutorials on CAD/CAE packages like Pro/Engineer, Pro/Mechanica, ANSYS, etc latest available in the lab.

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

CO1: Understand and Analyze various Sheet metal operations and blank development for various dies. **{Understand level, KL2}**

CO2: Use Sheet Metal tool to create base features and add more advanced features to them. **{Apply level, KL3}**

CO3: Use the Sketch Task Environment to create and edit profiles for sheet metal parts and Edit parametric features. **{Apply level, KL3}**

CO4: Use mold wizard tool to create parting surface and other elements. **{Apply level, KL3}**

CO5: Use mold wizard tool to create base features and add more advanced features to them. **{Apply level, KL3}**

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III-Year-I Semester | **DESIGN OF MACHINE MEMBERS – II**

L	T	P	C
3	1*	0	3

PC3101

Pre-requisites:

1. Engineering Mathematics
2. Mechanics of Solids
3. Design of Machine Members I

Course Objectives: The Students will acquire the knowledge to

1. Understand to select the suitable bearing based on the application of the loads and predict the life of the bearing
2. Design of engine parts such as connecting rod, crank, crankshaft and engine parts such as piston, cylinder and cylinder liners
3. Design of curved beams with various cross sections and crane hooks
4. Design power transmission elements such as belts, chains, ropes and gear drives

Contents

UNIT – I

BEARINGS

Classification of bearings- applications, types of journal bearings –lubrication – bearing modulus – full and partial bearings – clearance ratio – heat dissipation of bearings, bearing materials – journal bearing design – ball and roller bearings – static loading of ball & roller bearings, bearing life.

UNIT – II

ENGINE PARTS I

Connecting Rod: Thrust in connecting rod – stress due to whipping action on connecting rod ends.

Crankshaft: Cranks and crankshafts, strength and proportions of overhung and center cranks – crank pins, crank shafts.

UNIT – III

ENGINE PARTS II

Pistons, forces acting on piston – construction design and proportions of piston, cylinder, cylinder liners. **(12hrs.)**

UNIT – IV

DESIGN OF CURVED BEAMS

Introduction, stresses in curved beams, expression for radius of neutral axis for rectangular, circular, trapezoidal and t-section, design of crane hooks, c –clamps**.**

FLEXIBLE DRIVES

Transmission of power by belt and rope drives, transmission efficiencies, belts – flat and v types – ropes - pulleys for belt and rope drives, materials, chain drives. **(12hrs.)**

UNIT – V

SPUR & HELICAL GEAR DRIVES

Spur gears- helical gears – load concentration factor – dynamic load factor, surface compressive strength – bending strength – design analysis of spur gears – estimation of centre distance, module and face width, check for plastic deformation, check for dynamic and wear considerations. **(12hrs.)**

Content beyond syllabus: Design of electric machines for electric vehicles.

Note: Design data book is permitted for examination

Text Books:

1. Machine Design/V.Bandari/TMH Publishers
2. Machine Design/ NC Pandya & CS Shaw/ Charotar publishers

Design Data Hand books:

1. Design Data Hand Book/S. Md. Jalaluddin/Anuradha Publications
2. Machine Design Data Book/V.B. Bhandari/McGraw Hill Education India

References:

1. Machine Design: An integrated Approach / R.L. Norton / Pearson Education
2. Mech. Engg. Design / JE Shigley/Tata McGraw Hill education
3. Design of machine elements- spots/Pearson Publications
4. Machine Design-Norton/Pearson Publications

Course Outcomes

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

CO1 **Select** the suitable bearings based on the application of the loads and predict the life of the bearing. **(Analyze level, KL-4)**

CO2 **Sketch** the design procedure for engine parts such as connecting rod and crankshaft **(Apply level, KL-3)**

CO3 **Construct** the design procedures for the engine parts such as piston, cylinder and cylinder liners. **(Apply level, KL-3)**

CO4 **Apply** the knowledge in designing the curved beams with various cross sections and power transmission elements such as belts, chains and ropes. **(Apply level, KL-3)**

Demonstrate the design procedures of spur and helical gear drives for plastic deformation, dynamic and wear loads. **(Apply level, KL-3)**

III-Year-I Semester | **METAL CUTTING AND MACHINE TOOLS**

L	T	P	C
3	1*	0	3

PC3102

Pre-Requisites: Production Technology, Metallurgy & Material Science.

Course objectives:

1. The course provides students with fundamental knowledge and principles in material removal processes.
2. In this course, the students apply the fundamentals and principles of metal cutting to practical applications through multiple labs using lathes, milling machines, grinding machines, and drill presses, Computer Numerical Control etc
3. To demonstrate the fundamentals of machining processes and machine tools.
4. To develop knowledge and importance of metal cutting parameters.
5. To develop fundamental knowledge on tool materials, cutting fluids and tool wear mechanisms.

Contents

UNIT – I

FUNDAMENTAL OF MACHINING:

Elementary treatment of metal cutting theory – element of cutting process – geometry of single point cutting tool, tool angles, chip formation and types of chips – built up edge and its effects, chip breakers, mechanics of orthogonal cutting –Merchant's force diagram, cutting forces, cutting speeds, feed, depth of cut, tool life, tool wear, machinability, economics of machining, coolants, tool materials and properties.

UNIT – II

LATHE MACHINES:

Engine lathe – principle of working, specification of lathe – types of lathe – work holders tool holders – box tools taper turning, thread turning – for lathes and attachments, Turret and capstan lathes.

UNIT – III

SHAPING, SLOTTING AND PLANNING MACHINES: Principles of working – principal parts – specifications, operations performed, machining time calculations.

DRILLING & BORING MACHINES: Principles of working, specifications, types, operations performed – tool holding devices – twist drill – Boring Machines – fine Boring Machines – jig boring machine, deep hole Drilling Machine.

UNIT – IV

MILLING MACHINES: Principles of working – specifications – classification of Milling Machines – principal features of horizontal, vertical and universal Milling Machine, machining operations, types of cutters, geometry of milling cutters – methods of indexing, accessories to milling machines.

FINISHING PROCESSES: Theory of grinding – classification of grinding machines, cylindrical and surface grinding machines, tool and cutter grinding machines, different types of abrasives, bonds, specification and selection of a grinding wheel. Lapping,Honing& Broaching operations, comparison to grinding.

UNIT – V

JIGS & FIXTURES: Principles of design of jigs and fixtures and uses, classification of jigs & fixtures, principles of location and clamping, types of clamping & work holding devices, typical examples of jigs and fixtures.

CNC MACHINE TOOLS: CNC Machines, working principle, classification, constructional features of CNC machines, CNC controller, types of motion controls in CNC machines, applications of CNC machines.

Text books:

1. Manufacturing Processes / JP Kaushish/ PHI Publishers-2nd Edition
2. Manufacturing Technology Vol-II/P.N Rao/Tata McGraw Hill
3. Metal cutting Principles by M.C. Shaw ,Oxford University Press

Reference books:

1) Metal cutting and machine tools /Geoffrey Boothroyd, Winston A.Knight/ Taylor & Francis
2) Production Technology / H.M.T. Hand Book (Hindustan Machine Tools).
3) Production Engineering/K.C Jain & A.K Chitaley/PHI Publishers
4) Technology of machine tools/S.F.Krar, A.R. Gill, Peter SMID/ TMH
5) Manufacturing Processes for Engineering Materials-Kalpakjian S & Steven R Schmid/Pearson Publications 5th Edition
6) NPTEL lectures on metal cutting - http://nptel.ac.in/downloads/112105127/

Course Outcomes: Upon successful completion of the course, the student will be able to	
CO1:	**Understand** cutting mechanics to metal machining based on cutting force and power consumption.**{Understand level, KL2}**
CO2:	**Operate** lathe, milling machines, drill press, grinding machines, etc**{ Operate level, KL3}**
CO3:	**Operate** Shaper, Slotter, Planer, Drill press, Boring machines, etc **{Operate level, KL3}**
CO4:	**Select** appropriate Finishing processes and conditions for different metals **{Select lev}**

III-Year-I Semester	ENGINEERING ECONOMICS AND MANAGEMENT	L	T	P	C
HSM3101		3	1*	0	3

PRE-REQUISITES: 1) Basic Sciences and Humanities

Course objectives: The student should be able to

1. To understand the concept and nature of Economics and Demand and to familiarize about the Production function, Input Output relationship, Cost-Output relationship and Break Even Analysis.
2. To understand the nature of markets and the concepts of Money and RBI functions.
3. To familiarize with the process of management, principles, and to provide conceptual knowledge on functional management that is on Human resource management and Marketing management.
4. To learn different Accounting Systems, preparation of Financial Statement and to familiarize with the tools of project Management.
5. To understand the concept of Capital, Capital Budgeting and the techniques used to evaluate Capital Budgeting proposals.

Contents

UNIT-I

Introduction to Economics and Theory of Production

Introduction to Economics; Definitions, Nature, Scope, Difference between Microeconomics & Macroeconomics –Concept of Demand, Types of Demand, Determinants of Demand-Law of Demand -Elasticity of Demand, Types of Elasticity of Demand.

Theory of production; production function, Law of variable proportions & law of returns to scale, Cost; meaning, short run & long run cost, fixed cost, variable cost, total cost, average cost, marginal cost, opportunity cost. Break even analysis; meaning, explanation, simple problems.

UNIT-II

Introduction to Markets and Money

Markets: meaning, types of markets & their characteristics (Perfect Competition, Monopoly, Monopolistic Competition, Oligopoly). National Income, GNP, GDP, NNP, NDP, Personal income and GST (Goods & Service Tax).

Money: meaning, functions, types, Monetary policy- meaning, objectives, tools, fiscal policy- meaning, objectives, tools, Banking; meaning, types, functions, Central Bank- RBI; its functions, concepts; CRR, bank rate, repo rate, reverse repo rate, SLR.

UNIT-III

Introduction to Management

Concept –nature and importance of Management Functions of Management, Principles of Management.

Human Resource Management: Meaning and difference between Personnel Management and Human Resource Management, Functions of Human Resource Management.

Marketing Management: Functions of Marketing - Marketing strategies based on product Life Cycle, Channels of distributions.

UNIT-IV

Introduction to Accounting & Project Management

Introduction to Double Entry System, Journal, Ledger, Trail Balance and Preparation of Final Accounts with adjustments – Preparation of Financial Statements.

Project Management: (PERT/CPM): Development of Network – Difference between PERT and CPM Identifying Critical Path (Simple Problems).

UNIT-V

Capital and Capital Budgeting:

Capital Budgeting: Meaning of Capital-Capitalization-Meaning of Capital Budgeting-Time value of money- Methods of appraising Project profitability: Traditional Methods (payback period, accounting rate of return) and modern methods (Discounted cash flow method, Net Present Value method, Internal Rate of Return Method and Profitability Index).

Content Beyond the syllabus:

Introduction to Managerial Economics and demand Analysis: Managerial Economics, Nature & Scope, Demand forecasting for new products, Concept of supply**.**

Theory of Production and Cost Analysis: Production Process, Types of production, ISO- Quants, ISO Costs.

Introduction to Markets and Money: Price Output determination, Pricing Methods and Stock Market and inflation influence on industry.

Introduction to Management: Evolution of Management thought, theories of Motivation, Leadership styles.

Project Management: Brief about Project crashing.

Learning Resources

Text books:

1. Dr. A. R. Aryasri – Managerial Economics and Financial Analysis, TMH 2018, 2e.
2. Dr. N. Appa Rao, Dr. P. Vijay Kumar: 'Managerial Economics and Financial Analysis', Cengage Publications, New Delhi – 2012.
3. Management Science, Aryasri, Tata McGraw Hill, 2014.
4. Dr. P. Vijaya Kumar & Dr. N. Appa Rao, 'Introduction to *Management Science'* Cengage, Delhi, 2012.
5. Engineering Economy and Management 1 Edition Pravin Kumar – Wiley Publication.
6. Engineering Economics & Management- Dr. Vilas Kulkarni & HardikBavishi - Vikas Publishing.

Reference books:

1. R. L Varshney, K.L. Maheshwari : Managerial Economics, Sultan Chand&Sons 2014,22e.
2. Suma Damodaran : Managerial Economics, Oxford 2010,2e.
3. Ambrish Gupta: 'Financial Accounting for Management', Pearson 2015,5e.
4. Dr. S.N. Maheswari: Financial Accounting, Vikas Publications 2018.
5. S. A. Siddiqui & A. S. Siddiqui: Managerial Economics and Financial Analysis, New Age International Publishers, 2017.
6. Principles of Marketing: A South Asian Perspective, Kotler Philip, Gary Armstrong, Prafulla Y. Agnihotri, and EshanulHaque , 17th Edition, Pearson Education/ Prentice Hall of India, 2018.
7. Human Resource Management: Gary Dessler, 14th Edition, pearson 2015.
8. Project Planning and Control with PERT and CPM: Dr. B. C. Punmia, K. K Khandelwal, Laxmi Publication, 2017, 4th Edition.

e- Resources & other digital material

1. www.managementstudyguide.com
2. www.tutorialspoint.com
3. www.lecturenotes.in

Course Outcomes

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

CO1 The Learner is equipped with the knowledge of estimating the Demand and demand elasticity's for a product and Input-Output-Cost relationships.(KL2)

CO2 The Learner is also ready to understand the nature of different markets and also to have the knowledge of Money &Banking(KL1).

CO3 The Learner will acquire the knowledge on management, HRM and Marketing(.KL1)

CO4 The Learner will acquire the knowledge to prepare Financial Statements and the techniques of project management.(KL3)

CO5 The Learner can able to evaluate various investment project proposals with the help of capital budgeting techniques for decision making.(KL3)

III-Year-I Semester	REFRIGERATION AND AIR-CONDITIONING	L	T	P	C
		3	1*	0	3

PE3101X

Pre-Requisites: Basic Thermodynamics

Course objectives: After successfully completing this course, student able

1. To understand the concepts of various refrigeration systems
2. To estimate the loads for different applications of air conditioning.

UNIT-I

Introduction to Refrigeration: - Necessity and applications – Methods of refrigeration – Ice Refrigeration, Evaporative Refrigeration, Refrigeration by expansion of air & by throttling of gas, Vapour Refrigeration system, Steam Jet Refrigeration , Refrigeration by using liquid gases, dry ice refrigeration, Unit of refrigeration

Air Refrigeration: Bell Coleman cycle , Open and Dense air systems – Necessity of cooling the areoplane, Methods of air refrigeration systems- Simple air cooling system, Simple air evaporative cooling system, Bootstrap air cooling system, Bootstrap air evaporative cooling system,Regenerative air cooling system.

UNIT-II

Vapour compression refrigeration –Mechanism of a Simple Vapour Compression Refrigeration System, p-h chart, types of Vapour compression Cycles- Theoretical compression Cycle with dry saturated vapour after compression, with wet vapour after compression, with superheated vapour after compression, with superheated vapour before compression, with Undercooling or Subcooling of Refrigerant, Actual Vapour compression Cycle, Effect of Suction Pressure, Effect of Discharge Pressure- Problems.

UNIT-III

VCR System Components: Compressors – General classification – comparison – Advantages and Disadvantages. Condensers – classification – Working Principles, Evaporators – classification – Working Principles Expansion devices – Types – Working Principles

Refrigerants: Desirable properties – common refrigerants used – Nomenclature – Ozone Depletion – Global Warming

UNIT-IV

Vapor Absorption System: Introduction – Calculation of max COP – description and working of NH3 – water system – Li – Br system. Principle of operation Three Fluid absorption system, salient features.

Steam Jet Refrigeration System – Working of Steam Jet Refrigeration System- Steam Ejector, Analysis & efficiencies used in steam jet refrigeration system

Non-Conventional Refrigeration Systems: Principle and operation of Thermoelectric refrigerator, Vortex tube or Hilsch tube.

UNIT-V

Introduction to Air Conditioning: Psychometric Properties & Processes – Sensible and latent heat loads – Characterization – Need for Ventilation, Consideration of Infiltration – Load concepts of RSHF, ASHF, ESHF and ADP. Concept of human comfort and effective temperature –Comfort Air conditioning – Industrial air conditioning and Requirements – Air conditioning Load Calculations

Air Conditioning systems - Classification of equipment, cooling, heating humidification and dehumidification, filters, grills and registers, deodorants, fans and blowers. Heat Pump – Heat sources – different heat pump circuits – Applications

Content beyond Syllabus

Cryogenics

Text books:

1. A Course in Refrigeration and Air conditioning - SC Arora &Domkundwar, Dhanpatrai Rai Publishers
2. Refrigeration and Air Conditioning - CP Arora, Tata McGraw Hill

Reference books:

1. Refrigeration and Air Conditioning - Manohar Prasad, New Age
2. Principles of Refrigeration - Dossat, Pearson Education
3. Basic Refrigeration and Air-Conditioning- Ananthanarayanan, TMH

Course Outcomes

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

CO1 **Compute** the COP of air refrigeration systems. **{Apply level, KL3}**

CO2 **Describe** various components used in vapour-Compression refrigeration system and estimate the performance. **{Understand level, KL2}**

CO3 **Discuss** the working principles of vapour absorption, steam jet, thermoelectric and vortex tube refrigeration systems. **{Understand level, KL2}**

CO4 **Recognize** the properties of air, summarize the various Psychometric processes and acquire the knowledge of load estimation. **{Apply level, KL3}**

CO5 **Evaluate** cooling and heating loads in an air conditioning and describe the various components of air conditioning system. **{Analyze level, KL4}**

III-Year-I Semester	MATERIALS MANAGEMENT	L	T	P	C
		3	1*	0	3

PE3101X

Prerequisites: Basic Sciences and Humanities

Course Objective:

1. To understand the areas of the materials management and ABC analysis.
2. To understand the concepts of Codification and Standardization and how to purchase the raw materials.
3. To understand the concepts of inventory and selection of materials.
4. To understand the concepts of value analysis and stores management.
5. To understand the role of computers in materials management.

Syllabus

UNIT-I

Introduction: Meaning and Scope, Objectives and Significance of Materials Management, Material Management in Other Areas of Management Functions.

ABC Analysis: Meaning, Advantages, Objective, Purpose and Limitations, Simple Numerical of ABC Analysis. 10hrs

Codification and Standardization: Basis of Codification, Characteristics of Good Coding System, Types of Coding, Standardization and its Benefits.

UNIT-II

Purchasing Management: Objectives and Functions of Purchasing Department, Purchase Policy and Procedure, Negotiations, Purchase of High Capital Equipment and their Feasibilities. Supply Chain Management, Implementation of Supply Chain Principles within a Company. 11hrs

Selection of Materials:

Suppliers Selection, Vendor Rating and Vendor Rating Techniques, Vendors Development and Vendors' Relationship.

Inventory Management: Different Costs of Inventory, Optimal Order Quantity, **UNIT-III**

EOQ, Inventory Models with Purchase Discounts, Buffer Stocks, Fixed Order Period Model, Safety Stocks, Optimum Level of Safety Stock, Inventory Control, Elements of Effective Inventory Control, Advantages, Procedure for Setting up an Efficient Inventory Control System, V.E.D. Analysis, S.D.E. Classification, F.S.N. Analysis, X.Y.Z. Analysis, Logistics Management and Its Link with Inventory Control and other Areas. 11 hrs.

Value Analysis: Purchasing Research, Price Forecasting, Forward Buying, Make or Buy Decision.

UNIT-IV

Stores Management: Purpose of Store Management, Location and Layout, Cost Aspects and Productivity, Problems and Developments, New Developments in Storing. 9 hrs.

Evaluation of Materials Management: Organization, Difficulties, Process and Criteria, Reporting and Purchasing.

UNIT-V

Computers in Material Management: Electronic Computer, Integrated Computer System for Materials Management, Material Planning. 9 hrs.

TEXT BOOKS:

1. **Materials Management: A Supply Chain Perspective : Text And Cases by A.K. Chitale , R.C. Gupta , PHI Learning**
2. **Materials Management, Dr. A.K.SINGH, Laxmi Publiacations**

REFERENCES:

1. Materials management: An integrated systems approach, Prem wratt, Springer.
2. **Introduction to Materials Management | Eighth Edition | By Pearson Paperback – 29 September 2017**

Course Outcomes

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

CO1 Understand the areas of the materials management and ABC analysis.

CO2 Understand the concepts of Codification and Standardization and how to purchase the raw materials

CO3 Understand the concepts of inventory and selection of materials

CO4 Understand the concepts of value analysis and stores management

CO5 Understand the role of computers in materials management.

III-Year-I Semester | **INDUSTRIAL ROBOTICS**

L	T	P	C
3	1*	0	3

PE3101X

Prerequisites: Basics of CAD/CAM, Transformation techniques, Mathemathics.

Course Objectives:

1. To understand the concepts of automation
2. To understand the concepts of robot kinematics, Dynamics, Trajectory planning.
3. Mathematical approach to explain how the robotic arm motion can be described.
4. To understand the functioning of sensors and actuators and their applications
5. To understand the applications of robotics in manufacturing

Syllabus

UNIT-I

INTRODUCTION: Automation and Robotics, types of automation, assembly automation equipment, material handling systems, feed systems, Automated Guided Vehicles, Automated storage and retrieval systems, Flexible Manufacturing Systems, Computer Aided Process Planning Systems, Computer Aided manufacturing. CAD/CAM and Robotics – An over view of Robotics – present and future applications – classification by coordinate system and control system.

COMPONENTS OF THE INDUSTRIAL ROBOTICS: Function line diagram representation of robot arms, common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, determination of the end effectors, comparison of Electric, Hydraulic and

Pneumatic types of locomotion devices.

UNIT-II

MOTION ANALYSIS: Homogeneous transformations as applicable to rotation and translation – problems. **(5hrs)**

MANIPULATOR KINEMATICS: Specifications of matrices, D-H notation joint coordinates and world coordinates Forward and inverse kinematics – problems.

UNIT-III

Differential transformation and manipulators, Jacobians – problems

Dynamics: Lagrange – Euler and Newton – Euler formulations – Problems.

General considerations in path description and generation.

UNIT-IV

Trajectory planning and avoidance of obstacles, path planning, Skew motion, joint integrated motion –straight line motion – Robot programming, languages and software packages-description of paths with a robot programming language.

UNIT-V

ROBOT ACTUATORS AND FEED BACK COMPONENTS:

Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors. Feedback components: position sensors – potentiometers, resolvers, encoders – Velocity sensors.

ROBOT APPLICATIONS IN MANUFACTURING: Material Transfer - Material handling, loading and unloading- Processing - spot and continuous arc welding & spray painting - Assembly and Inspection.

Learning Resources

Text books:

1. Industrial Robotics / Groover M P /Pearson Edu.

2. Robotics and Control / Mittal R K &Nagrath I J / TMH.

Reference books:

1. Robotics / Fu K S/ McGraw Hill.

2. Robotic Engineering / Richard D. Klafter, Prentice Hall

3. Robot Analysis and Control / H. Asada and J.J.E. Slotine / BSP Books Pvt.Ltd.

4. Introduction to Robotics / John J Craig / Pearson Edu.

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

CO1: To **Explain** various robot configuration and components **{Understand level, KL2}**

CO2:	**Select** appropriate actuators and sensors for a robot based on specific application **{Understand level, KL2}**
CO3:	**Carry out** kinematic and dynamic analysis for simple serial kinematic chains **{Apply level, KL3}**
CO4:	**Perform** trajectory planning for a manipulator by avoiding obstacles **{Apply level, KL3}**
CO5:	**Use** knowledge of robotics for automation in manufacturing applications **{Understand level, KL2}**

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

PE3101X

Pre-requisites:

1. Engineering Mathematics
2. Mechanics of Solids

Course Objectives: The Students will acquire the knowledge

1. Determine stress, strain and deformations for statically in-determinate members.
2. Determine and analyse stresses and strains for pressure vessels & rotating discs.
3. Understand the concept to determine stresses in curved beams.
4. Evaluate shear centre for symmetric sections.
5. Determine the contact stresses for spheres and cylinders.

Contents

UNIT-I

STATICALLY INDETERMINATE BARS:

Analysis of bars of composite sections, Temperature stresses in composite sections.

STATICALLY INDETERMINATE BEAMS:

Types of beams, fixed beams, Analysis by the differential equations of the Deflection curve, Macaulay's Method, Moment Area Method.

UNIT-II

CONTINUOUS BEAMS: Clapeyron's theorem of three moments, Beams with overhang and fixed ends, Beams with constant and varying moments of inertia.

ENERGY METHODS: Strain energy, Castigliano's theorem, statically indeterminate beams, Applications of Castigliano's theorem.

UNIT-III

THICK CYLINDRICAL AND SPHERICAL PRESSURE VESSELS: Stresses in a thick cylindrical shell, Stresses in compound thick cylinders, Initial difference in radii at the junction of the compound cylinder for Shrinkage, Stresses in thick spherical shells.

CENTRIFUGAL STRESSES:

Introduction, Rotating Ring, Rotating Disc, Rotating Disc of uniform strength.

UNIT-IV

CURVED BEAMS:

Stresses in Beams of small and large initial curvature, The Winkler-Bach theory, Stresses in Crane Hook with trapezoidal cross-section.

SHEAR CENTER:

Shear centre, determination of shear centre for channel section, determination of shear centre for I – section.

UNIT-V

CONTACT STRESSES:

Hertz contact stresses: Determination of maximum contact pressure and stresses when two spheres are in contact, two cylinders are in contact, cylinder in contact with flat surface and sphere in contact with flat surface.

Stress concentration: Introduction, factors affecting stress concentration, theoretical stress concentration factor, determination of stress concentration or stress intensity factors, critical stress intensity factor or fracture toughness for plates subjected to in plane axial and transverse loads.

Text Books:

1. Egor P. Popov, “Mechanics of Materials” Second edition, Pearson Publisher, 2015
2. Dr. Sadhu Singh,”Strength of Materials”, Ninth edition, Khanna Publishers, 2007.

Reference books:

1. R.K. Rajput,“Strength of Materials”,First Edition, S.Chand& Company, 2006.
2. S.S.Rattan, “Strength of Materials”, Second Edition,Tata McGraw Hill Education Private Limited, 2012.

3. Surendra Singh,"Strength of Materials", First Edition, S.K.Kataria& Sons.

Course Outcomes

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

CO1 Solve the stress, strain and deformations for statically in-determinate members **(Apply level, KL-3)**

CO2 Determine the stresses and strains for pressure vessels & rotating discs **(Apply level, KL-3)**

CO3 Execute the concept to determine stresses in curved beams **(Apply level, KL-3)**

CO4 Determine shear centre for symmetric sections **(Apply level, KL-3)**

CO5 Understand the concepts of the contact stresses of spheres and cylinders and also the concept of stress concentration **(Understand level, KL-2)**

III-Year-I Semester	CLOUD COMPUTING	L	T	P	C
		3	1*	0	3

OE3101X

Pre-Requisites Nil

Students will be able to learn about cloud environment.

1. Students will be able to learn about the key dimensions of the challenges of cloud computing.
2. Student encounters with building software systems and components which scale millions of users in modern internet.
3. students will be able to deal with various cloud service models such as Iaas, Paas, Saas
4. Students will be able to learn about the storage and management of resources concepts in the cloud.
5. Students will learn about the components that scale to millions of users in modern internet, cloud concepts capabilities across the various cloud service models including Iaas, Paas, Saas, and developing cloud-based software applications on top of cloud platforms.

Contents

UNIT-I

Computing Paradigms: High-Performance Computing, Parallel Computing, Distributed Computing, Cluster Computing, Grid Computing, Cloud Computing, Bio computing, Mobile Computing, Quantum Computing, Optical Computing, Nano computing.

Cloud Computing Fundamentals: Motivation for Cloud Computing, The Need for Cloud Computing, Defining Cloud Computing, Definition of Cloud computing, Cloud Computing Is a Service, Cloud Computing Is a Platform, Principles of Cloud computing, Five Essential Characteristics, Four Cloud Deployment Models.

UNIT-II

Virtual Machines and Virtualization of Clusters and Data Centres Implementation Levels of Virtualization, Virtualization Structures/ Tools and mechanisms, Virtualization of CPU, Memory and I/O Devices, Virtual Clusters and Resource Management, Virtualization for Data Centre Automation.

UNIT-III

Cloud Platform Architecture Cloud Computing and service Models, Architectural Design of Compute and Storage Clouds, Public Cloud Platforms, Inter Cloud Resource Management, Cloud Security and Trust Management. Service Oriented Architecture, Message Oriented Middleware.

UNIT-IV

Cloud Resource Management and Scheduling Policies and Mechanisms for Resource Management Applications of Control Theory to Task Scheduling on a Cloud, Stability of a Two -Level Resource Allocation Architecture, Feedback Control Based on Dynamic Thresholds. Coordination of Specialized Autonomic Performance Managers, Resource Bundling, Scheduling Algorithms for Computing Clouds, Fair Queuing, Start Time Fair Queuing, Borrowed Virtual Time, Cloud Scheduling Subject to Deadlines, Scheduling MapReduce Applications Subject to Deadlines.

UNIT-V

Cloud Programming and Software Environments Features of Cloud and Grid Platforms, Parallel & Distributed Programming Paradigms, Programming Support of Google App Engine, Programming on Amazon AWS and Microsoft Azure, Emerging Cloud Software Environments.

Storage Systems Evolution of storage technology, storage models, file systems and database, distributed file systems, general parallel file systems. Google file system. Apache Hadoop, Big Table, Megastore, Amazon Simple Storage Service (S3)

Text books:

1. Essentials of cloud Computing: K. Chandrasekhran, CRC press, 2014
2. Distributed and Cloud Computing, Kai Hwang, Geoffry C. Fox, Jack J. Dongarra MK Elsevier.
3. Cloud Computing, Theory and Practice, Dan C Marinescu, MK Elsevier.
4. Cloud Computing, A Hands-on approach, ArshadeepBahga, Vijay Madisetti, University Press

Reference books:

1. Cloud Computing, A Practical Approach, Anthony T Velte, Toby J Velte, Robert Elsenpeter, TMH
2. Mastering Cloud Computing, Foundations and Application Programming, Raj Kumar Buyya, Christen vecctiola, S Tammaraiselvi, TMH

III-Year-I Semester	MICRO ELECTRO MECHANICAL SYSTEMS (MEMS)	L	T	P	C
OE3101X		3	1*	0	3

Pre-Requisites Nil

Course objectives: After successfully completing this course, student able to

1. To understand the standard micro fabrication techniques and working principles of mechanical sensors and actuators
2. To understand the fundamental principles of thermal sensors and actuators
3. To learn the fundamental principles of magnetic sensors and actuators and optic applications in MEMS
4. To understand Applications of RF MEMS and micro fluid actuation methods
5. To teach applications MEMS in chemical and biological systems

Contents

UNIT-I

INTRODUCTION Definition of Mems, mems history and development, micro machining, lithography principles &methods .structural and sacrificial materials. Thin film deposition, impurity doping, etching, surface micro machining .wafer bonding .LIGA

MECHANICAL SENSORS AND ACTUATORS: Principles of sensing and actuation: beam and cantilever, capacitative ,piezo electric ,strain, pressure flow, pressure measurement by micro phone ,MEMS gyroscopes ,shear mode piezo actuator ,gripping piezo actuator ,inchworm technology

UNIT-II

THERMAL SENSORS AND ACTUATORS: Thermal energy basics and heat transfer processes ,thermisters, thermo devices, thermo couple, micro machined thermo couple probe ,peltier effect heat pumps, thermal flow sensors, micro hot plate gas sensors. mems thermo vessels, pyro electricity, shape memory alloys (SMA),U-shaped horizontal and vertical electro thermal actuator ,thermally activated mems relay micro spring thermal actuator data storage cantilever .

UNIT-III

MAGNETIC SENSORS AND ACTUATORS: Magnetic materials for mems and properties ,magnetic sensing and detection ,magneto resistive sensor , more on hall effect ,magneto diodes ,magneto transistor ,mems magnetic sensor ,pressure sensor utilizing moke mag mems actuators by directional micro actuator feedback circuit integrated magnetic actuator ,large force reluctance actuator ,magnetic probe based storage device .

MICRO-OPTO –ELECTRO MECHANICAL SYSTEMS:MOEMS technology ,properties of light ,light modulators ,beam splitter ,micro lens ,micro mirrors, digital micro mirror device(DMD),light detectors ,grating light valve (GLV),optical switch .wave guide and tuning shear stress measurement

UNIT-IV

RADIO FREQUENCY (RF) MEMS: RF-based communication systems. RF MEMS, Mems inductors, varactors, tuner/filter resonator clarification of tuner, filter resonator, mems switches, phase shifter.

MICROFLUIDIC SYSTEMS: Applications considerations on micro scale fluid, fluid actuation methods, dielectrophoresis (DEP), electro wetting, electro thermal flow, thermo capillary effect electro osmosis flow, opto electro wetting (OEW),tuning using micro fluidics ,typical micro fluidic channel ,micro fluid dispenser, micro needle, molecular gate ,micro pumps

UNIT-V

CHEMICAL AND BIO MEDICAL MICRO SYSTEMS: Sensing mechanism &principle membrane transducer materials ,chem. Lab on chip (CLOC), chemo resisters ,chemo capacitors ,chemo transistors, electronic nose(E nose),mass sensitive chemo sensors, fluroscence detection ,calorimetric spectroscopy

Text books:

1. MEMS, NitaigourPremchandMahalik,TMH Publishing co.

Reference books:

1. Foundation of MEMS .Chang Liu .Prentice Hall Ltd.

2. Introductory MEMS, Thomas M Adams, Richard A Layton, Springer International Publishers.

3. MEMS design and fabrication by Mohamed gad -el -hak CRC

4. MEMS and NEMS, Sergey EdwrdLyshevski, CRC Press, Indian Edition.

5. Mems and Micro systems: Design and manufacture .Tai-ran Hsu.TMH Publishers

6. BIO-Mems (Micro Systems) Gerald Urban, Springer.

Course Outcomes

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

CO1 To **understand** the applications of micro-fabrication processes in MEMS and working principles of Mechanical sensors and actuators **(KL-2)**

CO2 To **Explain** the various working principles of Thermal sensors and actuators in MEMS. **(KL-2)**

CO3 To **Learn** working principles of Magnetic sensors, actuators and various principles Light and its applications in MEMS. **(KL-2)**

CO4 To **Learn** and apply the principles of RF and to understand multi domain problems of MEMS in micro-fluidic systems **(KL-2)**

CO5 An **ability** to learn knowledge of MEMS in Chemical and Bio Medical Micro Systems **(KL-2)**

III-Year-I Semester	OPTIMIZATION METHODS	L	T	P	C
OE3101X		3	1*	0	3

Prerequisites: Basics of mathematics and management

Course Objectives:

1. To understand the overview of optimization methods, concepts of design space, constraint surfaces and objective function.
2. To formulate real-life problems with Linear Programming models using graphical and simplex methods.
3. To formulate real-life transportation, assignment and travelling salesman problems to find the optimum solution using transportation algorithms and to find out probability of expected completion time using PERT-CPM networks.
4. To apply dynamic programming and integer programming to optimize multi stage decision problems.
5. To determine the level of game theory and simulation modelling that a business must maintain to ensure smooth operation.

Syllabus

UNIT-I

Introduction to Classical Optimization Techniques Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems.

Classical Optimization Techniques Single variable Optimization, Multi variable Optimization with and without constraints, Multivariable Optimization with equality constraints - solution by method of Lagrange multipliers, Multivariable Optimization with inequality constraints - Kuhn – Tucker conditions.

UNIT-II

Linear Programming Various definitions, statements of basic theorems and properties, Advantages, Limitations and Application areas of Linear Programming, Graphical method of Linear Programming problem.6 hrs

Simplex Method Phase I of the Simplex Method, Primal and Dual Simplex Method, Big –M method.

UNIT-III

Transportation Problem Finding initial basic feasible solution by north – west corner rule, least cost method and Vogel's approximation method – testing for optimality of balanced transportation problems. 5 hrs

Network Analysis Introduction, Project scheduling by CPM and PERT, Network diagram representations, Rules to construct Network diagrams, Time estimates in network analysis-EST, EFT, LST, LFT, float/slack and critical path, Time estimates and Probability considerations in PERT, Crashing in PERT

UNIT-IV

Dynamic Programming Dynamic programming multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution - examples illustrating the tabular method of solution.

Integer Programming Pure and mixed integer programming problems, Solution of Integer programming problems – Gomory's all integer cutting plane method and mixed integer method, branch and bound method, Zero-one programming.

UNIT-V

Game theory: Theory Of Games: Introduction – Terminology, Solution of games with saddle points and without saddle points, 2×2 games, dominance principle, m X 2 & 2 X n games, Graphical method.

Simulation Modelling Introduction, Definition and types, Limitations, Various phases of modelling, Monte Carlo method, Applications, advantages and limitations of simulation

TEXT BOOKS:

1. Engineering optimization: Theory and practice"-by S.S.Rao, New Age International (P) Limited.
2. Operations Research: An Introduction" by H A Taha, 5th Edition, Macmillan, New York.
3. Operations Research by P K GUPTA AND D S HIRA BY SCHAND PUBLICATIONS, 7E

REFERENCE BOOKS:

1. Optimization Methods in Operations Research and systems Analysis" – by K.V. Mittal and C. Mohan, New Age, International (P) Limited, Publishers
2. Operations Research – by S.D.Sharma, KedarnathRamanath& Co
3. Linear programming, G. Hadley, Narosa Publishing House, New Delhi.
4. Industrial Engineering and Production Management, M. Mahajan, DhanpatRai& co

Course Outcomes

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

CO1 To understand the overview of optimization techniques, concepts of design space, constraint surfaces and objective function.(Understand level,KL2)

CO2 To formulate real-life problems with Linear Programming models using graphical and simplex methods(.Understand level,KL2)

CO3 To formulate real-life transportation, assignment and travelling salesman problems to find the optimum solution using transportation algorithms and to find out probability of expected completion time using PERT-CPM networks.(Understand level KL2)

CO4 To apply dynamic programming and integer programming to optimize multi stage decision problems(Understandlevel KL2

CO5 To determine the level of game theory and simulation modelling that a business must maintain to ensure smooth operation.(Understand level KL2)

III-Year-I Semester | **NANO MATERIALS**

L	T	P	C
3	1*	0	3

OE3101X

Prerequisites: Material Science, Basic Manufacturing Processes.

Course Objectives:

1. To understanding the Nanoscience and Applications
2. Understand the synthesis of nanomaterials and their application
3. Apply knowledge to develop Nanomaterial's

Contents

UNIT – I

Nanomaterials and their production: Introduction, Classification, nanoparticles, nanofibers, nanoplates, composites, Applications, Basics of Quantum Mechanics, Harmonic oscillator, magnetic Phenomena, band structure in solids, Mossbauer and Spectroscopy, optical phenomena bonding in solids, Anisotropy.

UNIT – II

SILICON CARBIDE: Application of Silicon carbide, nano materials preparation, Sintering of SiC, Xray Diffraction data, electron microscopy sintering of nano particles

NANO PARTICLES OF ALUMINA AND ZIRCONIA: Nano materials preparation, Characterization, Wear materials and nano composites,

UNIT – III

MECHANICAL PROPERTIES: Strength of nano crystalline SiC, Preparation for strength measurements, Mechanical properties, Magnetic properties.

UNIT – IV

ELECTRICAL PROPERTIES: Switching glasses with nanoparticles, Electronic conduction with nano particles**.**

OPTICAL PROPERTIES: Optical properties, special properties and the coloured glasses

UNIT – V

INVESTIGAING AND MANIPULATING MATERIALS IN THE NANOSCALE: Electron microscopics, scanning probe microscopics, optical microscopics for nano science and technology, X-ray diffraction.

Text books:

1. Nano Materials- A.K.Bandyopadhyay/ New Age Publishers.
2. Nano Essentials- T.Pradeep/TMH
3. Nanoscience and Nanotechnology,By P. I. Varghese, T. Pradeep, Tata McGraw Hill Education, ISBN:9781259007323, 1259007324,2003

Reference books:

1. Nanosciene and Nanotechnology, by Murthy, Raj, Shankar Rath, Murd, 1st edition - 2012, ISBN-13978- 8173717383, Orient Blackswan Private Limited - New Delhi,2012.
2. Introduction to Nanoscience and Nanotechnology by Chattopadhyay, Chattopadhyay K. K., A. N. Banerjee, ISBN:9788120336087, 8120336089, PHI Learning,2009.
3. Springer Handbook of Nanotechnology by Bharat Bhushan 2004.

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

CO1: Understand the nanomaterials and their applications **{Understand level, KL2}**

CO2: Demonstrate the Characterizationof nano materials **{Understand level, KL2}**

CO3: Outline the mechanical properties of nanomaterials **{Understand level, KL2}**

CO4: Understand the Electro optic properties of nanomaterials. **{Understand level, KL2}**

CO5: Understand the manipulating of materials in the nanoscale **{Understand level, KL2}**

III-Year-I Semester | **THEORY OF MACHINES LAB**

L	T	P	C
0	0	3	1.5

PC3103L

Course Objectives: The Students will acquire the knowledge

To analyze gyroscope, frequency of free and forced vibration and study static and dynamic balancing and also whirling of shafts.

List of experiments:

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

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

CO1: Analyse the motion of a motorized gyroscope when the couple is applied along its spin axis **(Analyse level, KL-3)**

CO2: Test the frequency of undamped and damped free vibration of an equivalent spring mass system **(Analyse level, KL-4)**

CO3: Compute the position of sleeve against controlling force and speed of a Hartnell governor and to plot the characteristic curve of radius of rotation **(Apply level, KL-3)**

CO4: Analyse the static and dynamic balancing using rigid blocks, moment of inertia of a flywheel and whirling speed of shaft (**Analyse KL-4)**

III-Year-I Semester | **MACHINE TOOLS LAB** | **PC3102L**

L	T	P	C
0	0	3	1.5

Pre-Requisites: Production Technology Lab, Metallurgy & Material Science Lab.

Course objectives:

1) The students are required to understand the parts of various machine tools and operate them.
2) They are required to understand the different shapes of products that can be produced on these machine tools.

ALL THE EXPERIMENTS ARE MANDATORY:

1. Introduction of general purpose machines -lathe, drilling machine, milling machine, shaper, planning machine, slotting machine, cylindrical grinder, surface grinder and tool and cutter grinder.
2. Step turning and taper turning on lathe machine
3. Thread cutting and knurling on lathe machine.
4. Drilling and tapping
5. Shaping and planning
6. Slotting
7. Milling
8. Cylindrical surface grinding
9. Grinding of tool angles.
10. Measurement of Cutting Temperature during machining using Infrared Thermometer **(Additional Experiment)**

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

CO1: Understand different Machine tools by their terminology and working principle.
(Understand Level, KL-2)

CO2: Develop different part features to the desired quality **(Develop Level, KL-6)**

Reference books: Lab Manual

III-Year-I Semester	SKILL COURSE 3- SOFT SKILLS	L	T	P	C
SAC3101		0	0	3	1.5

Prerequisite: None

Objectives:

1. By the end of the program students will be able to:
2. communicate clearly, confidently, concisely, and persuasively both written as well as orally.
3. rediscover and boost self-confidence, to the zenith, and solve issues with ease.
4. recognize the results (change) of their behavior / conduct and teach them to take ownership of their acts rather than blaming others.
5. build confidence in their speaking / presentation skills and become industry-ready.
6. develop a stronger sense of consciousness and appreciation for others by analyzing prospects, and creating choices.
7. manage self-competence and self-confidence.

Preamble: Soft skills are character traits and interpersonal skills that portray a person's relationships with other people. In the workplace, soft skills are considered to be a balance to hard skills, which refer to a person's knowledge and professional skills.

Soft Skills amount to talents for adaptive and optimistic behavior that alter humans to deal effectively with the stress and challenges of life. This notion is additionally termed as psychosocial proficiency. The subject varies greatly reckoning on social norms and community expectations however skills that operate for well-being and aid people to change into active and productive members of their communities' square measure thought-about as Soft Skills.

They exemplify innovativeness, significant thinking, problem-solving, decision-making, the supremacy to speak-up and team-up, in aggregation with personal and social responsibility that

contribute to sensible citizenship – all essential skills for achievement within the twenty first century, each for healthy societies and for employable people.

The course of soft skills is introduced to boost the standard of learning and living by complementing scholastic records with skill-based coaching. Realizing that the dual purpose of education i.e. is to foster educational excellence among students and additionally guide them to transform themselves into responsible people and professionals.

Soft Skills are a unit, a crucial facet of having the ability to fulfill the strain of daily & professional lives in a very unendingly dynamical world. The big changes in international economies over the last 5 years have coincided with technological transformations, all of that area unit leaving an impression on education, the geographic point, and our personal lives. Students need dynamically guided soft skills and hands on exposure, like the power to face / tackle stress and frustration, to address the growing pace and alter recent life. Over the course of their careers, today's engineering aspirants can have various new professions, each one with its own set of constraints and necessities, with flexibility & adaptability in demand of learn ability.

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

CO1: master advanced nuances of both written and oral communication skills that are imperative for any professional to succeed coupled with being emphatic.

CO2: confidently ace different competitive exams and develop writing skills.

CO3: gain awareness of the industry expectations and craft CV / Résumé in lieu with desired job profiles.

CO4: crack behavioral (HR) interview confidently and exhibit professional persona.

CO5: make presentations effective and develop interview strategies while get rid of interview phobia.

III-Year-I Semester	ENVIRONMENTAL SCIENCE	L	T	P	C
MC3101		2	0	0	0

Prerequisites: Nil

Course Objective:

OBJECTIVE:

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

UNIT – I

MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES

Definition, Scope and Importance – Need for Public Awareness.

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

LEARNINGOUTCOMES

Students will be able to

1. articulate the basic structure, functions, and processes of key social systems affecting the environment.
2. explain how water resources should be used.
3. articulate basic understanding of effects of modern agriculture on environment.

4. explain how various paradigms or world views and their implicit and explicit assumptions and values shape the viewer's perception of environmental problems and solutions.

UNIT – II

Ecosystems, Biodiversity, and its Conservation

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.

LEARNING OUTCOMES

Students will be able to

1. get a clear picture of structure and functions of ecosystems.
2. explain why renewable and non-renewable energy resources are important.
3. get awareness about land degradation, soil erosion & desertification.
4. gain a rigorous foundation in various scientific disciplines as they apply to environmental science, such as ecology, evolutionary biology, hydrology, and human behavior.

UNIT – III:

Environmental Pollution and Solid Waste Management

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.

LEARNING OUTCOMES UNIT-3

Students will be able to

1. demonstrate knowledge and understanding of theories in the field of Biodiversity and Systematics in the broad sense.
2. conduct basic conservation biology research.
3. explain endangered and endemic species of India.
4. identify the threats to biodiversity.

UNIT – IV

Social Issues and the Environment

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.

LEARNING OUTCOMES:

Students will be able to

1. understand Cause, effects and control measures of air pollution.
2. understand soil, noise & water pollution.
3. explain the enforcement of Environmental legislation
4. understand solid waste management.

UNIT – V

Human Population and the Environment

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..

LEARNING OUTCOMES

Students will have

1. knowledge about watershed management and environmental ethics.
2. explain the reasons for global warming
3. explain principles and impact of disasters on environment.
4. explain disaster management cycle in India.

TEXT BOOKS :

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

REFERENCES :

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 byJ.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
6. Introduction to Environmental engineering and science by Gilbert M. Masters and Wendell P. Ela - Prentice hall of India Private limited.

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

COURSE OUTCOMES

CO1	Able to Understand The concepts of the ecosystem
CO2	Able to Understand 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 Understand Social issues both rural and urban environment

Rubric: Internship Evaluation

Rubric: Internship Evaluation				
Maximum Marks: 25				
S. No.	**Parameters & Marks**	**Below Average (upto 33%)**	**Good (34% -66%)**	**Excellent(67% and more)**
1	Selection of Industry (3)	Irrelevant industry with no scope in future study/job/business/work, limited societal/ environmental/ ethical relevance of the internship	Relevant industry with limited scope in future study/job/business/work, limited societal/ environmental/ ethical relevance of the internship - moderate.	Relevant industry with limited scope in future study/job/business/work, limited societal/ environmental/ ethical relevance of the internship - good.
2	Regularity (6)	Maintaining Attendance 75%-80%	Maintaining Attendance 80% - 85%	Maintaining Attendance 85% and more
3	Depth of understanding/ Knowledge gained during internship (Presentation & Oral) (9)	Average presentation and could answer only 1-2 questions out of 6-7 questions	Average presentation and could answer only 3 - 4 questions out of 6 -7 questions or nice presentation but could answer only 1-2 questions out of 6-7 questions	Nice presentation and could answer only 4-6 questions out of 6-7 questions

4	Internship Report (7)	Internship report not prepared according to the specified format, more language errors, incomplete/ improper explanation of the key concepts and/ or the knowledge gained during internship, poor figures.	Internship report prepared according to the specified format, less language errors, average explanation of the key concepts and/ or the knowledge gained during internship, average figures.	Internship report not prepared according to the specified format, minimum language errors, good explanation of the key concepts and/ or the knowledge gained during internship, better figures.

III-Year-II Semester	UNIVERSAL HUMAN VALUES-2	L	T	P	C
HSM3201		3	1*	0	3

Prerequisites: None. Universal Human Values 1 (desirable)

COURSE OBJECTIVES:

1. To evaluate the significance of value inputs in formal education and start applying them in their life and profession.

2. To distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.

3. To analyze the value of harmonious relationship based on trust and respect in their life and profession.

4. To examine the role of a human being in ensuring harmony in society and nature.

5. To apply the understanding of ethical conduct to formulate the strategy for ethical life and profession.

SYLLABUS:

Universal Human Values – Understanding Harmony and Ethical Human Conduct

UNIT I

Introduction-Basic Human Aspiration, its fulfillment through Allen compassing Resolution

The basic human aspirations and their fulfillment through Right understanding and Resolution, Right understanding and Resolution as the activities of the Self, Self being central to Human Existence; All-encompassing Resolution for a Human Being, its details and solution of problems in the light of Resolution.

UNIT II

Right Understanding (Knowing)- Knower, Known & the Process

The domain of right understanding starting from understanding the human being (the knower, the experiencer and the doer) and extending up to understanding nature/existence – its interconnectedness and co-existence; and finally understanding the role of human being in existence (human conduct).

UNIT III

Understanding Human Being

Understanding the human being comprehensively as the first step and the core theme of this course; human being as co-existence of the self and the body; the activities and potentialities of the self; Basis for harmony/contradiction in the self.

UNIT IV

Understanding Nature and Existence

A comprehensive understanding (knowledge) about the existence, Nature being included; the need and process of inner evolution (through self-exploration, self-awareness and self-evaluation), particularly awakening to activities of the Self: Realization, Understanding and Contemplation in the Self (Realization of Co-Existence, Understanding of Harmony in Nature and Contemplation of Participation of Human in this harmony/ order leading to comprehensive knowledge about the existence).

UNIT V

Understanding Human Conduct, All-encompassing Resolution & Holistic Way of Living

Understanding Human Conduct, different aspects of All-encompassing Resolution (understanding, wisdom, science etc.), Holistic way of living for Human Being with Allen compassing Resolution covering all four dimensions of human endeavor viz., realization, thought, behavior and work (participation in the larger order) leading to harmony at all levels from Self to Nature and entire Existence.

TEXT BOOK:

1. R R Gaur, R Asthana, G P Bagaria, 2019 (2nd Revised Edition), A Foundation Course in Human Values and Professional Ethics. ISBN 978-93-87034-47-1, Excel Books, New Delhi

REFERENCES:

1. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA
2. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
3. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
4. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
5. A Nagraj, 1998, Jeevan Vidya EkParichay, Divya Path Sansthan, Amarkantak.

COURSE OUTCOMES:

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

1. Evaluate the significance of value inputs in formal education and start applying them in their life and profession

2. Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.

3. Analyze the value of harmonious relationship based on trust and respect in their life and profession

4. Examine the role of a human being in ensuring harmony in society and nature.

5. Apply the understanding of ethical conduct to formulate the strategy for ethical life and profession

III-Year-II Semester | **HEAT TRANSFER**

L	T	P	C
3	1*	0	3

PC3201

PRE-REQUISITES: Thermodynamics.

Course objectives:

1. To develop the fundamental principles and laws of heat transfer and to explore the implications of these principles for system behaviour.
2. To formulate the models necessary to study, analyze and design heat transfer systems through the application of these principles.
3. To develop the problem-solving skills essential to good engineering practice of heat transfer in real-world applications

Syllabus

UNIT- I

Basics of Heat Transfer: Thermodynamics and Heat Transfer, Application areas of heat Transfer, Engineering Heat Transfer, Modes and mechanisms of heat transfer, Basic laws governing heat transfer.

Heat Conduction –Basic Equation: Fourier's law of heat conduction, Thermal conductivity of materials, General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates, steady, unsteady and periodic heat transfer, initial and boundary conditions.

One- Dimensional, Steady State, Conduction Heat Transfer: Homogeneous slabs, hollow cylinders and spheres with constant and variable thermal conductivity, Composite systems, Electrical analogy, Thermal Resistance, Overall heat transfer coefficient, Critical radius of insulation for cylinder and sphere, heat conduction with internal heat generation.

UNIT- II

Heat Transfer from Extended surface (fins): Analysis of long fin, fin with insulated tip and short fin, fin efficiency and effectiveness, Application to error measurement of temperature in a thermometer well.

Transient Heat Conduction: Systems with negligible internal resistance, Lumped heat analysis, Significance of Biot and Fourier Numbers, Systems with finite surface and internal resistance using Heisler Chart.

UNIT- III

Dimensional Analysis: Introduction, Buckingham Pi Theorem applied to Forced and Natural convection Significance of Non-Dimensional numbers.

Forced Convection: Introduction, Applications, convective heat transfer coefficient, External Flow-Laminar and Turbulent Flow over a Flat plate –Internal Flow through Circular pipe, Laminar and Turbulent Flows-Entry length and fully developed flow, Reynolds Colburn analogy.

Natural Convection: Introduction, Applications, Development of Hydrodynamic and Thermal boundary layer along Vertical plate- Empirical correlations for Vertical plate, Vertical Cylinder, Horizontal Plate and Horizontal Cylinder-Natural convection cooling in electronic equipment, Heat pipe.

UNIT- IV

Boiling and Condensation: Applications of Boiling Heat transfer phenomena, Pool Boiling, Boiling regimes, Calculations on Nucleate boiling, Critical Heat Flux, Condensation-Film wise and drop wise condensation, laminar film wise condensation on vertical plate horizontal cylinders using empirical correlate.

Heat Exchangers: Introduction, Classification of heat exchangers, Overall heat transfer coefficient, Fouling factor, LMTD method of Heat exchanger analysis, Correction for LMTD for use with Multi pass and Cross flow Heat Exchangers, Effectiveness - NTU method of Heat Exchanger Analysis-Applications of Heat Exchangers.

UNIT- V

Thermal Radiation: Introduction, Applications of Thermal Radiation, Nature of Thermal Radiation, Emissive Power, Absorption, Reflection and Transmission, Concept of Black body, Laws of Black Body Radiation, Radiation from Non-black Surfaces, Emissivity, Kirchhoff ‘s law , Radiation heat exchange between two black isothermal surfaces, shape factor, Heat exchange between non-black (Gray) bodies-small gray bodies-large parallel planes-large cylinders or spheres-a small gray body in a large gray enclosure, Radiation shields.

Content Beyond Syllabus: ***Natural convection cooling in electronic equipment, Heat pipe.***

Data Hand Book:

1. C.P. Kothandaraman and Subramanian Heat and Mass Transfer Data Book, New Age International Publications, 7th Edition, Reprint 2012

NOTE: Heat and Mass Transfer Data Hand Book by C.P. Kothandaraman and Subramanian- New Age Publications is to be allowed in Examination.

Learning Resources

Text books:

1. R.C.Sachdeva - Fundamentals of Engineering Heat and Mass Transfer —New Age Science Publishers, 3nd Edition, 2009.

2. Yunus. A. Cengel, Heat & Mass Transfer-A Practical Approach – Tata McGraw Hill, 4th Edition, 2012

Reference books

1. M.NecatiOzisik, Heat Transfer- A basic Approach,4th Edition, McGraw-Hill book company, 1985.

2. J.P.Holman, Heat transfer - Tata McGraw-Hill, 9th Edition, 2010.

3. P.K.Nag, Heat and Mass Transfer- TMH 2nd Edition, 2007.

4. P.S.Ghoshdastidar Heat Transfer - Oxford Higher Education 6th Edition 2011.

5. C.P.Kothandaraman and Subramanian, Heat and Mass Transfer, New Age International Publication's 7th Edition 2010.

Course Outcomes

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

CO1 Understand the basic heat transfer principles and their practical relevance in Planes, Cylinders and Spherical components. **{Understand level, KL2}**

CO2 Analyze steady and unsteady state heat transfer concepts and fins. **{Analyze level, KL4}**

CO3 Formulate the expressions to solve free and forced convection problems related to external and internal flows. **{Apply level, KL3}**

CO4 Apply the concepts of heat transfer in boiling, condensation and Design the heat exchanger for engineering applications. **{Apply level, KL3}**

CO5 Apply the concept of heat transfer in radiation thermal systems. **{Apply level, KL3}**

III-Year-II Semester | **METROLOGY AND INSTRUMENTATION**

L	T	P	C
3	1*	0	3

PC3202

Prerequisites: Introduction to engineering material science.

Course Objectives:

1. The methods of measurement of displacement, speed, acceleration, vibration, stress and strain, force, torque and power.
2. Inspection of engineering parts with various precision instruments
3. Design of part, tolerances and fits Principles of measuring instruments and gauges and their uses
4. Evaluation and inspection of surface roughness
5. Inspection of spur gear elements

Syllabus

UNIT- I

LIMITS AND FITS, Tolerance: Limits-Types of Limits, Fits-Types of Fits, Deviations, Tolerances, Hole and Shaft basis systems, Interchangeability, Selective assembly.

LIMIT GAUGES: Taylor's principle – design of go and no go gauges; plug, ring, snap, taper, profile and position gauges.

UNIT- II

MEASUREMENT OF ANGLES AND TAPERS: Different methods – bevel protractor, sine bar-sine table, rollers and spheres used to measure angles and tapers- Tools maker's microscope and uses

SURFACE ROUGHNESS MEASUREMENT: Differences between surface roughness and surface waviness –Numerical assessment of surface finish-Ra, R.M.S. Rz, values, **Method of measurement of surface finish** – Profilograph, Talysurf, ISI symbols for indication of surface finish.

FLATNESS MEASUREMENT: Measurement of flatness of surfaces- instruments used- straight edges- surface plates – auto collimator, optical projector, optical flats and their uses

UNIT- III

INTRODUCTION: Basic principles of measurement – measurement systems, generalized configuration and functional descriptions of measuring instruments – examples. Dynamic performance characteristics – Types of errors.

UNIT- IV

MEASUREMENT OF DISPLACEMENT: Theory and construction of various transducers to measure displacement – piezo electric, inductive, capacitance, resistance, ionization and photo electric transducers. **(5hrs)**

MEASUREMENT OF TEMPERATURE: Classification – ranges – various principles of measurement – expansion, electrical resistance – thermistor – thermocouple – pyrometers – temperature indicators.

UNIT- V

MEASUREMENT OF PRESSURE: Units – classification –Bourdon pressure gauges, Dead weight Piston Gauge, low pressure measurement – ionization pressure gauges, McLeod pressure gauge.

FLOW MEASUREMENT: Rotameter, magnetic, ultrasonic, turbine flow meter, hot – wire anemometer, laser Doppler anemometer (LDA).

MEASUREMENT OF SPEED: Mechanical tachometers – electrical tachometers – stroboscope

Learning Resources

Text books:

1. Engineering Metrology / R.K.Jain / Khanna Publishers.
2. Measurement Systems: Applications & design / D.S Kumar
3. Mechanical and Industrial Measurements / R.K. Jain/ Khanna Publishers.
4. Engineering Metrology and Measurements / NV Raghavendra, L Krishna Murthy/ Oxford publishers.
5. Engineering Metrology / KL Narayana/Scitech publishers

Reference books:

1. Measurement systems: Application and design/Doeblin Earnest. O. Adaptation/ TMH
2. Experimental Methods for Engineers / J.P.Holman/McGraw Hill
3. Instrumentation, measurement & analysis / B.C.Nakra&K.K.Choudhary/TMH
4. Engineering Metrology / Mahajan / Dhanpat Rai Publishers
5. Engineering Metrology / I.C.Gupta / Dhanpat Rai Publishers
6. Precision Engineering in Manufacturing / R.L.Murthy / New Age

WEB SOURCE REFERENCES

1 http://nptel.ac.in/courses/112106138/

2.http://ocw.mit.edu/courses/mechanical-engineering/2-830j-control-ofmanufacturing-processes-sma-6303-spring-20

3.https://www.edx.org/course/introduction-oil-country-tubular-goodstenarisuniversity-pipe01x

4 https://www.youtube.com/watch?v=8DTt-f6wQxE

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSIONAL REQUIREMENTS:

1. Measurement of microscopic material\components

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

1. Modern measuring devices

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

CO1: Apply the concepts of basic measurements.**{ Apply level, KL3}**

CO2: Understand the measurement of Angles,tapers and surface roughness.**{ Understand level, KL2}**

CO3: Understand the measurement of flatness and basic fundamentals of instrumentation.**{ Understand level, KL2}**

CO4: Choose appropriate Instrument for measuring Displacement and Temperature. **{ Apply level, KL3}**

CO5: Interpret Pressure, flow and Speed measurement. **{ Apply level, KL3}**

III-Year-II Semester | **GREEN ENGINEERING SYSTEMS**

L	T	P	C
3	1*	0	3

OE3201X

PRE-REQUISITES: Applied Thermodynamics

Course objectives:

1. To make the student learn and understand the solar radiation and energy collection.
2. To familiarize the student with the solar energy storage applications and wind energy.
3. To learn about biomass, wind and ocean energy.
4. To make the student learn to understand electrical and mechanical systems.
5. To make students learn about energy efficient process and green buldings.

Syllabus

UNIT-I

INTRODUCTION:

SOLAR RADIATION: Role and potential of new and renewable sources, the solar energy option, Environmental impact of solar power, structure of the sun, the solar constant, sun-earth relationships, coordinate systems and coordinates of the sun, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data, numerical problems. Photo voltaic energy conversion – types of PV cells, I-V characteristics.

SOLAR ENERGY COLLECTION: Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

UNIT-II

SOLAR ENERGY STORAGE AND APPLICATIONS: Different methods, sensible, latent heat and stratified storage, solar ponds, solar applications- solar heating/cooling technique, solar distillation and drying, solar cookers, central power tower concept and solar chimney.

WIND ENERGY: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, betz criteria, types of winds, wind data measurement.

UNIT-III

BIO-MASS: Principles of bio-conversion, anaerobic/aerobic digestion, types of bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, bio fuels, I.C. engine operation and economic aspects.

GEOTHERMAL ENERGY: Resources, types of wells, methods of harnessing the energy, potential in India.

OCEAN ENERGY: OTEC, Principles of utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.

UNIT-IV

ENERGY EFFICIENT SYSTEMS:

ELECTRICAL SYSTEMS: Energy efficient motors, energy efficient lighting and control, selection of luminaire, variable voltage variable frequency drives (adjustable speed drives), controls for HVAC (heating, ventilation and air conditioning), demand site management.

MECHANICAL SYSTEMS: Fuel cells- principle, thermodynamic aspects, selection of fuels & working of various types of fuel cells, Environmental friendly and Energy efficient compressors and pumps.

UNIT-V

ENERGY EFFICIENT PROCESSES: Environmental impact of the current manufacturing practices and systems, benefits of green manufacturing systems, selection of recyclable and environment friendly materials in manufacturing, design and implementation of efficient and sustainable green production systems with examples like environmental friendly machining, vegetable based cutting fluids, alternate casting and joining techniques, zero waste manufacturing.

GREEN BUILDINGS: Definition, features and benefits. Sustainable site selection and planning of buildings for maximum comfort. Environmental friendly building materials like bamboo, timber, rammed earth, hollow blocks, lime & lime pozzolana cement, agro materials and industrial waste, Ferro cement and Ferro-concrete, alternate roofing systems, paints to reduce heat gain of the buildings. Energy management.

Learning Resources

Text books:

1. Solar Energy – Principles of Thermal Collection and Storage/Sukhatme S.P. and J.K.Nayak/ TMH
2. Non-Conventional Energy Resources/ Khan B.H/ Tata McGraw Hill, New Delhi, 2006
3. Green Manufacturing Processes and Systems, Edited / J. Paulo Davim/Springer 2013

Reference books

1. Alternative Building Materials and Technologies / K.S Jagadeesh, B.V Venkata Rama Reddy and K.S Nanjunda Rao/New age international
2. Principles of Solar Engineering / D.Yogi Goswami, Frank Krieth& John F Kreider / Taylor & Francis
3. Non-Conventional Energy / Ashok V Desai /New Age International (P) Ltd
4. Renewable Energy Technologies /Ramesh & Kumar /Narosa
5. Non-conventional Energy Source/ G.D Roy/Standard Publishers
6. Renewable Energy Resources-2nd Edition/ J.Twidell and T. Weir/ BSP Books Pvt.Ltd
7. Fuel Cell Technology –Hand Book / Gregor Hoogers / BSP Books Pvt. Ltd.

Course Outcomes

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

CO1 **Understand** about solar energy, Utilization of it, Principles involved in solar energy collection and conversion of it to electricity generation. **{Understand level, KL2}**

CO2 **Describe** the concepts involved in solar energy storage and wind energy conversion systems by studying its components, types and performance. **{Understand level, KL2}**

CO3 **Comprehend** about ocean energy and Geothermal energy, and the operational methods of their utilization. **{Understand level, KL2}**

CO4 **Recognize** the concepts involved in Mechanical systems and Electrical Systems in the energy efficient systems. **{Understand level, KL2}**

CO5 **Understand** about the Energy efficient process and Green buildings and the concepts involved in it. **{Understand level, KL2}**

III-Year-II Semester	ROBOTICS	L	T	P	C
OE3201X		3	0	0	3

Prerequisites: Basics of CAD/CAM, Transformation techniques, Mathemathics.

Course Objectives:

1. To understand the concepts of automation
2. To understand the concepts of robot kinematics, Dynamics, Trajectory planning.
3. Mathematical approach to explain how the robotic arm motion can be described.
4. To understand the functioning of sensors and actuators and their applications
5. To understand the applications of robotics in manufacturing

Syllabus

UNIT-I

INTRODUCTION:

Automation and Robotics, types of automation, assembly automation equipment, material handling systems, feed systems, Automated Guided Vehicles, Automated storage and retrieval systems, Flexible Manufacturing Systems, Computer Aided Process Planning Systems, Computer Aided manufacturing. CAD/CAM and Robotics – An over view of Robotics – present and future applications – classification by coordinate system and control system.

COMPONENTS OF THE INDUSTRIAL ROBOTICS:

Function line diagram representation of robot arms, common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, determination of the end effectors, comparison of Electric, Hydraulic andPneumatic types of locomotion devices.

UNIT-II

MOTION ANALYSIS: Homogeneous transformations as applicable to rotation and translation – problems.

MANIPULATOR KINEMATICS: Specifications of matrices, D-H notation joint coordinates and world coordinates Forward and inverse kinematics – problems.

UNIT-III

Differential transformation and manipulators, Jacobians – problemsDynamics: Lagrange – Euler and Newton – Euler formulations – Problems.

UNIT-IV

General considerations in path description and generation. Trajectory planning and avoidance of obstacles, path planning, Skew motion, joint integrated motion –straight line motion – Robot programming, languages and software packages-description of paths with a robot programming language. **(10hrs)**

UNIT-V

ROBOT ACTUATORS AND FEED BACK COMPONENTS:

Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors. Feedback components: position sensors – potentiometers, resolvers, encoders – Velocity sensors.

ROBOT APPLICATIONS IN MANUFACTURING: Material Transfer - Material handling, loading and unloading- Processing - spot and continuous arc welding & spray painting - Assembly and Inspection.

Learning Resources

Text books:

1. Industrial Robotics / Groover M P /Pearson Edu.
2. Robotics and Control / Mittal R K &Nagrath I J / TMH.

Reference books:

1. Robotics / Fu K S/ McGraw Hill.
2. Robotic Engineering / Richard D. Klafter, Prentice Hall
3. Robot Analysis and Control / H. Asada and J.J.E. Slotine / BSP Books Pvt.Ltd.
4. Introduction to Robotics / John J Craig / Pearson Edu.

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

CO1: Explain various robot configuration and components **{Understand level, KL2}**

CO2: Select appropriate actuators and sensors for a robot based on specific application **{Understand level, KL2}**

CO3: Carry out kinematic and dynamic analysis for simple serial kinematic chains **{Apply level, KL3}**

CO4: Perform trajectory planning for a manipulator by avoiding obstacles **{Apply level, KL3}**

CO5: Use knowledge of robotics for automation in manufacturing applications **{Understand level, KL2}**

III-Year-II Semester	ADDITIVE MANUFACTURING (3D PRINTING)	L	T	P	C
OE3201X		3	1*	0	3

Pre requisites: Knowledge of manufacturing processes

Course Objectives:

CO1: The student shall be able to use liquid RP techniques by identifying the suitable applications

CO2: The student shall be able to use solid RP techniques by identifying the suitable applications

CO3: The student shall be able to use powder RP techniques by identifying the suitable applications

CO4: The student shall be able to use RP techniques by identifying the suitable software and data formats

CO5: The student shall be able to use RP techniques by identifying the suitable applications in different industries

Syllabus

UNIT-I

Introduction, History, Evaluation, Process, necessity, classification, Liquid 3D Printing, classification, materials used, applications, advantages and disadvantages of liquid 3D printing

UNIT-II

Solid 3D Printing, classification, materials used, applications, advantages and disadvantages of solid 3D printing

UNIT-III

Powder 3D Printing, classification, materials used, applications, advantages and disadvantages of powder 3D printing

Metal 3D Printing/AM classification, materials used, applications, advantages and disadvantages of metal 3D printing

UNIT-IV

Software for 3D printing, different data formats like .STL, .CLI, .RPI,

.STEP etc. file conversion, G code generation, medical data conversion.

UNIT-V

Applications of 3D Printing and additive manufacturing in rapid tooling and in different industries like aerospace, medical, automotive, jewellery, sports, bio-medical, fashion, agricultural etc.

Text books:

1. Rapid Prototyping by C. K. Chua, 5th edition, World scientific
2. Additive Manufacturing Technologies by Prof. Ian Gibson, 2nd edition, Springer

References:

1. Additive Manufacturing by C.P. Paul, Mc. Grawhill

Course outcomes:

By the completion of the course the student will be able to understand the advanced manufacturing process which doesn't use any tools that are specific to

the geometry of the component being manufactured, any jigs or fixtures but only the digital data

III-Year-II Semester	HEAT TRANSFER LAB	L	T	P	C
PC3201L		0	0	3	1.5

Pre-Requisite: Heat Transfer

Objectives:

1.Define the fundamental concepts to students in the area of heat transfer and its applications.

2. Recognize the practical significance of various parameters those are involved in different modes of heat transfer.

3.Apply the knowledge of heat transfer in an effective manner for different Applications

ANY TEN EXPERIMENTS OF THE FOLLOWING:

1. Determination of overall heat transfer coefficient of a composite slab
2. Determination of heat transfer rate through a lagged pipe.
3. Determination of heat transfer rate through a concentric sphere
4. Determination of thermal conductivity of a metal rod.
5. Determination of efficiency of a pin-fin
6. Determination of heat transfer coefficient in natural and forced convection
7. Determination of effectiveness of parallel and counter flow heat exchangers.
8. Determination of emissivity of a given surface.
9. Determination of Stefan Boltzman constant.
10. Determination of heat transfer rate in drop and film wise condensation.
11. Determination of critical heat flux.
12. Determination of Thermal conductivity of liquids and gases.

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

CO1: Analyze the heat transfer through lagged pipe, insulating powder and Drop and Film wise condensation **(Analyze Level, KL-4)**

CO2: Experiment the Thermal conductivity of a given metal Rod. **(Analyze Level, KL-4)**

CO3: Compute the heat transfer coefficients in forced convection, free convection and also determine effectiveness of heat exchangers and Pin Fin. **(Apply Level)**

CO4: Test Emissivity, Stefan Boltzmann Constant and Critical Heat flux **(Analyze Level, KL-4)** Reference books: Lab Manual

III-Year-II Semester	METROLOGY AND INSTRUMENTATION LAB	L	T	P	C
PC3202L		0	0	3	1.5

Prerequisites: Engineering Material science

Course Objectives:

1. Mechanical Measurements lab introduces the students with the theory and methods for conducting experimental work in the laboratory and calibration of various instruments for measuring pressure, temperature, displacement, speed, vibration etc.
2. The Metrology Lab course is designed for measuring and gauging instruments for inspection of precision linear, geometric forms, angular and surface finish measurements. The student can learn the measurements with and calibration of instruments.

Note: The students have to conduct at least 5 experiments from each lab.

INSTRUMENTATION CONTROL SYSTEMS LAB

1. Calibration of pressure gauge.
2. Calibration of transducer for temperature measurement.
3. Study and calibration of LVDT transducer for displacement measurement.
4. Calibration of strain gauge.
5. Calibration of thermocouple.
6. Calibration of capacitive transducer.
7. Study and calibration of photo and magnetic speed pickups.
8. Calibration of resistance temperature detector.
9. Study and calibration of a rotameter.
10. Study and use of a seismic pickup for the measurement of vibration amplitude of an engine bed at various loads.
11. Study and calibration of Mcleod gauge for low pressure.

ENGINEERING METROLOGY LAB

1. Measurement of lengths, heights, diameters by vernier calipers, micrometers etc.
2. Measurement of bores by internal micrometers and dial bore indicators.

3. Use of gear tooth vernier caliper for tooth thickness inspection and flange micro meter for checking the chordal thickness of spur gear.
4. Measurement using Mechanical comparator.
5. Measurements using Optical Projector.
6. Measurement of alignment using Autocollimator.
7. Angle and taper measurements with bevel protractor, Sine bar, rollers and balls.
8. Use of spirit level in finding the straightness of a bed and flatness of a surface.
9. Thread inspection with two wire/ three wire method & tool maker's microscope.

Surface roughness measurement with roughness measuring instrument.

COURSE OUTCOMES:

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

CO 1 Understand different instruments that are available for linear, angular, roundness and roughness measurements they will be able to select and use the appropriate measuring instrument according to a specific requirement. **{Understand level, KL2}**

CO 2 Apply the different measurement tools and perform measurements in quality Inspection. **{Understand level, KL2}**

CO 3 Students will be able to acknowledge proper measuring instruments and know requirements of calibration, errors in measurement etc. They can perform accurate measurements. **{Understand level, KL2}**

CO 4 Understand devices for measurement of force and torque; strain and stress and temperature. **{Understand level, KL2}**

III-Year-II Semester | **DESIGN ANALYSIS LAB** | **PC3203L**

L	T	P	C
0	0	3	1.5

Pre-Requisites: Finite Element Methods, Any CAD software.

Course Objectives:

1. To give exposure to MATLAB tools needed to solve engineering problems.
2. To develop line and surface plots.
3. To solve the linear equations and PDE using different numerical techniques.
4. To expose the students to different applications of simulation and analysis tools.

ANY TEN EXPERIMENTS OF THE FOLLOWING:

1. To perform mathematical operations on matrices.
2. To draft bar chart, pie chart, 2-D and 3-D surface plots.
3. To determine numerical differentiation and integration.
4. To determine the solution for a system of linear algebraic equations.
5. To solve data analysis problems.
6. To solve a simple vibration problem.
7. To determine the efficiency and network of Brayton cycle.
8. To solve ordinary differential equations by exact methods.
9. To solve ordinary/partial differential equations by finite difference methods.
10. To analyze stress distribution of flat plates.
11. To perform a static structural analysis of a flat plate with a hole.
12. To determine stress and deflection of a beam with different end conditions.

13. To compute shear force and bending moments of a cantilever beam.
14. To solve a steady state heat transfer problem.
15. To perform modal analysis of beams with different end conditions.

TEXT BOOKS AND REFERENCE BOOKS

1. MATLAB programming by Y.Kirani Singh &B.B.Chaudhuri. PHI Publications (2010).
2. Getting started with MATLAB -a quick reference for scientists & engineers by Rudra Pratap. Oxford University Press (2009).
3. An introduction to programming and numerical methods in MATLAB by S.R.Otto, J.P. Denier. Springer Publications (2007)
4. Ordinary and Partial Differential Equation Routines in C, C++, FORTRAN, Java, Maple, and MATLAB by H.J. Lee, W.E. Schiesser.
5. Graphics and GUIs with MATLAB, Third Edition (Graphics & GUIs with MATLAB) 3rd Edition by O. Thomas Holland, Patrick Marchand.

E-RESOURCES AND OTHER DIGITAL MATERIAL WEB REFERENCES:

1. http://www.math.ucsd.edu/~bdriver/21d-s99/matlab-primer.html
2. http://www.mathworks.in/academia/student_center/tutorials/ launchpad.html
3. http://www.cyclismo.org/tutorial/matlab/
4. http://www.mathworks.com/matlabcentral/fileexchange?s_cid=wiki_matlab_17

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

1. **Analyze** the basic matrix operations to solve various engineering problems. **(KL-4)**
2. **Apply** finite difference methods to determine the solution of partial differential equations. **(KL-3)**

3. **Analyze** the stresses and deflections in beams with different end conditions. **(KL-4)**
4. **Analyze** the heat transfer in 2D structures (**KL-4)**
5. **Examine** the modal analysis of beams under various end conditions. **(KL-3)**
6. **Apply** computer simulations to solve engineering-related problems**.(KL-3)**

III-Year-II Semester	SKILL COURSE 4 - CNC PROGRAMMING & MACHINING	L	T	P	C
SAC3201		1	0	2	2

Prerequisites: Basic Manufacturing Processes & Machining processes.

Course Objectives:

1. Demonstrate technical competency in practice.
2. Function effectively in an industrial and academic environments.
3. Engage in professional ethics and development.
4. Enrich their society and environment through their skills

Syllabus

UNIT-I

Introduction to CNC Machining:

CNC Turning: Definition of turning, working principle of lathe, Different operations of turning-contour turning, chamfer turning, straight turning, form turning, parting off etc.

CNC Milling: Introduction to milling machine & its parts, Fundamentals of CNC milling, Different operations of milling-Plain milling, Step milling, Slot milling, Pocket milling.

UNIT-II

NC Part Programming: Definition, introduction to Coordinate systems- Cartesian Coordinate System, polar coordinate system, ISO machine tools axis, Right hand thumb rule for CNC machine, Types of dimensioning systems- Absolute, Incremental,Different types of codes- G codes, M codes, Programming Format, Introduction to Control panels- sinumerik , Fanuc etc.

NC Turing Part Programming: Introduction to basic ISO codes of CNC programming Turning Basic Operations, Manual programming for various operations of turning, Hand on practice on 808D turning control manual programming using ISO codes.

NC Milling Part Programming: : Introduction to basic ISO codes of CNC programming Milling Basic Operations, Manual programming for various operations of milling, Hand on practice on 808D,828d,840d turning control manual programming using ISO codes.

UNIT-III

Standard Cycles: Introduction, Different types of cycles of Milling & turning control, Basic milling operation Cycle programming, Turning operation cycles, Drilling operation cycles, Hands on Practice on 808D,828d,840d Cycles.

UNIT-IV

CNC Machining: Introduction, Elements of CNC machines, Hands on Practice on 808D,828d,840d control panel, Defining cutting speed, Depth of cut, feed of for the various operations.

UNIT-V

Introduction to digital machining processes :introduction to 3d modelling,CNC CAM Programming, creation of virtual cutting tools, work pieces, cutting parameters by using software, hands on practice on executing the computer generated program.

Learning Resources

Text books:

1. CNC Programming by S K Sinha
2. CNC Fundamentals and Programming by P. M. Agrawal (Author), Dr. V. J. Patel (Author)
3. CNC Programming for Machining by Kaushik Kumar, Chikesh Ranjan, J. Paulo Davim

Reference books:

1. Refer Siemens SINUMERIK 840D sl / 828D Fundamentals
2. SINUMERIK 808D ADVANCED Programming and Operating Manual
3. SINUMERIK 840D sl/840Di sl/840D/840Di/810D Fundamentals
4. https://cache.industry.siemens.com/dl/files/860/63629860/att_79745/v1/808D_OP_Milling_0113_en.pdf
5. SINUMERIK 802D sl840D/ 840D sl 840Di/840Di sl/810D Programming Manual ISO Turning

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

CO1: To Illustrate the basic comonents of CNC machine **{Understand level, KL2}**

CO2: To Develop NC part programming for Turning & milling opearations **{Understand level, KL3}**

CO3: To Utilize various standard cycles for programming of Turning & milling opearations . **{Understand level, KL3}**

CO4: To Apply concept of part progarmming for cnc machining. **{Understand level, KL2}**

CO5: Able to perform and execute the programming by using CAM software. **{Understand level, KL2}**

III-Year-II Semester	ENTREPRENEURIAL SKILL DEVELOPMENT	L	T	P	C
MC3201		1	0	2	2

Prerequisites: Basic Sciences and Humanities

Course Objective:

1. To impart the basic knowledge of entrepreneurship skills for better understanding of entrepreneurial scenario.
2. To understand the knowledge of theories of entrepreneurship and to motivat students to become entrepreneur.
3. To identify opportunities in starting own ventures.
4. To understand and plan business model for a start up.
5. To analyze the role of government and non government institutions in supporting entrepreneurial activities.

Syllabus

UNIT- I

Foundation of Entrepreneurship

Concept and Need of Entrepreneurship, Characteristics and types of Entrepreneurship, Charm of becoming Entrepreneur, Entrepreneurial decision process, Entrepreneurship as a career, Entrepreneurship as style of management, Changing role of Entrepreneur, Entrepreneurial traits, factors effecting Entrepreneur.

UNIT-II

Theories of Entrepreneurship and Entrepreneurial motivation

Influences of Entrepreneurship development, external Influences of Entrepreneurship development, Socio – cultural, political and economical, personal entrepreneurial success and failure, reason and remedies, women entrepreneurs, challenges and achievements of women entrepreneurs. Meaning of Entrepreneurial motivation, motivation cycle or process, theories of Entrepreneurial motivation, Entrepreneurial motivational factors, changes in Entrepreneurial motivation.

UNIT-III

Opportunities Identification and Selection

Need for opportunities identification and selection, Environmental Dynamics and Changes, Business Opportunities in various sectors, Identification of Business opportunities, and Opportunity selection.

UNIT-IV

Business Planning Process

The business plan as an entrepreneurial tool, Elements of business planning, Objectives, Market analysis, Development of product/idea, Marketing, Finance, organization and management, Ownership, Critical risk contingencies of the proposal, Scheduling and milestones.

UNIT-V

Entrepreneurial Development and Role of Central Government and State Government in promoting entrepreneurship with various incentives, subsidies, grants, programmed schemes and challenges, Government initiatives and inclusive entrepreneurial growth.

TEXT BOOKS:

1. Entrepreneurship Development and Small Business Enterprises, Poornima M. Charantimath, 2e, Pearson, 2014.
2. P.Narayana Reddy, Entreprenurship, Cengage Learning, New Delhi,2010.
3. Steven Fisher, Ja-nae Duane, The startup equation – A visual guide book for building your startup, Indian edition, McGraw Hill Education India Pvt. Ltd. 2016.

4. Arya Kumar: “Entrepreneurship”, Pearson, Publishing House, New Delhi, 2012.
6. VSP Rao, Kuratko: “Entrepreneurship’, Cengage Learning, New Delhi, 2011.
7. K.Ramachandran: “Entrepreneurship Development”, TMH, New Delhi, 2012.
8. Robert Hisrich, & Michael Peters: Entrepreneurship, TMH, 2009.
9. Dollinger: Entrepreneurship, Pearson, 2009.

REFERENCE BOOKS:

1. Entrepreneurship, Arya Kumar, 4 e, Pearson 2015.
2. Entrepreneurship, a South – Asian Perspective, D.F. Kuratko and T. V. Rao, 3e, Cengage, 2012.
3. The Dynamics of Entrepreneurial Development and Management, Vasant Desai, Himalaya Publishing House, 2015.
4. AnajanRai Chaudhuri, Managing new ventures, concepts and cases, Prentice Hall International, 2010.
5. Rajeev Roy: Entrepreneurship, Oxford university press, New Delhi, 2010.

Web Resources:

1. https://nptel.ac.in/courses/110105067/50
2. http://www.yourarticlelibrary.com/project-management/5-methods-of-project-appraisalexplained/40771
3. https://springhouse.in/government-schemes-every-entrepreneur/
4. http://nptel.ac.in/courses
5. https://www.tutorialspoint.com/
6. https://www.ediindia.org/
7. http://www.quickmba.com/entre/

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

CO 1: The basics of entrepreneurship skills for better understanding of entrepreneurial scenario are understood.
CO 2: Apply Knowledge of theories of entrepreneurship and to identify entrepreneurial opportunities for women.
CO 3: identify opportunities supporting entrepreneurship.
CO 4: analyze the milestones and related challenges in developing new venture.
CO 5: Understand government role supporting entrepreneurship.

IV-Year-I Semester	APPLIED THERMODYNAMICS-II	L	T	P	C
PC4101		3	0	0	3

Prerequisites:-Nil-

Course Objectives:

1. To analyze the performance of various components of steam power plant as boiler, nozzle, turbines, and condensers.
2. To understand the working principles of various jet and rocket engines.
3. To gain an understanding of how thermodynamic principles govern the behavior of various systems of vapour power cycle and gas power cycle.

Syllabus

Unit- I

BASIC CONCEPTS: Performance parameters of Vapour Power Cycle-Carnot Vapour Power Cycle-Rankine cycle - schematic layout, thermodynamic analysis, concept of mean temperature of heat addition, Comparison between Carnot, and Rankine Cycles- methods to improve Rankine cycle performance – regeneration & reheating. Cogeneration, Combined Gas-Vapour power cycle.

BOILERS: Classification – Fire tube boilers (Cochran boiler and Lancashire boiler), Water tube boilers (Babcock and Wilcox boiler and Stirling boiler), High pressure boiler (La Mont boiler and Benson boiler) - working principles – with sketches – Mountings and Accessories – working principles, boiler horse power and equivalent evaporation efficiency– draught, classification – height of chimney for given draught and discharge, condition for maximum discharge, efficiency of chimney.

Unit- II

STEAM NOZZLES: Function, Applications & types of steam nozzles, Steam flow through nozzles, thermodynamic analysis – assumptions -velocity of fluid at nozzle exit-Ideal and actual expansion in a nozzle, velocity coefficient, condition for maximum discharge, critical pressure ratio, criteria to decide nozzle shape:

STEAM TURBINES: Classification – impulse turbine; mechanical details – velocity diagram – effect of friction – power developed, axial thrust, blade or diagram efficiency – condition for maximum efficiency. De-Laval turbine - methods to reduce rotor speed-velocity compounding, pressure compounding and velocity & pressure compounding, velocity, and pressure variation along the flow – combined velocity diagram for a velocity compounded impulse turbine, condition for maximum efficiency.

Unit- III

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

STEAM CONDENSERS: Functions of a steam condenser-Elements of a condensing plant – classification of condensers – working principle of different types – Estimation of cooling water required-vacuum efficiency and condenser efficiency – Air leakage, Sources, and its affects-Air

Pump.

Unit- IV

GAS TURBINES: Simple gas turbine plant, Applications – Classification- ideal cycle, essential components – parameters of performance – derivation of actual gas turbine cycle from Brayton cycle, Comparison between closed cycle and open cycle gas turbine, Methods for improvement of thermal efficiency – Regeneration, Inter cooling and Reheating –closed and semi-closed cycles – merits and demerits, types of combustion chambers.

Unit- V

JET PROPULSION: Principle of operation –classification of jet propulsive engines – working principles with schematic diagrams and representation on T-s diagram - thrust, thrust power and propulsive efficiency – turbo jet engines – needs and demands met by turbo jet – schematic diagram, thermodynamic cycle, performance evaluation, thrust augmentation – methods.

ROCKETS: Application – working principle – classification – propellant type – thrust, propulsive efficiency – specific impulse – solid and liquid propellant rocket engines.

Content beyond syllabus: *Cogeneration, Combined Gas-Vapour power cycle.*

NOTE: Use of steam tables and Mollier chart is allowed.

Learning Resources

Text books:

1. Thermal Engineering by Mahesh M Rathore,Mc Graw Hill Publishers.
2. Thermal Engineering by R K Rajput, Lakshmi Publications

Reference books:

1. Thermodynamics and Heat Engines- Yadav- Central book depot.
2. Gas Turbines – V.Ganesan /TMH.
3. Gas Turbines / Cohen, Rogers and Saravana Muttoo / Addison Wesley – Longman - Oxford Higher Education 6th Edition 2011.
4. Thermal Engineering-M.L.Marthur & Mehta/Jain bros.

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

CO1: Analyze Simple Rankine Cycle, Identify the different types of steam generators and the functions of boiler mountings & accessories **(Analyze level, KL-4).**

CO2: Apply thermodynamic concepts to study the characteristics of steam nozzles and evaluate the performance of an impulse Turbine **(Apply level, KL-3).**

CO3: Analyze steam flow through the Reaction Turbine and Describe the working of Various types of steam condensers **(Analyze level, KL-4).**

CO4: Investigate the ways to increase the cycle thermal efficiency of real gas turbine systems **(Apply level, KL-3).**

CO5: Understand the working of different types of Jet engines and Rockets **(Understand level, KL-2).**

IV-Year-I Semester | **INDUSTRIAL ENGINEERING AND MANAGEMENT**

L	T	P	C
3	0	0	3

PE4101X

Prerequisites: Basic knowledge of management and production process.

Course Objectives:

1. To understand the concepts of Entrepreneurship and organization and how to motivate the employee in an organization.
2. To Design a system, component, or process, and synthesize solutions to achieve desired needs and can be able to organize MRP processes.
3. To Use the techniques, skills, and modern engineering tools necessary for engineering practice with appropriate considerations for public health and safety, cultural, societal, and environmental constraints using automation.
4. To Organize the quality control w.r.t. charts and with LPP and VAM techniques and assigning the production to increase the production quality.
5. To Function effectively within multi-disciplinary teams using value analysis and understand the fundamental precepts of effective project management.

Syllabus

Unit -I

INDUSTRIAL ENGINEERING AND MANAGEMENT:
Definition of Industrial engineering, functions of industrial engineering – Entrepreneurship and organization – Nature and Importance of Management, Functions of Management, Taylor's Scientific Management Theory, Fayol's Principles of Management, Maslow's Theory of Human Needs, Douglas McGregor's Theory X and Theory Y, Herzberg's Two-Factor Theory of Motivation, Systems Approach to Management, Leadership Styles, Social responsibilities of Management

Unit -II

PLANT LOCATION AND PLANT LAYOUT – CRAFT, ALDEP, AND CORELAP. Cellular Manufacturing: Group Technology – Cellular layout – Machine Part Cell Formation (MPCF) – Heuristic approaches – Hierarchical clustering for MPCF.

MATERIAL REQUIREMENT PLANNING (MRP) – MRP logic – Manufacturing resource planning – capacity requirement planning (CRP) –Bill of material. Automation in manufacturing operations.

Unit -III

PRODUCT/PRODUCTION RELATIONSHIPS- Automated systems – Machine tool drives components, feedback, position control, and active damping of feed drives. PLC –. Human machine and Man-machine interfaces Control of electro-hydraulic and electro-pneumatic systems.

NUMERICAL CONTROL AND ROBOTICS. Robot anatomy – Flexible manufacturing systems - Automated systems - Bar coding technology. Sensor assisted machining intelligent machine module - hardware and software architecture - Adaptive control of forces in machining – control algorithm, generalized predictive control, In-process detection of tool failure. Vibration control modal testing of machine structures. In- process monitoring systems.

Unit -IV

QUALITY- CONTROL CHARTS- SPC -process capability analysis. Multi – variable chart, individual measurement charts. Acceptance Sampling– O.C. curves, Average outgoing quality (AOQ), Average sample number (ASN), Average total inspection (ATI), Multiple and sequential sampling, sampling plans – military standards, Dodge – Romig, IS 2500. ISO and Six Sigma.

WORK STUDY- Method study – Time study – stopwatch time study – Work measurement - performance rating- allowances – Ergonomics.

Unit -V

VALUE ANALYSIS: Value engineering, implementation procedure, enterprise resource planning and supply chain management.

NETWORK MODELS – CPM and PERT - Critical Path Scheduling – Crashing of Network-Simple problems.

Learning Resources

Text books:

1 Industrial Engineering and management / O.P Khanna/KhannaPublishers.
2 Industrial Engineering and Production Management/MartandTelsang/S.Chand& CompanyLtd. New Delhi
3 Operations Research by P K GUPTA AND D S HIRA BY SCHAND PUBLICATIONS, 7E

Reference books:

1. Industrial Management / Bhattacharya DK/Vikas publishers
2. Operations Management / J.G Monks/Mc Graw Hill Publishers.
3. Industrial Engineering and Management Science/T.R. Banga, S.C.Sharma, N. K. Agarwal / Khanna Publishers
4. Industrial Engineering and Management /NVS Raju/Cengage Publishers

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

CO1: Understand the concepts of Entrepreneurship and organization and how to motivate the employee in an organization.**(KL-1)**

CO2: Design a system, component, or process, and synthesize solutions to achieve desired needs and can be able to organize MRP processes. **(KL-2)**

CO3: Use the techniques, skills, and modern engineering tools necessary for engineering practice with appropriate considerations for public health and safety, cultural, societal, and environmental constraints using automation.**(KL-2)**

CO4: Organize the quality control w.r.t. charts and with LPP and VAM techniques and assigning the production to increase the production quality.**(KL-2)**

CO5: Function effectively within multi-disciplinary teams using value analysis and understand the fundamental precepts of effective project management.**(KL-2)**

IV-Year-I Semester | **COMPOSITES AND NANO MATERIALS**

L	T	P	C
3	0	0	3

PE4101X

Prerequisites: Material science

Course Objectives:

1. To understand the mechanics of different materials. This understanding will include concepts such as anisotropic material behavior, constituent properties and manufacturing processes of different composites.
2. The objective for this course is Suitability of smart and nano materials for engineering applications.

Syllabus

Unit -I

INTRODUCTION TO COMPOSITE MATERIALS: Introduction, classification: polymer matrix composites, metal matrix composites, ceramic matrix composites, carbon–carbon composites, fiber reinforced composites and nature-made composites, and applications.

REINFORCEMENTS: Fibres- glass, silica, kevlar, carbon, boron, silicon carbide, and born carbide fibres.

Polymer composites, thermoplastics, thermosetting plastics, manufacturing of PMC, MMC & CCC and their applications.

Unit -II

MANUFACTURING METHODS: Hand and spray lay - up, injection molding, resin injection, filament winding, pultrusion, centrifugal casting and prepregs. Fibre/Matrix Interface, mechanical. Measurement of interface strength. Characterization of systems; carbon fibre/epoxy, glass fibre/polyester, etc.

Unit -III

MECHANICAL PROPERTIES: -Stiffness and Strength: Geometrical aspects – volume and weight fraction. Unidirectional continuous fibre, discontinuous fibers, Short fiber systems, woven reinforcements –Mechanical Testing: Determination of stiffness and strengths of unidirectional composites; tension, compression, flexure and shear.

Unit -IV

INTRODUCTION TO NANO MATERIALS: History of nano science, definition of nano meter, nano materials, nano technology. Classification of nano materials. Crystal symmetries, crystal directions, crystal planes. Band structure.

PROPERTIES OF MATERIALS: Mechanical properties, electrical properties, dielectric properties, thermal properties, magnetic properties, opto electronic properties. Effect of size reduction on properties, electronic structure of nano materials.

Unit -V

SYNTHESIS AND FABRICATION: Synthesis of bulk polycrystalline samples, growth of single crystals. Synthesis techniques for preparation of nano particle – Bottom Up Approach – sol gel synthesis, hydro thermal growth, thin film growth, PVD and CVD; Top Down Approach – Ball milling, micro fabrication, lithography. Requirements for realizing semiconductor nano structures, growth techniques for nano structures.

Learning Resources

Text books:

1. Engineering Mechanics of Composite Materials / Isaac and M Daniel/Oxford University Press.
2. Mechanics of Composite Materials – Second Edition (Mechanical Engineering) /Autar K.Kaw / CRC Press.
3. Nano science and Nano technology by M.S Ramachandra Rao, Shubra Singh, Wiley publishers.

Reference books:

1. Material science and Technology: A comprehensive treatment/Robert W.Cahn,/VCH
2. Mechanics of Composite Materials / R. M. Jones/ Mc Graw Hill Company, New York, 1975.
3. Introduction to Nano Technology by Charles P. Poole, Jr., Frank J.Owens, Wiley publishers.
4. Nanotechnology by Jermy J Ramsden, Elsevier publishers
5. Nano Materials- A.K.Bandyopadhyay/ New Age Introdu.

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

CO1: Acquaint the knowledge of understanding different materials, reinforcements and their properties. **(Understand level, KL-2).**

CO2: To understand polymer composites and their applications. Different manufacturing methods for composite materials. **(Understand level, KL-2).**

CO3: To understand mechanical properties of composite materials and understand the concept of nano materials. **(Understand level, KL-2).**

CO4: To understand the properties of nano materials. **(Understand level, KL-2).**

CO5: To understand various synthesis and fabrication of nano materials.**(Understand level, KL-2).**

IV-Year-I Semester	SOLAR AND PHOTO VOLTAIC SYSTEMS	L	T	P	C
		3	0	0	3

PE4101X

Prerequisites:-Nil-

Course Objectives:

1. To learn about physics of solar and various methods of capturing solar radiation.
2. To Knowing about power generation of solar.
3. To understand the thermal energy storage and its applications.

Syllabus

UNIT-I

INTRODUCTION

Solar energy option - Specialty and potential - Sun - Earth - Solar radiation - Beam and diffuse - Measurement - Estimation of average solar radiation on horizontal and tilted surfaces – Problems - Applications.

Capturing solar radiation - Physical principles of collection - Types - Liquid flat plate collectors - Construction details - Performance analysis - Concentrating collection - Flat plate collectors with plane reflectors - Cylindrical parabolic collectors - Orientation and tracking – Performance analysis.

UNIT-II

Power generation from Solar Thermal

Power generation - Solar central receiver system - Heliostats and receiver - Heat transport system - Solar distributed receiver system - Power cycles - Working fluids and prime movers - Concentration ratio.

UNIT-III

Thermal Energy Storage

Introduction - Need for - Methods of sensible heat storage using solids and liquids - Packed bed storage - Latent heat storage - Working principle - Construction - Application and limitations - Solar devices - Stills - Air heaters - Dryers - Solar Ponds & Solar Refrigeration - Active and passive heating systems. Thermochemical storage.

UNIT-IV

Energy Collection, Storage and applications

Flat plate and concentrating collectors - Classification of concentrating collectors – Orientation and thermal analysis - Advanced collectors - Different storage techniques - Sensible - Latent heat and stratified storage - Solar ponds - Solar applications - Solar heating/cooling techniques – Solar distillation and drying - Photovoltaic energy conversion.

UNIT-V

PV System Design and Applications:

Standalone PV systems - Lighting - Water pumping - Hybrid PV Systems - PV wind and PV diesel - Grid connected PV Systems - PV power plants - Roof top and ground mounted small & large power plants, Solar cell Technologies.

Content beyond syllabus: *Thermochemical storage, Solar cell Technologies*

Learning Resources

Text books:

1) Solar Energy – Principles of Thermal Collection and Storage/Sukhatme S.P. and J.K.Nayak/ TMH
2) Non-Conventional Energy Resources- Khan B.H/ Tata McGraw Hill, New Delhi, 2006

Reference books:

1) Principles of solar engineering, Kreith and Kerider, Taylor and Franscis, 2nd edition.
2) Solar energy thermal processes, Duffie and Beckman, John Wiley & Sons.
3) Solar energy: Principles of Thermal Collection and Storage, Sukhatme, TMH, 2nd edition.
4) Solar energy, Garg & Prakash, H. P. Garg, Tata McGraw-Hill Education, 2000.
5) Solar energy, B.S. Magal, McGraw-Hill Education (India) Pvt Limited, 01-Nov-1999.
6) Solar Thermal Engineering Systems, Tiwari and Suneja, Narosa Publishing House, 1997.
7) Power plant Technology, M. M. El-Wakil, McGraw-Hill, 1984.
8) Solar Photovoltaics: Fundamentals, Technologies and Applications, Chetan Singh Solanki, PHI Learning Private Limited 2011 (or later edition).

E- RESOURCES & OTHER DIGITAL MATERIAL

1. https://onlinecourses.nptel.ac.in/noc21_ch11/preview
2. https://nptel.ac.in/courses/103103206
3. https://nptel.ac.in/courses/121106014

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

CO1: Understand the capturing of solar radiation**.(KL-2)**

CO2: Describe the power generation from solar energy. **(KL-2)**

CO3: Understand the thermal energy Storage. **(KL-2)**

CO4: Explain the various methods of energy collection, storage, and its applications. **(KL-2)**

CO5: Describe the PV system design and its applications. **(KL-2)**

IV-Year-I Semester | **DESIGN FOR MANUFACTURING**

L	T	P	C
3	0	0	3

PE4101X

Prerequisites:-Nil-

Course Objectives:

1. Understand the design rules and considerations with reference to various manufacturing processes.
2. To discusses capabilities and limitations of each manufacturing process in relation to part design and cost.
3. To examine DFM principles including how the design affects manufacturing cost, lean manufacturing, six sigma, etc.

Syllabus

Unit- I

Introduction: Design philosophy-steps in design process-general design rules for manufacturability-basic principles of designing for economical production – creativity in design.

Unit- II

Machining processes: Overview of various machining processes-general design rules for machining-dimensional tolerance and surface roughness- Design for machining – ease – redesigning of components for machining ease with suitable examples. General design recommendations for machined parts.

Unit- III

Metal casting: Appraisal of various casting processes, selection of casting process,-general design considerations for casting-casting tolerance-use of solidification, simulation in casting design-product design rules for sand casting.

Plastics: Visco elastic and creep behaviour in plastics-design guidelines for plastic components-design considerations for injection moulding – design guidelines for machining and joining of plastics.

Unit- IV

Metal joining: Appraisal of various welding processes, factors in design of weldments – general design guidelines-pre and post treatment of welds- effects of thermal stresses in weld joints-design of brazed joints. Forging: Design factors for forging – closed die forging design – parting lines of dies – drop forging die design – general design recommendations

Unit- V

Extrusion & Sheet metal work: Design guide lines extruded sections- design principles for punching, blanking, bending, and deep drawing-Keeler Goodman forging line diagram – component design for blanking.

Learning Resources

Text books:

1. Design for manufacture, John cobert, Adisson Wesley 1995

2. Design for Manufacture by Boothroyd
3. Design for manufacture, James Bralla

Reference books:

1. ASM Hand book Vol.20

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

CO1: Design components for machining.**(KL-2)**

CO2: Simulate the casting design and choose the best casting process for a specific product. **(KL-2)**

CO3: Evaluate the effect of thermal stresses in weld joints.**(KL-3)**

CO4: Design components for sheet metal work by understanding in depth the sheet metal processes and their formation mechanisms. **(KL-2)**

CO5: Design plastic components for machining and joining and selecting a proper process for different joining cases. **(KL-2)**

IV-Year-I Semester | **CAD/CAM** | **PE4102X**

L	T	P	C
3	0	0	3

Prerequisites: Basics of computer, Parametric designing, manufacturing processes.

Course Objectives:

1. To understand the basic fundamentals of computer aided design and manufacturing.
2. To learn 2D & 3D transformations of the basic entities like line, circle, ellipse etc.
3. To understand the different geometric modeling techniques like solid modeling, surface modeling, feature based modeling etc. and to visualize how the components look like before its manufacturing or fabrication.
4. To learn the part programming, importance of group technology, computer aided process planning.
5. To learn about the computer aided quality control & elements of computer integrated manufacturing systems.

Syllabus

Unit –I

Introduction to CAD/CAM, product cycle, CAD / CAM Hardware, basic structure.
COMPUTER GRAPHICS: Raster scan graphics coordinate system, database structure for graphics modeling, transformation of geometry, 2D and 3D transformations, mathematics of projections, clipping, hidden surface removal
Unit –II

GEOMETRIC MODELING: Requirements, geometric models, geometric construction models, curve representation methods, parametric representation of various curves:cubic spline, Bezier curves. Surface representation methods, Solid modelling.
Unit –III

PART PROGRAMMING FOR NC MACHINES: NC, NC modes, NC elements, CNC machine tools, structure of CNC machine tools, features of Machining center, turning center, CNC Part Programming: fundamentals, manual part programming methods, Computer Aided Part Programming. Direct Numerical Control, Adaptive Control.
Unit –IV

GROUP TECHNOLOGY: Part family, coding and classification, production flow analysis, types and advantages. Computer aided processes planning – importance, types. FMS-Introduction, Equipment, Tool management systems, Layouts, FMS Control
Unit –V

COMPUTER INTEGRATED MANUFACTURING SYSTEMS: Types of manufacturing

systems, machine tools and related equipment, material handling systems, material requirement planning, computer control systems, human labor in manufacturing systems, CIMS benefits. (5hrs)

COMPUTER AIDED QUALITY CONTROL: Terminology used in quality control, use of computers in Quality control. Inspection methods- contact and noncontact types, computer aided testing, integration of CAQC with CAD/CAM.

Learning Resources

Text books:

1. CAD / CAM Principles and Applications/PN Rao / McGraw-Hill
2. Automation, Production systems & Computer integrated Manufacturing/M.P.Groover/Pearson Education

Reference books:

1.Mastering CAD / CAM / Ibrahim Zeid / McGraw-Hill
2.Principles of Computer Aided Design and Manufacturing / Farid Amirouche / Pearson
3.Computer Numerical Control Concepts and programming / Warren S Seames / Thomson learning, Inc
4.Product manufacturing and cost estimation using CAD/CAE/ Kuang Hua Chang/Elsevier Publishers

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

CO1: Understand the role of computers in design and manufacturing with transformations of geometric model **{Understand level, KL2}**

CO2: Illustrate various entities of wire frame, surface, and solid models **{Understand level, KL2}**

CO3: Distinguish between a CNC machine and a conventional machine {**Understand level, KL2}**

CO4: Formulate manufacturing cell based on similar manufacturing attributes of parts **{Understand level, KL2}**

CO5: Understand the benefits of computer aided quality control & Manufacturing systems **{Understand level, KL2}**

IV-Year-I Semester | **PRODUCT DESIGN**

L	T	P	C
3	0	0	3

PE4102X

Prerequisites: Material Science, Basic Manufacturing Processes.

Course Objectives:

1. Demonstrate technical competency in practice.
2. Function effectively in an industrial and academic environment.
3. Engage in professional ethics and development.
4. Enrich their society and environment through their skills.

Syllabus

Unit –I

INTRODUCTION TO PRODUCT DEVELOPMENT: Introduction, Need for developing products, the importance of engineering design, Identifying customer needs, Creative thinking, creativity and problem solving, creative thinking methods- generating design concepts-systematic methods for designing, morphological methods-TRIZ- axiomatic design.

Unit –II

INDUSTRIAL DESIGN: human factors design, user friendly design, design for serviceability, design for environment, prototyping and testing, cost evaluation, categories of cost, overhead costs ,activity based costing ,methods of developing cost estimates, manufacturing cost ,value analysis in costing.

Unit –III

PRODUCT AND PROCESS ENGINEERING TOOLS: Tools for concept development, Tools for process improvement, statistical process control, bench marking and establishing engineering specifications, project management.

Unit –IV

MATERIALS SELECTION FOR PRODUCT DEVELOPMENT:

Material behaviour and selection: Mechanism of Plastic deformation-yield stress and shear strength-Perfect and Real crystals- Effect of strain rate and temperature on plastic behaviour- Super plasticity, Selection of material for mechanical properties Strength, toughness and fatigue- Material selection for durability and surface wear and Corrosion resistance- Manufacturing characteristics of metals.

PROCESS MODELING: Basic analysis of process Forging, Drawing and sheet metal forming- machining- Turning- modern materials- micro alloyed and dual phase steel- High strength low alloy metals- Smart materials- Shape memory metals- Metallic Glasses- Nano Materials- Metal foams- Properties and applications for product design.

DEVELOPMENT IN MATERIALS PROCESSING: Micro fabrication technologies- Tool for micro fabrication- Diamond and high speed machining- LIGA micro fabrication process- Multilayer X-ray lithography.

Unit –V

QUALITY CONCEPTS IN PRODUCT DEVELOPMENT: Quality Function Deployment, design process- Identification of control factors, noise factors, developing the experimental plan-experimental design –testing noise factors Running the experiments.

FAILURE MODE EFFECT ANALYSIS: Basic methods: Refining geometry and layout, general process of product embodiment, Advanced methods: systems modeling, mechanical embodiment principles-FMEA method.

DESIGN FOR SIX SIGMA: Basis of SIX SIGMA –Project selection for SIX SIGMA- SIX SIGMA problem solving- SIX SIGMA in service and small organizations - SIX SIGMA and lean production –Lean SIX SIGMA and services.

Learning Resources

Text books:

1. Engineering Design, George E Deiter, 5th Edition, McGraw-Hill, 2012.
2. Product Integrity and Reliability in Design, John W.Evans and Jillian Y.Evans, Springer Verlag.
3. Karl T Ulrich, Steven D Eppinger, “Product Design & Development.” Tata McGrawhill New Delhi 2003

Text books:

4. Engineering Design, George E Deiter, 5th Edition, McGraw-Hill, 2012.
5. Product Integrity and Reliability in Design, John W.Evans and Jillian Y.Evans, Springer Verlag.
6. Karl T Ulrich, Steven D Eppinger, “Product Design & Development.” Tata McGrawhill New Delhi 2003
7. Kevin N. Otto and Kristin L. Wood - Product Design Pearson Education 2001
8. Kevin Otto & Kristin Wood Product Design: “Techniques in Reverse Engineering and new Product Development.” 1 / e 2004, Pearson Education New Delhi
9. L D Miles “Value Engineering.”

Reference books:

1. The Product Management Handbook, Richard S. Hanscombe, McGRAW – Hill
2. New Product Design, Ulrich Eppinger
3. Product Design ,Kevin Otto
4. David G Ullman, “The Mechanical Design Process.” McGrawhill Inc Singapore 1992 N J M Roozenberg, J Ekels, N F M Roozenberg “Product Design Fundamentals and Methods.” John Willey & Sons 1995
5. Boothroyd G, Dewhurst P and Knight W, Product Design for Manufacture and Assembly, 2nd Edition, Marcel Dekker, New York, 2002.
6. Hollins B & Pugh S “Successful Product Design.” Butter worths London.
7. Baldwin E N & Neibel B W “Designing for Production.” Edwin Homewood Illinois
8. Jones J C “Design Methods.” Seeds of Human Futures. John Willey New York.

9. Bralla J G “Handbook of Product Design for Manufacture, McGrawhill New York**.**
10. A K Chitale and R C Gupta, Product Design and Manufacturing, 6th Edition, PHI, New Delhi, 2003.

Web links:

1. https://nptel.ac.in/courses/112107217
2. Vladimir Petrov, Theory of Inventive Problem Solving, Level 1, Springer Series, 2019, ISBN: 978-3-030-04253-0.

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

CO1: Understand the basic concepts of engineering design and product development **{Understand level, KL2}**

CO2: Understand the effects of other human factors **{Understand level, KL2}**

CO3: Understand and apply the various tools used for design development analysis and optimization. **{Understand level, KL2}**

CO4: Understand the behaviour of various metals and non-metals **{Understand level, KL2}**

CO5: Understand about the quality function deployment, design process **{Understand level, KL2}**

IV-Year-I Semester | **RENEWABLE ENERGY SOURCES**

L	T	P	C
3	0	0	3

PE4102X

Prerequisites: -Nil-

Course Objectives:

1. The course aims to highlight the significance of alternative sources of energy, processes and provides the theory and working principles of probable sources of renewable energy systems that are environmentally friendly.
2. The students are expected to identify the new methodologies / technologies for effective utilization of renewable energy sources.
3. This course envisages the new and renewable source of energy, available in nature and to expose the students on sources of energy crisis and the alternatives available, also stress up on the application of non-conventional energy technologies.

Syllabus

UNIT –I

SOLAR RADIATION: Role and potential of renewable sources, the solar energy option, Environmental impact of solar power, Solar energy utilization in India, structure of the sun, the solar constant, sun-earth relationships, extraterrestrial and terrestrial solar radiation, the celestial vault and basic earth angles, determination of solar time, solar radiation on tilted surface, instruments for measuring solar radiation and sunshine, solar radiation data, numerical problems, A basic Photovoltaic system for power generation, Solar cell modules, types of solar cells, Solar cell production, Applications, Solar cell Technologies.

UNIT –II

SOLAR ENERGY COLLECTION: Liquid flat plate collector, Selective absorber coatings, selection of materials, classification of concentrating collectors, its working and orientation systems.

SOLAR ENERGY STORAGE AND APPLICATIONS: Different methods, sensible, latent heat and stratified storage, solar ponds, Buildings and other solar thermal applications: Air heaters, energy -efficient buildings, passive solar systems, active solar systems, integrated energy-efficient buildings, crop driers, space cooling, water desalination, solar cookers, central power tower concept and solar chimney, Solar cell Technologies.

UNIT –III

WIND ENERGY: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, betz criteria, types of winds, wind data measurement.

BIO-MASS: Properties, principles of production, classification fixed dome-floating type, comparison, site selection, Plant models in India: floating gas holder- KVIC, fixed dome - Janata type, pragati

model, deenbandhu model, constraints for implementation, Factors affecting, Waste Recycling Plants.

UNIT –IV

GEOTHERMAL ENERGY: Origin and Distribution of Geothermal Energy, Types of Geothermal Resources- Hydrothermal Resources, Geopressured Resources, Hot Dry Rock Resources, Magma Resources, Types of wells,potential in India.

OCEAN ENERGY: OTEC: Principles, utilization, setting of OTEC plants, thermodynamic cycles. Tidal Energy: Origin and Potential, conversion techniques: types of basins Wave Energy: Origin and Potential, conversion techniques: Heaving Float type, pitching type, Heaving and Pitching type, Oscillating water column type, Surge devices.

UNIT –V

DIRECT ENERGY CONVERSION: Need for DEC, limitations, principles of DEC. Thermoelectric generators, Seebeck, Peltier and Joule Thompson effects, figure of merit, materials, applications, Thermionic Generator.

FUEL CELLS: Principle, Faraday's laws, thermodynamic aspects, Performance limiting factors of fuel cells- Types of fuel cells.

MHD POWER: MHD Generator-Open and Closed Systems, applications of direct energy conversion systems.

Content beyond syllabus: *Thermochemical storage, Solar cell Technologies.*

Learning Resources

Text books:

1. Nonconventional Energy Source- G.D Roy/Standard Publishers
2. Non-Conventional Energy Resources- Khan B.H/ Tata McGraw Hill, New Delhi, 2006
3. Green Manufacturing Processes and Systems - J. Paulo Davim/Springer 2013

Reference books:

1. Alternative Building Materials and Technologies - K.S Jagadeesh, B.V Venkata Rama Redd and K.S Nanjunda Rao/New age international
2. Principles of Solar Engineering - D.Yogi Goswami, Frank Krieth& John F Kreider / Taylo & Francis 3. Non-Conventional Energy - Ashok V Desai /New Age International (P) Ltd
3. Renewable Energy Technologies -Ramesh & Kumar /Narosa
4. Solar Energy – Principles of Thermal Collection and Storage/Sukhatme S.P. and J.K.Nayal TMH
5. Renewable Energy Resources-2nd Edition/ J.Twidell and T. Weir/ BSP Books Pvt.Ltd
6. Fuel Cell Technology -Hand Book / Gregor Hoogers / BSP Books Pvt. Ltd
7. Solar Energy Utilization by GD Rai, Khanna Publications

E- RESOURCES & OTHER DIGITAL MATERIAL

1) https://onlinecourses.nptel.ac.in/noc21_ch11/preview
2) https://nptel.ac.in/courses/103103206
3) https://nptel.ac.in/courses/121106014

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

CO1: To understand the physics of solar radiation,the principles and working of measuring solar radiation. **{Understand level, KL2}**

CO2: To comprehend solar energy storage, buildings and other solar thermal applications. **{Understand level, KL2}**

CO3: To acknowledge the principles and working of wind and biomass energy conversion systems. **{Understand level, KL2}**

CO4: To capture and apply other forms of energy sources like Geo-thermal energy & Ocean energy. **{Understand level, KL2}**

CO5: To understand the principles of Direct Energy Conversion,Fuel cells & MHD Power. **{Understand level, KL2}**

IV-Year-I Semester | **PRODUCTION PLANNING AND CONTROL**

L	T	P	C
3	0	0	3

PE4102X

Prerequisites:-Nil-

Course Objectives:

1. To understand the various components and functions of production planning and control, its development and design.
2. To understand the various concepts of work study carried out in an industry.
3. To understand the various concepts of product planning and process planning.
4. To understand the various concepts of production scheduling.
5. To know the recent trends like manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

Syllabus

Unit –I

INTRODUCTION

Objectives and benefits of planning and control-Functions of production control-Types of production- job- batch and continuous-Product development and design.

Marketing aspect - Functional aspects- Operationalaspect-Durability and dependability aspect. Break even analysis-Economics of a new design.

Unit –II

WORK STUDY

Work study, Method study, basic procedure-Selection-Recording of process - Critical analysis, Micro motion and memo motion study –

WORK MEASUREMENT - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.

Unit –III

PRODUCT PLANNING AND PROCESS PLANNING

Product planning-Extending the original product information-Value analysis-Problems in lack of product planning.

PROCESS PLANNING AND ROUTING-Pre requisite information needed for process planning- Steps in process planning-Quantity determination in batch production-Machine capacity, balancing- Analysis of process capabilities in a multi-product system.

Unit –IV

PRODUCTION SCHEDULING AND PRODUCT SEQUENCING

Production Control Systems-Loading and scheduling-Master Scheduling-Scheduling rules-Gantt charts- Basic scheduling problems - Line of balance – Flow production scheduling- Batch production scheduling.

PRODUCT SEQUENCING –Periodic batch control-Material requirement planning- kanban – Dispatching-Progress reporting and expediting- Manufacturing lead time-Techniques for aligning completion times and due dates.

Unit –V

INVENTORY CONTROL AND RECENT TRENDS IN PPC

Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system - Ordering cycle system-Determination of Economic order quantity and economic lot size.

Introduction to computer integrated production planning systems- elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP

Learning Resources

Text books:

1. James. B. Dilworth,"Operations management – Design, Planning and Control for manufacturing and services" McGraw Hill International edition 1992.
2. Martand Telsang, "Industrial Engineering and Production Management", First edition, S. Chand and Company, 2000.

Reference books:

1. Chary. S.N., "Theory and Problems in Production & Operations Management", Tata McGraw Hill, 1995.
2. Elwood S.Buffa, and Rakesh K.Sarin, "Modern Production / Operations Management", 8th Edition John Wiley and Sons, 2000.
3. Jain. K.C. & Aggarwal. L.N., "Production Planning Control and Industrial Management", Khanna Publishers, 1990.
4. Kanishka Bedi, "Production and Operations management", 2nd Edition, Oxford university press, 2007.
5. Melynk, Denzler, "Operations management – A value driven approach" Irwin McGraw hill.
6. Norman Gaither, G. Frazier, "Operations Management" 9th Edition, Thomson learning IE, 2007
7. 7. Samson Eilon, "Elements of Production Planning and Control", Universal Book Corpn.1984.

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

CO1: To understand the various components and functions of production planning and control, its development and design.**(KL2)**

CO2: To understand the various concepts of work study carried out in an industry.**(KL2)**

CO3: To understand the various concepts of product planning and process planning.**(KL2)**

CO4: To understand the various concepts of production scheduling.**(KL2)**

CO5: To know the recent trends like manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).**(KL2)**

IV-Year-I Semester | **CONDITION MONITORING**

L	T	P	C
3	0	0	3

PRE-REQUISITES: -Nil-

Course objectives:

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

1. Understand and apply maintenance schemes in industries.
2. Monitor condition of rotating machinery using signature, temperature and corrosion analysis.
3. Understand and apply the thermography techniques.
4. Apply oil analysis technique to diagnose the wear debris.
5. Understand modern technologies for effective plant maintenance.

Syllabus

Unit –I

Introduction to maintenance and condition based maintenance, Definition, system approach, objectives, responsibilities of maintenance department, maintenance strategies, principles of maintenance, concepts of maintainability, availability and reliability, implementation of CBM, comparison of CBM with other maintenance techniques and case studies (overview). Introduction to condition monitoring, Basic concept, techniques - visual monitoring, temperature monitoring, vibration monitoring, lubricant monitoring, crack monitoring, thickness monitoring, noise and sound monitoring.

Unit –II

Basic signal processing techniques Probability distribution and density, Fourier analysis, Hilbert Transform, Cepstrum analysis, Digital filtering, Deterministic / random signal separation, Time frequency analysis. Wavelet Transform Introduction to Wavelets, Continuous Wavelet Transform (CWT), Discrete Wavelet Transform (DWT), Wavelet Packet Transform (WPT),types of wavelets – Haarwavelets, Shannon wavelets, Meyer wavelets, Daubechies wavelets, Coifmann wavelets and applications of wavelets.

Unit –III

Vibration Monitoring, Introduction, vibration data collection, techniques, instruments, transducers, selection, measurement location, time domain analysis, frequency domain analysis, time-frequency domain analysis and commonly witnessed machinery faults diagnosed by vibration analysis. Rotating and reciprocating machines, Vibration signals from rotating and reciprocating machines – signal classification, signals, generated by rotating machines, signals generated by reciprocating machines.

Unit –IV

Mechanical fault diagnosis, Wear monitoring and lubricant analysis - sources of contamination, techniques, Spectrometric, Oil Analysis Procedure (SOAP) and ferrography. Nondestructive testing techniques, Measurement of surface and subsurface flaws – liquid penetrant inspection, eddy current inspection, radiographic inspection, ultrasonic inspection.

Unit –V

Condition monitoring of rolling element bearings and gear, Introduction, construction, types of faults, rolling element bearing diagnostics and gear diagnostics. Tool wear monitoring, Introduction, techniques and case studies.

Learning Resources

Text books:

1. Rao J. S., Vibration Condition Monitoring, Narosa Publishing House, 2/e 2000.
2. Choudary KK., Instrumentation, Measurement and Analysis, Tata McGraw Hill.

Reference books

1. Isermann R., Fault Diagnosis Application, Springer-Verlag Berlin, 2011.
2. Allan Davis, Hand book of Condition Monitoring, Chapman and Hall, 2000.
3. Amiya Ranjan Mohanty Machinery Condition Monitoring: Principles and Practices, CRC Press, 2017.
4. Robert Bond Randall, Vibration based Condition Monitoring: Industrial, Aerospace and Automotive Applications, Wiley Publications, 2011.

e-Resources & other digital material

1. http://nptel.ac.in/courses/112103112/40

Course Outcomes

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

CO1 **Understand** the types of maintenance used and its significance, role of condition based maintenance in industries, familiarize with different condition monitoring techniques and its advantages in industries. **(KL-2)**

CO2 **Implement** the basic signal processing techniques. **(KL-3)**

CO3 **Understand** the role of vibration monitoring, its methodology and its use in condition monitoring of rotating and reciprocating machines. **(KL-2)**

CO4 **Understand** the significance of mechanical fault diagnosis and non-destructive testing techniques in monitoring and maintenance. (KL-3)

CO5 **Interpret** condition monitoring of rolling element bearing, gears and tool condition monitoring techniques in machining. **(KL-3)**

IV-Year-I Semester | **OPTIMIZATION TECHNIQUES**

L	T	P	C
3	1	0	3

PE4103X

Prerequisites:-Nil-

Course Objectives:

1. To understand the overview of optimization techniques, concepts of design space, constraint surfaces and objective function.
2. To formulate real-life problems with Linear Programming models using graphical and simplex methods.
3. To formulate real-life transportation, assignment and travelling salesman problems to find the optimum solution using transportation algorithms and to find out probability of expected completion time using PERT-CPM networks.
4. To apply dynamic programming and integer programming to optimize multi stage decision problems.
5. To determine the level of game theory and simulation modelling that a business must maintain to ensure smooth operation.

Syllabus

Unit –I

Introduction to Classical Optimization Techniques: Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems.

Classical Optimization Techniques: Single variable Optimization, Multi variable Optimization with and without constraints, Multivariable Optimization with equality constraints - solution by method of Lagrange multipliers, Multivariable Optimization with inequality constraints - Kuhn – Tucker conditions.

Unit –II

Linear Programming: Various definitions, statements of basic theorems and properties, Advantages, Limitations and Application areas of Linear Programming, Graphical method of Linear Programming problem.

Simplex Method –Phase I of the Simplex Method, Primal and Dual Simplex Method, Big –M method.

Unit –III

Transportation Problem: Finding initial basic feasible solution by north – west corner rule, least cost method and Vogel's approximation method – testing for optimality of balanced transportation problems.

Network Analysis: Introduction, Project scheduling by CPM and PERT, Network diagram representations, Rules to construct Network diagrams, Time estimates in network analysis-EST, EFT, LST, LFT, float/slack and critical path, Time estimates and Probability considerations in PERT, Crashing in PERT.

Unit –IV

Dynamic Programming: Dynamic programming multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution - examples illustrating the tabular method of solution.

Integer Programming: Pure and mixed integer programming problems, Solution of Integer programming problems – Gomory's all integer cutting plane method and mixed integer method, branch and bound method, Zero-one programming.

Unit –V

Game theory: Theory Of Games: Introduction – Terminology, Solution of games with saddle points and without saddle points, 2×2 games, dominance principle, m X 2 & 2 X n games, Graphical method.
Simulation Modelling: Introduction, Definition and types, Limitations, Various phases of modelling, Monte Carlo method, Applications, advantages and limitations of simulation

Learning Resources

Text books:

1. Engineering optimization: Theory and practice"-by S.S.Rao, New Age International (P) Limited.
2. Operations Research: An Introduction" by H A Taha, 5th Edition, Macmillan, New York.
3. Operations Research by P K GUPTA AND D S HIRA BY SCHAND PUBLICATIONS, 7E

Reference books:

1. Optimization Methods in Operations Research and systems Analysis" – by K.V. Mittal and C. Mohan, New Age, International (P) Limited, Publishers
2. Operations Research – by S.D.Sharma, KedarnathRamanath& Co
3. Linear programming, G. Hadley, Narosa Publishing House, New Delhi.
4. Industrial Engineering and Production Management,M. Mahajan, DhanpatRai& co

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

CO1: To understand the overview of optimization techniques, concepts of design space, constraint surfaces and objective function.**(KL-2)**

CO2: To formulate real-life problems with Linear Programming models using graphical and simplex methods.**(KL-3)**

CO3: To formulate real-life transportation, assignment and travelling salesman problems to find the optimum solution using transportation algorithms and to find out probability of expected completion time using PERT-CPM networks.**(KL-3)**

CO4: To apply dynamic programming and integer programming to optimize multi stage decision problems.**(KL-3)**

CO5: To determine the level of game theory and simulation modelling that a business must maintain to ensure smooth operation.**(KL-3)**

IV-Year-I Semester	AUTOMOBILE ENGINEERING	L	T	P	C
PE4103X		3	0	0	3

Prerequisites: Advanced Thermo-dynamics (IC Engines)

Course Objectives:

After successfully completing this course, student will be able to

1. Describe the layout of automobile, its components and enlist the emission standards of an automobile.
2. Describe various transmission systems.
3. Describe the steering and braking systems.
4. Describe the suspension and safety systems.
5. Describe the electrical systems

Syllabus

Unit –I

Automotive Power plant:

Introduction, components of automobiles, types of engines, classification of automobiles, types of wheel drives – two wheel drive - front and rear wheel drives, four wheel drives

Automotive exhaust system – exhaust manifold, silencer muffler-types and working Pollution control – exhaust gases that cause pollution, effects, Euro and Bharat norms and pollution control systems.

Engine servicing & maintenance – decarburization and over-hauling

Engine reconditioning - re-boring, honing and valve lapping

Unit –II

Transmission system:

Clutch – single plate, multi plate, centrifugal, cone clutches, fluid flywheel Gear box – sliding mesh, constant mesh, synchro-mesh and epi-cyclic gear boxes, torque converter

Propeller shaft – universal joint, slip joint.

Differential Live axle – classification - full floating, semi floating and three quarter floating axles

Unit –III

Control systems:

Steering mechanism – recap of Ackerman and Davis mechanisms, steering wheel, gear box, drop arm, track rod, tie rods, ball joints etc., caster, camber, toe-in, toe-out, king pin inclination.

Braking system – mechanical, hydraulic – master cylinder assembly, brake cylinder assembly, tandem master assembly, air brake system, pneumatic brakes and power assisted brakes.

Unit –VI

Suspension, chassis and body:

Suspension systems – leaf spring, coil spring, torsion bar, wishbone, independent and rigid axle systems, shock absorbers, front axle and stub axles Chassis-frame, frameless.

Body – bonnet, hood, doors, wind screen glasses, seats, child lock mechanism.

Safety – ABS, air bags, safety aspects in construction of body

Unit –V

Electrical systems and accessories:

Auto ignition system – Electronic ignition Starter motor, solenoid switch, bendix drive, alternator, relays and regulators.

Fuel and temperature gauges, speedometer, wind screen wiper, horn and wiring harness.

Electrical vehicles – introduction, working, classification and hybrid vehicles - advantages and limitations.

Content beyond Syllabus: *Wheels and tyres – alloy wheels, vulcanization of tyres Hybrid vehicles – introduction.*

Learning Resources

Text books:

1. Automobile Engineering by Kripal Singh Vol. 1 & Vol. 2
2. Automobile Engineering by R.B.Gupta, 8th edition, Tech India publication series, 2013.

Reference books:

1. A System approach to Automotive Technology by Jack Erjavec YesDee publishing pvt Ltd
2. Automobile Engineering by William Crouse
3. Automotive Mechanics by Heitner
4. Automobile Engineering by Rajput

E- RESOURCES & OTHER DIGITAL MATERIAL:

1) https://nptel.ac.in/courses/107/106/107106088/

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

CO1: Acquire the knowledge of layout of automobile, its components and emission standards of an automobile. **{Understand level, KL2}**

CO2: Knowledge of various transmission systems **{Understand level, KL2}**

CO3: Knowledge of the control systems like steering and braking mechanism **{Understand level, KL2}**

CO4: Knowledge of the suspension and safety systems **{Understand level, KL2}**

CO5: Knowledge of the auto-electrical systems and electrical vehicles **{Understand level, KL2}**

IV-Year-I Semester | **ADVANCED MANUFACTURING PROCESSES**

L	T	P	C
3	0	0	3

PE4103X

Prerequisites: Basic Manufacturing Processes

Course Objectives:

1. The course aims in identifying the classification of Advanced Manufacturing processes.
2. To understand the principle, mechanism of metal removal of various Advanced Manufacturing processes.
3. To study the various process parameters and their effect on the component manufactured on various Advanced Manufacturing processes.
4. To understand the applications of different Advanced Manufacturing processes.
5. To understand importance of Additive Manufacturing, classifications, specifications of various Additive Manufacturing Techniques.

Syllabus

Unit – I

Introduction: Need for Advanced Manufacturing processes -classification of advanced Manufacturing processes – considerations in process selection, applications.

Ultrasonic Machining – Elements of the process, mechanics of material removal, MRR process parameters, economic considerations, applications and limitations

Unit – II

Electro – Chemical Machining: Fundamentals of electro chemical machining, electrochemical grinding, electro chemical honing and deburring process, metal removal rate in ECM.

Thermal Metal Removal Processes: General principle and applications of Electric Discharge Machining, Electric Discharge Grinding and wire EDM – Power circuits for EDM, Mechanics of metal removal in EDM, Process parameters.

Unit – III

Beam Machining: Electron Beam Machining, Laser Beam Machining - Basic principle and theory, mechanics of material removal, process parameters, efficiency & accuracy, applications

Jet Machining: Abrasive jet machining, Water jet machining and abrasive water jet machining: Basic principles, equipment's, process variables, mechanics of material removal, MRR, application and limitations

Unit – IV

Introduction to Additive Manufacturing-Concept, History and Classification of AM processes, applications, advantages and limitations

Liquid-Based AM Systems:

Stereo lithography Apparatus (SLA) - Process, working principle, applications, advantages and disadvantages.

Solid Ground Curing (SGC) - Process, working principle, applications, advantages and disadvantages.

Multi Jet Printing (MJP) - Process, working principle, applications, advantages and disadvantages.

Unit – V

Solid-Based AM Systems:

Laminated object manufacturing (LOM) –Process, working principle, applications, advantages and disadvantages.

Fused deposition modelling (FDM) –Process, working principle, applications, advantages and disadvantages.

Paper Lamination: Process, working principle, applications, advantages and disadvantages.

Powder Based AM Systems:

Selective laser sintering (SLS): Process, working principle, applications, advantages and disadvantages

Direct Metal Laser Sintering (DMLS): Process, working principle, applications, advantages and disadvantages

Laser Engineered Net Shaping (LENS): Process, working principle, applications, advantages and disadvantages

Learning Resources

Text books:

1. Fundamentals of Machining Processes-Conventional and non – conventional processes/Hassan Abdel – Gawad El-Hafy/CRC Press-2016.
2. Advanced Machining Processes- Vijay K Jain-Allied Publishers.
3. Rapid prototyping: Principles and Applications /Chua C.K., Leong K.F. and LIM C.S/World Scientific publications

Reference books:

1. Modern Machining Process / Pandey P.C. and Shah H.S. / TMH.
2. New Technology / Bhattacharya A/ the Institution of Engineers, India 1984.
3. Non Traditional Manufacturing Processes / Benedict /
4. Rapid Manufacturing / D.T. Pham and S.S. Dimov/Springer
5. Wohlers Report 2000 /Terry T Wohlers/Wohlers Associates
6. Rapid Prototyping & Manufacturing / Paul F.Jacobs/ASME Press
7. Rapid Prototyping / Chua & Liou

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

CO1: Categorize the advanced manufacturing processes and interpret the principles of ultrasonic machining process **(KL-2)**

CO2: Understand the principles, processes and applications of Electro chemical and discharge Machining.**(KL-2)**

CO3: Annotate the principles, processes and applications of Beam and Jet machining.**(KL-1)**

CO4: Express about Additive manufacturing and interpret liquid based AM systems**(KL-2)**

CO5: Annotate the principles, processes and applications of solid based and powder based AM systems.**(KL-1)**

IV-Year-I Semester | **ORGANIZATIONAL BEHAVIOUR**

L	T	P	C
3	0	0	3

OE4101X

Prerequisites:-Nil-

Course Objectives:

1. To understand the conceptual framework of management and organizational behaviour and correlate them to manage 21st century organizations.
2. To analyze the real-time problems and examples related to managerial functions and concepts of decentralization.
3. To understand how an organization behaves and motivates its employees effectively.
4. To understand how dynamics and teams will act in a company for optimal output.
5. To understand and overcome the Organizational Conflict and Negotiations for steady and stable development in the industry.

Syllabus

Unit –I

INTRODUCTION:

Concept, Nature and Evolution of Management Thought: Early contributors, Scientific, process, human behaviour and social system school; Decision theory school; Quantitative and system school; Contingency theory of management; Social and Ethical issues in management, Challenges of managing 21st century corporations/organization.

Unit –II

Managerial Functions: Planning -concept, significance, types; Organizing -concept, principles, theories, types of organizations, authority, responsibility, power, delegation.

Decentralization; Staffing; Directing; Coordinating; Control -nature, process, and techniques

Organizational Behaviour: Organizational behaviour -concept and significance; Relationship between management and organizational behaviour; organizational culture, Attitudes; Perception; Learning; Personality and values; emotions and moods.

Motivation: Process of motivation; Theories of motivation - need hierarchy theory, theory X and theory Y, two factor theory, Alderfer's ERG theory, McCleland's learned need theory, Victor Vroom's expectancy theory, Stacy Adams equity theory.

Leadership Concept: Leadership styles; Theories -trait theory, behavioral theory, Fielder's contingency theory; Harsey and Blanchard's situational theory; Managerial grid; Likert's four systems of leadership, contemporary issues in leadership Group.

Dynamics and Team Development: Group dynamics -definition and importance, types of groups, group formation, group development, group composition, group performance factors; Principle-centred approach to team development

Organizational Conflict and Negotiations: Dynamics and management; Sources, patterns, levels, and types of conflict; Traditional and modern approaches to conflict; Functional and dysfunctional organizational conflicts; Resolution of conflict.

Organizational Development: Concept; Need for change, resistance to change; Theories of

planned change; organization change and stress management, Organizational diagnosis.

Learning Resources

Text books:

1. Koontz, Harold, Cyril O'Donnell, and Heinz Weihrich: Essentials of Management, Tata McGraw-Hili, New Delhi. Luthans, Fred: Organizational Behaviour, McGraw-Hili, New York.
2. Govindarajan & Natarajan: Principles of Management, Prentice Hall of India Private Limited, New Delhi.
3. Robbins, Stephen P, and Mary Coulter: Management, Prentice Hall, New Delhi. Robbins, Stephen P: Organizational Behavior" Prentice Hall, New Delhi.

Reference books:

1. Griffin, Ricky W: Organizational Behaviour, Houghton Mifflin Co., Boston.
2. Hellreigel, Don, John W. Slocum, Jr., and Richard W. Woodman: Organizational Behavior, South Western College Publishing, Ohio.
3. Hersey, Paul, Kenneth H. Blanchard and Dewey E. Johnson: Management of Organizational Behaviour: Utilizing Human Resources, Prentice Hall, New Delhi.
4. Ivancevich; John and Micheeol T.Matheson: Organizational Behaviour and Management, Business Publication Inc., Texas.
5. Newstrom, John W. and Keith Davis: Organizational Behavior: Human Behavior at Work, Tata McGraw-Hili, New Delhi.
6. Steers, Richard M. and J. Stewart Black: Organizational Behavior, Harper Collins College Publishers, and New York. Sukla, Madhukar: Understanding Organizations: Organization Theory and Practice in India, Prentice Hall, New Delhi.
7. Stoner, Freeman & Gilbert, Jr.: Management, Prentice Hall of India private Limited, New Delhi.
8. Tripathy & Reddy: Principles of Management, Tata McGraw-Hill Publications, New Delhi.
9. Fred Luthans: Organizational Behaviour, Tata McGraw-Hill Publications, New Delhi.
10. Udai Pareek: Understanding Organizational Behaviour, Oxford University Press, New Delhi.
11. S. Stephen P. Robbins: Organizational Behaviour, Prentice Hall of India Private Limited, New Delhi

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

CO1: Understand the conceptual framework of management and organizational behaviour and correlate them to manage 21st century organizations.

(KL-2)

CO2: Analyze the real-time problems and examples related to managerial functions and concepts of decentralization.**(KL-3)**

CO3: Understand how an organization behaves and motivates its employees effectively.**(KL-2)**

CO4: Understand how dynamics and teams will act in a company for optimal output.**(KL-2)**

CO5: Understand and overcome the Organizational Conflict and Negotiations for steady and stable development in the industry.**(KL-2)**

IV-Year-I Semester | **MARKETING MANAGEMENT**

L	T	P	C
3	0	0	3

OE4101X

Prerequisites:-Nil-

Course Objectives:

1. To familiarize with the basic concepts, and techniques of marketing management
2. To understand the behaviour of consumers
3. To create awareness of marketing mix elements, and
4. To analyze and solve marketing problems in the complex and fast changing business environment.

Syllabus

Unit –I

Introduction to Marketing and Marketing Management, Marketing Concepts - Marketing Process Marketing mix - Marketing environment. - Consumer Markets and buying behaviour - Market segmentation and targeting and positioning.

Unit –II

Product Decisions - concept of a Product - Product mix decisions - Brand Decision - New Product Development – Sources of New Product idea - Steps in Product Development - Product Life Cycle strategies- Stages in Product Life Cycle

Unit –III

Price Decisions - Pricing objectives - Pricing policies and constraints - Different pricing method - New product pricing, Product Mix pricing strategies and Price adjustment strategy.

Unit –IV

Channel Decision - Nature of Marketing Channels –. Types of Channel flows - Channel functions - Functions of Distribution Channel – Structure and Design of Marketing Channels -Channel co-operation, conflict and competition – Retailers and wholesalers

Unit –V

Promotion Decision - Promotion mix - Advertising Decision, Advertising objectives - Advertising and Sales Promotion – Developing Advertising Program – Role of Media in Advertising - Advertisement effectiveness - - Sales force Decision

Learning Resources

Text books:

1. K.S. Chandrasekhar, Marketing Management Text And Cases, Tata McGraw-Hill Publication, New Delhi.2010
2. Govindarajan, Marketing Management Concepts, Cases, Challenges and Trends, Prentice Hall of India, New Delhi. 2009

Reference books:

1. Philip Kotler, Marketing Management- Analysis Planning And Control, Prentice Hall of India, New Delhi,
2. Ramaswamy. V S & Namakumari. S, Marketing Management-Planning Implementation And Control, Macmillan Business Books, New Delhi, 2002,

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

CO1: familiarize with the basic concepts, and techniques of marketing management **(KL-2)**

CO2: understanding the product decisions by consumers**(KL-2)**

CO3: Create awareness of marketing price elements, **(KL-2)**

CO4: Understanding Channel decisions.**(KL-2)**

CO5: Understanding Promotion decisions **(KL-2)**

IV-Year-I Semester

ERGONOMICS

L	T	P	C
3	0	0	3

OE4101X

Prerequisites:-Nil-

Course Objectives:

1. Be exposed to principles of ergonomics.
2. Learn the mechanics of muscle physiology.
3. Be familiar with the mathematical models, analysis and design of biomedical devices using case studies.

Syllabus

Unit –I

VISUAL AND AUDITORY ERGONOMICS:

Process of seeing – visual capabilities-factors affecting visual acuity and contrast sensitivity – human factor aspects of hard copy text and computer screen text, factors in selecting graphic representations symbols, qualitative visual display-process of hearing-principles of auditory display.

Unit –II

MUSCLE PHYSIOLOGY:

Muscle physiology -muscle metabolism-respiratory response-joint motion study- measure of physiological in-efficiency and energy consumption-work rest cycles-aspects of manual and posture study, material handling (MMH) Bio-mechanical recommended limits of MMH

Unit –III

CONTROLS AND DISPLAYS:

Spatial compatibility physical arrangement of displays and controls- movement capability- rotary controls and rotar displays movement of displays orientation of the operator and movement relationships control orders and control responses- human limitations in tracking task.

Unit –IV

ANTHROPOMETRY:

Anthropometry- anthropometric design principles –work space envelope- factors in design of work space surfaces- principles of seat design –principles of control panel. Organization classification of human errors theories of accident causation-reducing accidents by altering behavior.

Unit –V

CASE STUDIES:

Case Study 1: computer design, control panel design of an electronic instrument, computer key board, hand drill etc. Case Study 2: Biomedical Application, Design optimization of Medical Equipment.

Learning Resources

Text books:

1. Pascale Carayon, Handbook of Human Factors and Engineering, Second Edition, CRC Press, 2011
2. Robert.N. Bailey, Human Performance Engineering, Third Edition, 1996
3. Martin Helander, Guide to Human Factors and Ergonomics, Second Edition, CRC Press, 2005

Reference books:

1. Shrawan Kumar, Biomechanics in Ergonomics, Second Edition, CRC Press 2007.
2. Stephen Pheasant, Christine M. Haslegrave, Body space: Anthropometry, Ergonomics and the Design of Work, CRC Press, Third Edition, 2016.

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

CO1: Understand principles of ergonomics**(KL-2)**

CO2: Design Muscle physiology**(KL-2)**

CO3: Understand movement capabilities**(KL-2)**

CO4: Design biomedical devices.**(KL-2)**

CO5: Understanding the concepts with help of CASE studies**(KL-2)**

IV-Year-I Semester | **STRATEGIC MANAGEMENT**

L	T	P	C
3	0	0	3

OE4101X

Prerequisites:-NIL-

Course Objectives:

1. To understand the concepts, components and levels of strategic management.
2. To have proficiency in competitive strategies in different types of industries.
3. To have proficiency in forms of corporate restructuring.
4. To have proficiency in forms of mergers andacquisitions.
5. To become an expert in solving the challenges of e-business strategy.

Syllabus

Unit –I

Introduction to Strategic Management–Evolution of the concept of strategic management – Company Vision **–** Mission statements **-** components of strategic management – the three levels of strategic planning – making strategic decisions. Strategic Management Process– Benefits and limitations of Strategic Management. Company Vision **–** Mission statements

Unit –II

Competitive Strategies – Cost leadership – differentiation – focus – other strategic issues – pitfalls of strategies – competitive strategies in different types of industries – formulation of strategies in an emerging industry – maturing industries – declining industries

Unit –III

Sustaining competitive advantage – Defining the value chain – the value chain and the buyer value – competitive scope and the value chain – value chain and the organizational structure. Formulating e–business strategy

Unit –IV

Corporate Restructuring-1: Forms of Corporate Restructuring: Expansion, Sell- offs, Turnaround Management, Joint Ventures and Strategic Alliances, Mergers &Acquisitions, Diverstitures and Spin offs.Takeover Strategies and Defenses: Kinds of Takeovers.The challenges of e-business strategy creation: Top-down analytical planning, Bottom-up just-do-it planning, continuous planning with Feedback.

Unit –V

Corporate Restructuring-2: Roadmap to a move a company into e–business: Knowledge building, capability evolution, e–business design. Implementing e– business strategies **–** e–business blueprint creation: Why is a blueprint necessary, e– business blueprint planning: steps of blueprint planning, A prioritization blueprint: current way of prioritizing projects, Types of e–business projects.

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

CO1: Understand the concepts, components and levels of strategic management.**(KL-2)**

CO2: Have proficiency in competitive strategies in different types of industries.**(KL-2)**

CO3: Have proficiency in forms of corporate restructuring**(KL-2)**

CO4: Have proficiency in forms of Mergers and acquisitions.**(KL-2)**

CO5: Become an expert in solving the challenges of e-business strategy. **(KL-2)**

IV-Year-I Semester | **HUMAN RESOURCE MANAGEMENT**

L	T	P	C
3	0	0	3

OE4102X

Prerequisites:-Nil-

Course Objectives:

1. To Integrated perspective on role of HRM in modern business
2. To able to plan human resources and implement techniques of job design
3. To compete to recruit, train, and appraise the performance of employees
4. To rational design of compensation and salary administration
5. To develop ability to handle employee issues

Syllabus

Unit –I

Introduction: Importance and Functions, Scope of HRM, Human Resource Management in a changing environment;

Unit –II

Manpower Planning: Manpower planning process, Job Description and Job specification, Job analysis and Job design; Techniques of Job design.

Unit –III

HR Processes: Employee Selection and Development - Recruitment, Selection and Induction, Training and Development, Performance Appraisal. Compensation Planning- Employee Compensation,Job evaluation, Employee Benefits and Welfare, Compensation and Salary Administration.

Unit –IV

Governance: Integration and Separation- Employee Discipline, Suspension, Dismissal and Retrenchment; Employee Grievance Handling, Trade Unionism, Collective Bargaining, Industrial Democracy.

Unit –V

New Trends in HRM: HRM in India, HRM in International Firms, talent management, HR Accounting, HR Audit, HRIS

Learning Resources

Text books:

1. Dessler, Human Resource Management, Pearson Education, Eleventh edition, New Delhi, 2011.

Reference books:

1. Raymond Andrew Noe, John R. Hollenbeck, Barry Gerhart, Patrick M Wright, Human Resource Management, 8th Ed., The McGraw Hill Pub, 2012
2. Louis & Gomitz Mejia et. al: Managing Human Resources, 7th Ed., Pearson Education, 2011.

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

CO1: Integrated perspective on role of HRM in modern business**(KL-2)**

CO2: Ability to plan human resources and implement techniques of job design**(KL-2)**

CO3: Compete to recruit, train, and appraise the performance of employees**(KL-2)**

CO4: Rational design of compensation and salary administration **(KL-2)**

CO5: Develop ability to handle employee issues**(KL-2)**

IV-Year-I Semester | **PRODUCT DESIGN AND DEVELOPMENT**

L	T	P	C
3	0	0	3

OE4102X

Prerequisites: Material Science, Basic Manufacturing Processes

Course Objectives:

1. Demonstrate technical competency in practice.
2. Function effectively in an industrial and academic environments.
3. Engage in professional ethics and development.
4. Enrich their society and environment through their skills.

Syllabus

Unit –I

Introduction to Product Development: Introduction, Need for developing products,the importance of engineering design, Identifying customer needs, Creative thinking, creativity and problem solving, creative thinking methods- generating design concepts-systematic methods for designing, morphological methods-TRIZ- axiomatic design.

Unit –II

Industrial Design: human factors design, user friendly design, design for serviceability, design for environment,prototyping and testing,cost evaluation, categories of cost, overhead costs,activitybased costing,methods of developing cost estimates, manufacturing cost,value analysis in costing.

Unit –III

PRODUCT AND PROCESS ENGINEERING TOOLS: Tools for concept development, Tools for process improvement, statistical process control, bench marking and establishing engineering specifications, project management.

Unit –IV

Materials Selection for Product Development:

Material behavior and selection: Mechanism of Plastic deformation-yield stress and shear strength-Perfect and Real crystals- Effect of strain rate and temperature on plastic behavior- Super plasticity, Selection of material for mechanical properties Strength, toughness and fatigue- Material selection for durability and surface wear and Corrosion resistance- Manufacturing characteristics of metals.

PROCESS MODELING: Basic analysis of process Forging, Drawing and sheet metal forming-machining- Turning- modern materials- micro alloyed and dual phase steel- High strength low alloy metals- Smart materials- Shape memory metals- Metallic Glasses- Nano Materials- Metal foams-Properties and applications for product design.

DEVELOPMENT IN MATERIALS PROCESSING: Micro fabrication technologies- Tool for micro fabrication- Diamond and high speed machining- LIGA micro fabrication process- Multilayer X-ray lithography.

Unit –V

Quality Concepts in Product Development: Quality Function Deployment, design process-Identification of control factors, noise factors, developing the experimental plan- experimental design –testing noise factors Running the experiments.

FAILURE MODE EFFECT ANALYSIS: Basic methods: Refining geometry and layout, general process of product embodiment, Advanced methods: systems modeling, mechanical embodiment principles-FMEA method.
DESIGN FOR SIX SIGMA: Basis of SIX SIGMA –Project selection for SIX SIGMA- SIX SIGMA problem solving- SIX SIGMA in service and small organizations - SIX SIGMA and lean production – Lean SIX SIGMA and services.

Learning Resources

Text books:

1. Engineering Design, George E Deiter, 5th Edition, McGraw-Hill, 2012.
2. Product Integrity and Reliability in Design, John W.Evans and Jillian Y.Evans, Springer Verlag.
3. Karl T Ulrich, Steven D Eppinger, "Product Design & Development." Tata McGrawhill New Delhi 2003
4. Kevin N. Otto and Kristin L. Wood - Product Design Pearson Education 2001
5. Kevin Otto & Kristin Wood Product Design: "Techniques in Reverse Engineering and new Product Development." 1 / e 2004, Pearson Education New Delhi
6. L D Miles "Value Engineering."

Reference books:

1. The Product Management Handbook, Richard S. Hanscombe, McGRAW – Hill
2. New Product Design, Ulrich Eppinger
3. Product Design ,Kevin Otto
4. David G Ullman, "The Mechanical Design Process." McGrawhill Inc Singapore 1992 N J M Roozenberg, J Ekels, N F M Roozenberg "Product Design Fundamentals and Methods." John Willey & Sons 1995
5. Boothroyd G, Dewhurst P and Knight W, Product Design for Manufacture and Assembly, 2nd Edition, Marcel Dekker, New York, 2002.
6. Hollins B & Pugh S "Successful Product Design." Butter worths London.
7. Baldwin E N & Neibel B W "Designing for Production." Edwin Homewood Illinois
8. Jones J C "Design Methods." Seeds of Human Futures. John Willey New York.
9. Bralla J G "Handbook of Product Design for Manufacture, McGrawhill New York**.**
10. A K Chitale and R C Gupta, Product Design and Manufacturing, 6th Edition, PHI, New Delhi, 2003.

Web links:

1. https://nptel.ac.in/courses/112107217
2. Vladimir Petrov, Theory of Inventive Problem Solving, Level 1, Springer Series, 2019, ISBN: 978-3-030-04253-0.

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

CO1: Understand the basic concepts of engineering design and product development **{Understand level, KL2}**

CO2: Understand the effects of other human factors **{Understand level, KL2}**

CO3: Understand and apply the various tools used for design development analysis and optimization. **{Understand level, KL2}**

CO4: Understand the behaviour of various metals and non-metals **{Understand level, KL2}**

CO5: Understand about the quality function deployment, design process **{Understand level, KL2}**

IV-Year-I Semester | **CUSTOMER RELATIONSHIP MANAGEMENT**

L	T	P	C
3	0	0	3

OE4102X

Prerequisites: Basic knowledge of management.

Course Objectives:

1. Demonstrate technical competency in practice.
2. Function effectively in an industrial and academic environments.
3. Engage in professional ethics and development.
4. Enrich their society and environment through their skills.

Syllabus

Unit –I

Emerging Concepts in Customer Relationship Management: CRM Definition, Need and Importance: Conceptual Framework of Customer Relationship Management; The Value Pyramid, Customer Interaction Cycle, Customer Profiling and Total Customer Experience, Goals of a CRM Strategy and Obstacles, CRM Solutions Map, Discussing People, Processes and Technology, CRM myths

Unit –II

CRM as a Business Strategy: CRM - Issues and Strategies; Winning Markets through Effective CRM; CRM as a business strategy, CRM Process, Effective Customer Relation Management through Customer Knowledge Management; Customer Interaction Management, Call Centre management in CRM. Customer Centricity in CRM-Concept of Customer centricity, Customer touch points, Customer Service, Measuring Customer lifetime value-. Customer life cycle Management

Unit –III

Technological Tools for CRM: Data Mining for CRM - Some Relevant Issues; Changing Patterns of e-CRM Solutions in the Future; Structuring a Customer Focused IT Organization to Support CRM

Unit –IV

Implementation Organizational Framework for Deploying Customer Relationship; measuring profitability CRM implementation –set by step process.

Unit –V

CRM in Services : Status of Customer Relationship Management in service industry in India; Relevance of CRM for Hospital Services; Customer Relationship Management in Banking and Financial Services; CRM in Insurance Sector, Supply-Demand Mismatches and their impact on CRM; The Past, Present and Future of CRM.

Learning Resources

Text books:

1. Jagdish NSheth,Parvatiyar Atul, G Shainesh, Customer Relationship Management:

Emerging Concepts, Tools and Applications, 1st Edition, Tata McGraw Hill, June 2008

Reference books:

1. Judith W. Kincaid, Customer Relationship Management Getting it Right, Pearson Education
2. H. Peeru Mohamed, A Sagadevan ,Customer Relationship Management, A Step by Step Approach, Vikas Publishing House
3. Customer Centricity–Focuson right customer for strategic advantage, by Peter Fader, Wharton Digital Press, 2012

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

CO1: Apply the concept of CRM, the benefits delivered by CRM, the context sinwhichit is used, the technologies that are deployed and how it can be implemented.**(KL-2)**

CO2: Implement how CRM practices and technologies enhance the achievement of marketing, sales and service objectives throughout the customer life-cycle stages of customer acquisition**(KL-2)**

CO3: Retention and development whilst simultaneously supporting broader organizational goals.**(KL-2)**

CO4: Implement various technological tools for data mining and also successful implementation of CRM in the Organization.**(KL-2)**

CO5: Designcustomerrelationshipmanagementstrategiesbyunderstandingcustomers' preferences for the long-term sustainability of the Organizations.**(KL-2)**

IV-Year-I Semester	MATERIALS FOR ENGINEERING	L	T	P	C
OE4102X		3	0	0	3

Prerequisites: Knowledge of physics and chemistry

Course Objectives:

1. The student shall be able to understand the properties of materials
2. The student shall be able to understand the process for testing the materials.
3. The student shall be able to understand the process of changing the properties of materials
4. The student shall be able to understand the properties applications of steels, cast irons and other non-ferrous metals
5. The student shall be able to understand the applications of composites and ceramics in engineering.

Syllabus

Unit –I

Introduction, Classification, Mechanical properties of materials like stress, strain, hardness, creep, fatigue etc. space lattice, miller indices, amorphous and crystalline structure of materials

Unit –II

Grain formation, size measurement, defects – point, line and surface defects, metallurgical and mechanical testing of materials, constitution of alloys and their necessity

Unit –III

Phase diagrams, heat treatment – annealing, normalizing, hardening, tempering and surface treatments, TTT curves

Unit –IV

Steels, cast iron, copper and its alloys, aluminium and its alloys, introduction to other metals like Zinc, Titanium etc.

Unit –V

composite materials – classification, applications, pros and cons, ceramics – classification, applications, glasses, nano materials

Learning Resources

Text books:

1. Introduction to Physical metallurgy by Sydney Avner, Tata Mc Grawhill
2. Materials science by Rajput

Reference books:

1. Materials science and engineering by Callister R Balasubramanian
2. Material science and metallurgy by Kodgiri

Course Outcomes: By the completion of the course the student will be able to understand the properties, behaviour and applications of different materials used in engineering.Upon successful completion of the course, the student will be able to

CO1: Understand the properties of materials**(KL-2)**

CO2: Understand the process for testing the materials.**(KL-2)**

CO3: Understand the process of changing the properties of materials**(KL-2)**

CO4: Understand the properties applications of steels, cast irons and other non-ferrous metals**(KL-2)**

CO5: Understand the applications of composites and ceramics in engineering.**(KL-2)**

IV-Year-I Semester | **Skill Course 5 - PLM & ROBOTICS LAB**

L	T	P	C
3	0	0	3

SAC4101

Prerequisites: -Nil-

Course Objectives:

1. Demonstrate technical competency in practice.
2. Function effectively in an industrial and academic environment.
3. Engage in professional ethics and development.
4. Enrich their society and environment through their skills

Syllabus

Unit –I

COMPONENTS OF THE INDUSTRIAL ROBOTICS: Function line diagram representation of robot arms, common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, determination of the end effectors, comparison of Electric, Hydraulic and Pneumatic types of locomotion devices. Forward & Inverse Kinematics, Communication, Safety

Unit –II

Introduction to Robot Studio, building stations, programming robots, simulating programs, File tab, Home tab, Modeling tab, Simulation tab, Controller tab, RAPID tab, Add-Ins tab, How to create Links, Joints, Robots Flex pendent with IRC5 Controller Intro, Navigating and handling Flex Pendant, Jogging, Rapid Overview, RAPID programming, Motion and I/O programming RAPID Instructions, Functions and Data types Functions, Data types, Programming type examples, Back Up & Restore Abb

Unit –III

Online Programming of ABB Robots: IRB 140 Material Handling Robot, IRB 6700 Spot Welding Robot, IRB 1520 Arc Welding Robot

Unit –IV

Introduction to Teamcenter, Working in Teamcenter, working with items in Teamcenter, Viewing and modifying the object properties, Creating and managing data sets, applying data security practices, Performing and managing searches.

Unit –V

Working in projects, Opening and viewing product structures, Controlling Assembly configuration views, Creating and Managing the product structures, Working with Product Structures, Navigating the relation hierarchy of an object, Viewing and working with visualization files, initiating a workflow, managing workflow task assignments, Managing Teamcenter data through the Microsoft office integration, Working in teamcenter thin client

Learning Resources

Text books:

1. Siemens ROBOTICS & PLM Course material
2. Web reference: https://new.abb.com/products/robotics/robotstudio/tutorials
3. Teamcenter Engineering and Product Lifecycle Management Basics by Stephen M. Samuel (Author), Eric D. Weeks and Mark A. Kelley (Author) Design Visionaries, Inc.; 1st edition (24 November 2006) ISBN-10 : 0975437747
4. Industrial Robotics / Groover M P /Pearson Edu.
5. Robotics and Control / Mittal R K & Nagrath I J / TMH.

Reference books:

1. Robotics / Fu K S/ McGraw Hill.
2. Robotic Engineering / Richard D. Klafter, Prentice Hall
3. Robot Analysis and Control / H. Asada and J.J.E. Slotine / BSP Books Pvt.Ltd.
4. Introduction to Robotics / John J Craig / Pearson Edu.
5. Product Lifecycle Management - Driving the Next Generation of Lean Thinking Author: Michael Grieves DOI: 10.1036/0071452303 ISBN: 0071452303

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

CO1: Illustrate the basic components of Robots **{Remember level, KL1}**

CO2: Develop offline programming using ABB Robotstudio software **{Apply level, KL3}**

CO3: Operate& create online program for various robots in Welding and material handling applications **{Apply level, KL3}**

CO4: Understand the concept of PLM basics **{Understand level, KL2}**

CO5: Understand team center software and apply its usage in the concept of PLM **{Apply level, KL3}**