VASIREDDY VENKATADRI INSTITUTE OF TECHNOLOGY

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

DEPARTMENT OF MECHANICAL ENGINEERING

COURSE STRUCTURE AND SYLLABUS (R19)

for

B. Tech Mechanical Engineering

(Applicable for batches admitted from 2019-2020)

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

ACADEMIC REGULATIONS (R19) FOR B. TECH. (REGULAR)

Applicable for the students of B. Tech. (Regular) from the Academic Year 2019-20 onwards

The B.Tech Degree of Jawaharlal Nehru Technological University Kakinada, Kakinada shall be conferred on candidates who are admitted to the programmeand who fulfill all the requirements for the award of the Degree.

VISION

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

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 andcognitive, 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.

OBJECTIVES

- Equip the institute with state of the art infrastructure comparable to thebest in the industry.
- Tap the resources of the best minds in the field as faculty and visitingfaculty.
- Groom students to become global entrepreneurs and responsible citizens.
- Provide financial assistance to meritorious students.
- Requisition the services of the best HR managers to place our students inreputed industries.
- Provide conducive atmosphere to the faculty for Research & Developmentand ensure active participation of the students.

1. Admission Criteria

The eligibility criteria for admission into UG Engineering programmes are as per the norms approved by Government of Andhra Pradesh from time to time. The sanctioned seats in each programme in the college are classified into CATEGORY-A, and CATEGORY-B at 1st year level and only CATEGORY-A at Lateral Entry 2nd year level. The percentages of Category–A, Category-B and Lateral Entry Seats are decided from time to time by the Government of Andhra Pradesh.

- CATEGORY – A (70%): These seats are filled through Convener, EAMCET as per the norms approved by the Government of Andhra Pradesh.
- CATEGORY – B (30%): These seats are filled by the College as per the norms approved by the Government of Andhra Pradesh.
- Lateral Entry: Lateral entry candidates shall be admitted into the Third semester directly as per the norms approved by the Convener, ECET, and Government of Andhra Pradesh.

2. Award of B. Tech. Degree

A student will be declared eligible for the award of B. Tech. Degree if hefulfills the following academic regulations:

- A student after securing admission shall complete the B.Tech programmein a minimum of four academic years (8 Semesters), and a maximum period of eight academic years starting from the date of commencementof first year first semester, failing which student shall forfeit seat in B.Tech Course. Each student shall secure 160 credits (with CGPA>=4) required for the completion of the under graduate programme and awardof B.Tech Degree.

3. Courses of Study

The following courses of study are offered at present as specializations forthe B. Tech. Courses

S. No	Branch	Branch Code	Intake
1	Civil Engineering	01	120
2	Electrical and Electronics	02	180

3	Mechanical Engineering	03	180
4	Electronics and Communication	04	180
5	Computer Science and Engineering	05	240
6	Information Technology	12	180

4. Distribution and Weightage of Marks

i)The performance of a student in each semester shall be evaluated subject wise with a maximum of 100 marks for theory subject and 75 marks for practical subject. The Mini project work shall be evaluated for 50 marks and the Major Project work shall be evaluated for 150 Marks.

ii) For theory subjects the distribution shall be 40 marks for Internal Evaluation and 60 marks for the Semester End Examinations.

iii) For theory subjects, during the semester there shall be two internal Mid Examinations. The weightage of internal marks for 40 consists of Descriptive Test – 15 Marks, Assignment Test- 10 Marks (Open book system with questions of L4 standard on Bloom's scale), Objective Test - 10 Marks and Subject Seminar 5 marks.The Descriptive Test is for 90 minutes duration conducted for 30 marks and will be scaled down to 15 Marks. Each Descriptive test question paper shall contain 3 questions, one question from each unit and all questions need to be answered. All the questions shouldbe mapped to all levels of Blooms Taxonomy.

- The Assignment Test conducted for 20 Marks and will be scaled down to 10 Marks. The test is open book system and the duration of the exam is 60 minutes. The assignment question paper contains 3 questions given by the subject teacher concerned and all questions should be answered. Students can bring a maximum of three printed text books related tothat subject. (Soft copies of the text books will not be allowed.) Theassignments have to provide broadened exposure to the course. The questions shall include problem solving approach, problem analysis & design, implementation, case studies etc.

- The objective examination is for 20 minutes duration. (Conducted with 20 multiple choice question with a weightage of ½ Mark each)

- For the subject seminar, marks of 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.
- Internal Marks shall be calculated with 70% weightage for better of thetwo Mid Exams and 30% weightage for other.

iv) The Semester End Examination shall be conducted for 3 hours duration. The question paper shall be given in the following pattern: The question paper contains one question from each unit with internal choice. Each question carries 12 marks. Each course shall consist of five units of syllabus. The questions shall be framed in line with the Course Outcomes defined and cognitive levels.

v) For practical subjects there shall be continuous evaluation during the semester for 25 marks and 50 Marks for Semester end examination. The internal 25 marks shall be awarded as follows: day to day work - 05 marks, Record-05 marks and the remaining 15 marks are to be awarded by conducting an internal laboratory test of 3 hours duration. The semester end examination for laboratory courses shall be conducted for three hour duration at the end of semester for 50 marks as follows: Procedure - 10 marks, Experiment/Program execution – 15 Marks, Results-10 Marks and Viva-voice -15 Marks. For laboratory course in English 30 marks for written exam which includes listening comprehension and 20 marks for viva which includes JAM and Group Discussion.

vi) For the subject having design and / or drawing, (such as Engineering Graphics, Engineering Drawing, Machine Drawing) and estimation, the distribution shall be 40 marks for internal evaluation (20 marks for day–to– day work, and 20 marks for internal tests) and 60 marks for end examination. There shall be two internal tests in a Semester and the Marks for 20 can be calculated with 70% weightage for better of the two performances and 30% weightage for other and these are to be added tothe marks obtained in day-to-day work.

vii) For Engineering Project for Community services / Mini Project, there shall be continuous evaluation during the semester for 20 marks and semester end evaluation for 30 marks. The distribution of continuous evaluation marks is as follows: Day to Day Assessment- 05 Marks and average of two reviews of 15 Marks each.The distribution of semester end examination marks for Engineering Project for Community services/Mini Project is as follows: Report -10 Marks and Presentation and Viva Voce – 20 Marks.

vii) For Major Project, there shall be continuous evaluation during the semester for 50 marks and semester end evaluation for 100 marks The distribution of continuous evaluation marks is as follows: Day-to-day Assessment- 30 Marks and average of at least two reviews of 20 Marks each. The Departmental review committee consists of HoD, Two senior Faculty and supervisor concerned.The semester end examination for Major Project work shall be conducted at the end of VIII Semester. It is evaluated by the Committee consisting of an external examiner, Head of the Department, Senior Faculty and Supervisor of the Project

viii) Laboratory marks and the internal marks awarded by the faculty are final. However, any grievance regarding marks will be addressed by the result committee if necessary. The recommendations of the committee are final and binding.

ix) MOOCS Courses: All students are eligible to register and complete MOOCS courses relevant to their professional electives listed by the respective departments in the curriculum.However, if any student fails to complete a MOOCS course, or the course is not offered by the agency concerned, that student is eligible to attend the examination following the same syllabus and pattern of examination in the VIII semester.The MOOCS grades awarded to the student by the agency are converted to the course grades based on the percentage of marks obtained. The duration for course registered under MOOCS should range between8 to 12 Weeks.

x) A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to Industrial Oriented Mini Project/Summer Internship/practical training, if the student secures not less than 40% of marks (i.e., 40 out of 100 allotted marks) in each of them. The student is deemed to have failed, if he/she (i) does not submit a report on Industrial Oriented Mini Project/Summer Internship, or doesnot make a presentation of the same before the evaluation committee asper schedule, or (ii) does not present the seminar as required, or (iii) secures less than 40% of marks in Industrial Oriented Mini Project/Summer Internship and project seminar evaluations. A student may reappear once for each of the above evaluations, when they are scheduled again; if the student fails in such ‘one reappearance’ evaluation also, the student has to reappear for the same in the next subsequent semester, as and when it is scheduled.

5. Attendance Requirements

- ➢ Students shall put in a minimum average attendance of 75% in the semester. Condonation of shortage in attendance may be recommended by respective Heads of Departments on genuine medical grounds, provided the student puts in at least 65% attendance provided the Principal is satisfied with the genuineness of the reasons and the conduct of the student.
- ➢ Students, having more than 65% and less than 75% of attendance, shall have to pay requisite fee towards condonation.
- ➢ Students whose shortage of attendance is not condoned in any semester are not eligible to take their end examinations of that semester. They get detained and their registration for that semester shall stand cancelled. They will not be promoted to the next semester. They may rejoin in that semester in which the student is detained by getting approval from the principal.
- ➢ If any candidate fulfils the attendance requirement in the present semester, he shall not be eligible readmit into the same class.

6. Minimum Academic Requirements

The following academic requirements have to be satisfied in addition to the attendance requirements mentioned in item No.5

- ➢A student is deemed to have satisfied the minimum academic requirements if he has earned the credits allotted to each theory/practical design/drawing subject/project and secures not less than 35% of marks in the end semester exam, and minimum 40% of marks in the sum total of the internal marks and end semesterexamination marks.
- ➢ A student shall be promoted from first year to second year if he fulfillsthe minimum attendance requirement.
- ➢A student will be promoted from II year to III year if he fulfills the academic requirement of

40% of the credits up to II B.Tech II semester from all the examinations.

- ➢ A student shall be promoted from III year to IV year if he fulfills the academic requirements of 40% of the credits up to III year II semester from all the examinations.
- ➢ A student shall register and put up minimum attendance in all 160 credits and earn all 160 credits.Break in Study: Student who discontinues the studies for whatever may be the reason, can get readmission into appropriate semester of B. Tech programme after break in study, with the prior permission of the Principal and following the transitory regulations applicable to each batch in which he/she joins. A student may utilize this break in study (Maximum of Two years) only once in the entire period of B. Tech program.

7. Course Pattern

- ➢ The entire course of study is for four academic years, all the years are on semester pattern and the medium of instruction is English.
- ➢ A student who 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.
- ➢ When a student is detained for lack of credits/shortage of attendance, he may be readmitted in to the same semester in which he has been detained. However, the academic regulations under which he was first admitted shall continue to be applicable to him.

8. CGPA

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 (Theory/Lab)	Letter Grade	Level	Grade Points
≥ 90	**O**	Outstanding	10
≥80 to <90	**S**	Excellent	9
≥70 to <80	**A**	Very Good	8
≥60 to <70	**B**	Good	7

≥50 to <60	**C**	Fair	6
≥40 to <50	**D**	Satisfactory	5
<40	**F**	Fail	0
ABSENT	**AB**	Absent	0

Computation of SGPA

- The performance of each student at the end of the each semester is indicated in terms of Semester Grade Point Average(SGPA)calculated asshown in below equation (1).

  - **SGPA (Si) = ∑ (Ci X Gi) / ∑ Ci---------**(1)

- Where Ci is the number of credits of the ith course and Gi is the grade pointscored by the student in the ith course.

Computation of CGPA

- The Cumulative Performance of each student at the end of each semester isindicated in terms of CGPA is calculated as shown in equation (2).

  - **CGPA = ∑ (C_i X S_i) / ∑ C_i ------------------**(2)

- Where Si is the SGPA of the i^{th} semester and C_i is the total number ofcredits in that semester.

- The SGPA and CGPA shall be rounded off to 2 decimal points andreported in the transcripts.

- The approximate equivalence of marks to a given CGPA is calculated byusing the formula:

  - Percentage Equivalence of CGPA = [CGPA – 0.5] x 10

9. **Award of Class**

The criterion for award of division, after successful completion of program isas shown in the following table.

Class Awarded	CGPA to be secured	From the CGPAsecured from 160 credits
First Class with distinction*	≥7.75	
First Class	≥6.5 - <7.75	
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/start-ups will also be considered for award of first class with distinction
- ➢ For the purpose of awarding First, Second and Pass Class, CGPA obtained in the examinations appeared within the maximum period allowed for the completion of the program shall been considered.

10. Minimum Days of Instructions

Each semester consists of a minimum of 90 instruction days excludingexamination days.

11. Transfer of Branch

There shall be no branch transfer after the completion of the first year admission process.

12. Withholding of results

If the student has not paid any dues to the college or if any case of indiscipline is pending against him/her, the result of the student will be withheld. His/her degree will be withheld in such cases.

13.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 theacademic regulations be applicable to him/her which are in force at the timeof 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.

14. Amendments to Regulations

Revisions of Regulations, Curriculum and Syllabi

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.

15. 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.

ACADEMIC REGULATIONS (R19) FOR B. TECH.(LATERAL ENTRY SCHEME)

Applicable for the students admitted into II year B. Tech. from the AcademicYear 2020-21 onwards

1. Award of B. Tech. Degree

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

- ➢ A student shall be declared eligible for the award of the B. Tech Degree, if he pursues a course of study in not less than three academic years and not more than six academic years.
- ➢ The candidate shall register for 120 credits and secure all the 120 credits. The attendance regulations of B. Tech. (Regular) shall be applicable to B.Tech Lateral Entry Students.

2. 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 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.

3. 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	From the CGPA
First Class with distinction*	≥7.75	secured from 121 credits for CE,EEE and MECH Branches, 119.5 credits for ECE,CSE & IT Branches
First Class	≥6.5 - <7.75	
Second Class	≥5.5 - <6.5	
Pass Class	≥4 - <5.5	
Fail	<4	

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/Improperconduct	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 withor 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 candidateis to be cancelled and sent to the University.

3.	Impersonates any other candidate in connection withthe 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 allUniversity examinations. The continuation of the course by the candidate is subject to theacademic 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 Answerbook 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 theexamination.	Expulsion from the examination hall and cancellation of performance in that subject andall 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. Thecandidate 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 performancein that subject.
6.	Refuses to obey the orders of the Chief Superintendent /Assistant – Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred

	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.	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	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

	inside or outside the examination hall.	candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9.	If student of the college, who is not a candidate for the particular examination or any person not connected	Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared

	with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	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 behanded over to police and, apolice case will be registered against them.
10.	Comes in a drunken condition to the examinationhall.	Expulsion from the examination hall and cancellation of the performance in that subject andall other subjects the candidate has already appeared including practical examinations andproject work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11.	Copying detected on thebasis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate hasappeared 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 tothe University for furtheraction to award suitable punishment.	

Ragging

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

Ragging

ABSOLUTELY NO TO RAGGING

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

In case any emergency call Toll Free No. 1800 425 1288
LET US MAKE VVIT A RAGGING FREE CAMPUS

Department of Mechanical Engineering

B.Tech. 1st Year Proposed Course Structure (w.e.f AY 2019-20)

I Year I Semester (Semester-1)

S. No.	Course Code	Course Title	L	T	P	Credits
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	Programming for Problem Solving Using C	3	1*	0	3
5	ES1102	Engineering Graphics	1	0	3	2.5
6	HS1101L	Communicative English Lab-I	0	0	3	1.5
7	BS1102L	Engineering Physics Lab	0	0	3	1.5
8	ES1101L	Programming for Problem Solving Using C Lab	0	0	3	1.5
9	MC1101	Constitution of India	3	0	0	0
		Total Credits				**19**

Category	**CREDITS**
Basic Science Course	7.5
Engineering Science Course	7.0
Humanities and Social Science	4.5
Mandatory Course	0.0
TOTAL CREDITS	**19.0**

I Year II Semester (Semester-2)

S. No.	Course Code	Course Title	L	T	P	Credits
1	BS1201	Mathematics - II	3	1*	0	3
2	BS1202	Mathematics - III	3	1*	0	3
3	BS1203	Engineering Chemistry	3	1*	0	3
4	ES1201	Engineering Mechanics	3	1*	0	3
5	ES1202	Basic Electrical and Electronics Engineering	3	1*	0	3
6	HS1201L	Communicative English Lab - II	0	0	3	1.5
7	ES1203L	Engineering Workshop	0	0	3	1.5
8	BS1203L	Engineering Chemistry Lab	0	0	3	1.5
9	ES1202L	Basic Electrical and Electronics Engineering Lab	0	0	3	1.5
10	MC1201	Environmental Science	3	0	0	0
		Total Credits				**21**

Category	CREDITS
Basic Science Course	10.5
Engineering Science Course	09
Humanities and Social Science	1.5
Mandatory Course	0.0
TOTAL CREDITS	21

II Year I Semester (Semester-3)

S. No.	Course Code	Course Title	L	T	P	Credits
1	BS2101	Complex Variables and Statistical Methods	3	1*	0	3
2	PC2101	Mechanics of Solids	3	1*	0	3
3	PC2102	Material Science and Metallurgy	3	1*	0	3

4	PC2103	Production Technology	3	1*	0	3
5	PC2104	Thermodynamics	3	1*	0	3
6	ES2101	Computer Aided Advanced Engg. Drawing	1	0	3	2.5
7	PC2103L	Production Technology Lab	0	0	3	1.5
8	PC2105L	Metallurgy & Mechanics of Solids Lab	0	0	3	1.5
9	MC2101	Essence of Indian Traditional Knowledge	2	0	0	0
		Total Credits				20.5

Category	**CREDITS**
Basic Science Course	3
Professional Core courses	15
Engineering Science Course	2.5
Mandatory Course	0.0
TOTAL CREDITS	20.5

II Year II Semester (Semester-4)

S.No	Course Code	Course Title	L	T	P	Credits
1	PC2201	Kinematics of Machinery	3	1*	0	3
2	PC2202	Applied Thermodynamics	3	1*	0	3
3	PC2203	Fluid Mechanics and Hydraulic Machines	3	1*	0	3
4	PC2204	Design of Machine Members-I	3	1*	0	3
5	ES2201	Python Programming	3	1*	0	3
6	PC2202L	Thermal Engineering Lab	0	0	3	1.5
7	PC2203L	Fluid Mechanics and Hydraulic Machines Lab	0	0	3	1.5
8	PC2205	Machine Drawing	1	0	2	2
9	ES2201L	Python Programming Lab	0	0	3	1.5
10	PR2201	Socially relevant project	0	0	2	0
		Total Credits				21.5

Category	**CREDITS**
Professional Core courses	17
Engineering Science Course	4.5
Socially relevant project	0
TOTAL CREDITS	21.5

III Year I Semester (Semester-5)

S. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credits**
1	PC3101	Dynamics of Machinery	3	1*	0	3
2	PC3102	Design of Machine Members-II	3	1*	0	3
3	PC3103	Metal Cutting and Machine Tools	3	1*	0	3
4	PC3104	Finite Element Methods	3	1*	0	3
5	ES3101	Fundamentals & Principles of Internet of Things	3	1*	0	3
6	ES3101L	Fundamentals & Principles of Internet of Things Lab	0	0	3	1.5
7	PC3101L	Theory of Machines Lab	0	0	3	1.5
8	PC3103L	Machine Tools Lab	0	0	3	1.5
		Total Credits				19.5

Category	CREDITS
Professional Core courses	15
Engineering Science Course	4.5
TOTAL CREDITS	19.5

III Year II Semester (Semester-6)

S. No	Course Code	Course Title	L	T	P	Credits
1	OE320X	**Open Elective -I** 1. MEMS 2. Optimization methods 3. Operations Management 4. Nano Technology	3	1*	0	3
2	PC3201	Heat Transfer	3	1*	0	3
3	HS3201	Managerial Economics and Financial Accountancy (Common to EEE & ME)	3	1*	0	3
4	PE320X	**Professional Elective- I** 1. Composite Materials 2. Refrigeration & Air Conditioning 3. Advanced Manufacturing Processes 4. Statistical Quality Control	3	1*	0	3
5	PE320X	**Professional Elective- II** 1. Advanced Mechanics of Solids 2. Power Plant Engineering 3. Design for Manufacturing & Assembly 4. Mechatronics	3	1*	0	3
6	PC3201L	Heat Transfer Lab	0	0	3	1.5
7	PC3202L	Simulation Lab	0	0	4	1.5
8	PR3201	Mini Project	0	0	6	3
		Total Credits				21

SUMMER INTERNSHIP

(INTER SEMESTER)

S. No.	Course Code	Course Title	L	T	P	Credits
1	PROJ- ME	Summer Internship	0	0	60 Hrs	0

Category	CREDITS
Professional Core courses	6
Professional Elective courses	6
Open Elective courses	3
Humanities and Social Science	3
Mini Project	3
TOTAL CREDITS	21

IV Year I Semester (Semester-7)

S. No.	Course Code	Course Title	L	T	P	Credits
1	HS4101	Management Science (Common to ME & EEE)	3	1*	0	3
2	PE410X	Professional Elective- III 1. Mechanical Vibrations 2. CAD/CAM 3. Renewable Energy Sources 4. Production Planning Control	3	1*	0	3
3	PE410X	Professional Elective- IV 1. Automation in Manufacturing 2. Additive Manufacturing 3. Automobile Engineering 4. Optimization Techniques	3	1*	0	3

4	OE410X	**Open Elective -II** 1. Industrial psychology 2. Safety Engineering 3. Basics of Fluid Mechanics and Heat Transfer 4. Traditional and Modern Machining	3	1*	0	3
5	PC4101	Instrumentation Control Systems and Engineering Metrology	3	1*	0	3
6	PC4101L	Instrumentation Control Systems and Engineering Metrology Lab	0	0	2	1.5
7	PR4101	Project 1	0	0	6	3
		Total Credits				19.5

Category	CREDITS
Professional Core courses	4.5
Humanities and Social Science	3
Professional Elective courses	6
Open Elective courses	3
Project	3
TOTAL CREDITS	19.5

IV Year II Semester (Semester-8)

S. No.	Course Code	Course Title	L	T	P	Credits
1	PE420X	**Professional Elective- V** 1. Industrial Robotics 2. Gas Dynamics and Jet Propulsion 3. Nano Materials 4. Reliability Engineering	3	1*	0	3

2	PE420X	**Professional Elective- VI** 1. Condition Monitoring 2. Computational Fluid Dynamics 3. Non-Destructive Evaluation 4. Industrial Hydraulics and Pneumatics	3	1*	0	3
3	OE420X	**Open Elective -III** 1. Green Energy Systems 2. Robotics 3. Energy Consumption and Management 4. IPR& Patents	3	1*	0	3
4	OE420X	**Open Elective -IV** 1. Total Quality Management 2. Supply Chain Management 3. Product Design & Development 4. Entrepreneurship	3	1*	0	3
5	PR4201	Project 2	0	0	12	6
		Total Credits				18

Category	**CREDITS**
Professional Elective courses	6
Open Elective courses	6
Project	6
TOTAL CREDITS	18

PROFESSIONAL ELECTIVES

Professional Elective- I	Professional Elective- II
1. Composite Materials 2. Refrigeration & Air Conditioning 3. Advanced Manufacturing Processes 4. Statistical Quality Control	1. Advanced Mechanics of Solids 2. Power Plant Engineering 3. Design for Manufacturing & Assembly 4. Mechatronics
Professional Elective- III	**Professional Elective- IV**
1. Mechanical Vibrations 2. CAD/CAM 3. Renewable Energy Sources 4. Production Planning Control	1. Automation in Manufacturing 2. Additive Manufacturing 3. Automobile Engineering 4. Optimization Techniques
Professional Elective- V	**Professional Elective- VI**
1. Industrial Robotics 2. Gas Dynamics and Jet Propulsion 3. Nano Materials 4. Reliability Engineering	1. Condition Monitoring 2. Computational Fluid Dynamics 3. Non-Destructive Evaluation 4. Industrial Hydraulics and Pneumatics

OPEN ELECTIVES OFFERED BY DEPARTMENT

Open Elective- I	Open Elective- II
1. MEMS 2. Optimization methods 3. Operations Management 4. Nano Technology	1. Industrial psychology 2. Safety Engineering 3. Basics of Fluid Mechanics and Heat Transfer 4. Traditional and Modern Machining

Open Elective- III	Open Elective- IV
1. Green Energy Systems 2. Robotics 3. Energy Consumption and Management 4. IPR& Patents	1. Total Quality Management 2. Supply Chain Management 3. Product Design & Development 4. Entrepreneurship

Category	CREDITS
Basic Science Course	21
Engineering Science Course	27.5
Humanities and Social Science	12
Professional core courses	57.5
Professional Elective courses	18
Open Elective courses	12
Summer Internships and Projects	12
Mandatory Courses	00
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 Members II	4	0	0	4
4	Automation in Manufacturing	Production Technology	4	0	0	4
5	Experimental Techniques and Data Analysis	ICS and Metrology	4	0	0	4

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

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

I-Year-I Semester	COMMUNICATIVE ENGLISH	L T P C
HS1101		3 1* 0 3

(Common to All Branches)

Course Objectives

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

Course Outcomes

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

1. identify the context, topic, and pieces of specific information from social or transactional dialogues spoken by native speakers of English (L3)
2. formulate sentences using proper grammatical structures and correct word forms (L3)

3. speak clearly on a specific topic using suitable discourse markers in informal discussions (L3)

4. write summaries based on global comprehension of reading/listening texts (L3)

5. produce a coherent paragraph interpreting a figure/graph/chart/table (L4)

6. take notes while listening to a talk/lecture to answer questions (L3)

Syllabus Blueprint

Contents	**Learning Outcomes**	**Bloom's Level**	**No of Hrs**
Unit-1 **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: countables and uncountables; singular and plural; basic sentence structures; simple question form - wh-questions; word order in sentences.	1. Identify the context, topic, and pieces of specific information from social or transactional dialogues spoken by native speakers of English 2. ask &answer general questions on familiar topics 3. employ suitable strategies for skimming &scanning to get the general idea of a text and specific information 4. recognize paragraph structure with beginnings/endings 5. form sentences using proper grammatical structures and correct word forms	L3 L2 L3 L3 L3	10

Unit-2 **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, sign posts and transition signals; use of articles and zero article; prepositions.	1. comprehend short talks on general topics 2. speak clearly on a specific topic using suitable discourse markers in informal discussions 3. understand the use of cohesive devices for better reading comprehension 4. write well-structured paragraphs on specific topics 5. make necessary grammatical corrections in short texts	L2 L3 L2 L3 L3	10
Unit-3 **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.	1. summarize the content with clarity &precision from short talks 2. report what is discussed in informal discussions 3. infer meanings of unfamiliar words using contextual clues 4. write summaries based on global comprehension of reading/ listening texts 5. use correct tense forms, appropriate structures and a range of reporting verbs in speech and writing	L3 L3 L3 L3 L3	10

Unit-4 **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	1. infer &predict about content of spoken discourse 2. engage in formal/informal conversationsunderstanding verbal &non-verbal features of communication 3. interpret graphic elements used in academic texts 4. produce a coherent paragraph interpreting a figure / graph / chart / table 5. use language appropriate for description and interpretation of graphical elements	L4 L3 L2 L4 L4	10

Unit-5 **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)	1. take notes while listening to a talk/lecture to answer questions 2. make formal oral presentations using effective strategies 3. produce a well-organized essay with adequate details 4. edit short texts by correcting common errors	L3 L3 L3 L4	10

Detailed Syllabus

Unit 1 A Proposal to Girdle the Earth (Excerpt) by Nellie Bly

Theme: Exploration

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

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

Listening

- ➢ identifying thetopic, the context and specific pieces of information

Speaking

- ➢ introducing oneself and others

Reading

- ➢ skimming for main ideas
- ➢ scanning for specific pieces of information

Writing/ Reading for Writing

- ➢ paragraphs, beginnings, introducing the topic, key words, main idea

Grammar and Vocabulary

- content words and function words
- word forms: verbs, nouns, adjectives and adverbs
- nouns: countable and uncountable; singular and plural forms
- basic sentence structures; simple question form: why-questions; word order in sentences

Learning Outcomes

- understand social or transactional dialogues spoken by native and non-native speakers of English and identify the context, topic, and pieces of specific information.
- ask and answer general questions on familiar topics and introduce oneself/others
- employ suitable strategies for skimming and scanning to get the general idea of a text and locate specific information
- recognize paragraph structure and be able to match headings/main ideas with paragraphs
- form sentences using proper grammatical structures and correct word forms

Unit 2 An excerpt from The District School As It Was by One Who Went to It by Warren Burton

Theme: On Campus

- "How to Conquer the Ten Most Common Causes of Failure" by Lois Binstock
- "How to Develop Your Strength to Seize Opportunities" by Maxwell Maltz

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; preparing and delivering short structured talks using suitable cohesive devices

Reading

- identifying sequence of ideas

- ➢ recognizing verbal techniques that help link the ideas in a paragraph

Writing/ Reading for Writing

- ➢ paragraph writing (specific topics) using suitable cohesive devices; using key words/phrases and organizing points in a coherent manner
- ➢ mechanics of writing: punctuation, capital letters

Grammar and Vocabulary

- ➢ cohesive devices-linkers, sign posts and transition signals
- ➢ use of articles and zero articles
- ➢ prepositions

Learning Outcomes

- ➢ comprehend short talks on general topics
- ➢ participate in informal discussions and speak clearly on a specific topic using suitable discourse markers
- ➢ understand the use of cohesive devices for better reading comprehension
- ➢ write well-structured paragraphs on specific topics using suitable cohesive devices
- ➢ identify basic errors of grammar/usage and make necessary corrections in short texts

Unit 3 The Future of Work?

Theme: Working Together

- ➢ **"How to Make the Most of Your Abilities" by Kenneth Hildebrand**
- ➢ **"How to Raise Your Self-Esteem and Develop Self-Confidence" by James W. Newman**

Listening

- ➢ listening for global comprehension
- ➢ summarizing what is listened to

Speaking

- discussing specific topics in pairs/ small groups
- 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/ Reading for Writing

- summarizing-identifying main idea/s
- 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

Learning Outcomes

- comprehend short talks and summarize the content with clarity and precision
- participate in informal discussions and report what discussed
- infer meanings of unfamiliar words using contextual clues
- write summaries based on global comprehension of reading/listening texts
- use correct tense forms, appropriate structure and a range of reporting verbs in speech and writing.

Unit 4 H.G Wells and the Uncertainties of Progress by Peter J. Bowler

Theme: Fabric of Change

- **"How to Win Your War Against Negative Feelings" by Dr Maxwell Maltz**
- **"How to Find the Courage to Take Risks" by Drs Tom Rust and Randy Reed**

Listening

- ➢ making predictions while listening to conversations/transactional dialogues without video
- ➢ listening with video

Speaking

- ➢ role plays for practice of conversational English in social and academic contexts (formal & informal)
- ➢ asking for and giving information/directions/instructions/suggestions

Reading

- ➢ understand and interpret graphic elements used in texts (convey information, reveal trends/ patterns/relationships, communicate processes or display data)

Writing/ Reading for 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

Learning Outcomes

- ➢ make inferences and predictions while listening to spoken discourse
- ➢ understand verbal and non-verbal features of communication and hold formal / informal conversations
- ➢ interpret graphic elements used in academic texts

- ➢ produce a coherent paragraph interpreting a figure/graph/chart/table
- ➢ use language appropriate for description and interpretation of graphical elements

Unit 5 Leaves from the Mental Portfolio of a Eurasian by Sui Sin Far

Theme: Tools for Life

9. **“How to Become a Self-Motivator” by Charles T Jones**
10. **“How to Eliminate Your Bad Habits “by OgMandino**

Listening

- ➢ identifying the key terms
- ➢ understanding concepts
- ➢ 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/ Reading for Writing

- ➢ writing structured essays on specific topics using suitable claims and evidences

Grammar and Vocabulary

- ➢ reinforcing learning: articles, prepositions, tenses, subject-verb agreement

Learning Outcomes

- ➢ take notes while listening to a talk/lecture and make use of them to answer questions
- ➢ make formal oral presentations using effective strategies
- ➢ comprehend, discuss and respond to academic texts oral and in writing

- produce a well-organized essay with adequate support and detail
- edit short texts by correcting common errors

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I-Year-I Semester	MATHEMATICS – I (Calculus)	L T P C
BS1101		3 1* 0 3

(Common to ALL branches)

Course Objectives:

- This course will illuminate the students in the concepts of calculus.
- To enlighten the learners in the concept of differential equations and multivariable calculus.
- 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, 44^{th} 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, 22^{nd} Edition, S. Chand & Company Ltd.
2. **Erwin Kreyszig**, Advanced Engineering Mathematics, 10^{th} Edition, Wiley-India.

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

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

Micro-Syllabus of MATHEMATICS – I (Calculus)

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

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

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

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

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 $x^n V(x)$ - Method of Variation of Parameters.

Applications: LCR circuit – Simple harmonic motion

Unit	Module	Micro content
3a. & 4a. **Linear differential equations of higher order**	Homogeneous equations of higher order with constant coefficients	Finding the Complementary function
	Non-homogeneous equations of higher order with constant coefficients	Particular integral of the type $'e^{ax}'$
		Particular integral of the type 'sinax' (or) $'\cos ax'$
		Particular integral of the type x^n
		Particular integral of the type $'e^{ax}\text{V(x)}'$
		Particular integral of the type $'\text{x}^n\text{v(x)}'$
3b. & 4b. **Applications**	Applications of Non-homogeneous equations of higher order with constant coefficients	Method of variation of parameters
		LCR circuit
		Basic problems on 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	Module	Micro content
5a. & 6a. **Mean value theorems**	Mean value theorems	Rolle's theorem
		Lagrange's mean value theorem
5b. & 6b. **Mean value**	Mean value theorems	Cauchy's mean value theorem
		Taylor's expansions of $f(x)$

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

Unit-4: Partial differentiation:

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

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

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

Unit-5: Multiple integrals:

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

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

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

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

Course Objectives:

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

The course is designed to:

- ➢Impart Knowledge of physicaloptics 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 ultrasonics.
- ➢Study the structure- property relationship exhibited by solid materials within the elastic limit.

Unit-I: Wave Optics:

Interference: PrincipleofSuperposition-Interferenceoflight – ConditionsforsustainedInterference-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 Ajoy Ghatak, 6th Edition McGraw Hill Education, 2017.

3. “Solid State Physics” by A.J.Dekker, Mc Millan Publishers (2011).

Course Outcomes:

The students will be able to

1. **Understand** the principles such as interference and diffraction to design and enhance the resolving power of various optical instruments.
2. **Learn** the basic concepts of LASER light Sources and Apply them to holography
3. **Study** the magnetic and dielectric materials to enhance the utility aspects of materials.
4. **Analyze** acoustic properties of typically used materials in buildings
5. **Understand** the concepts of shearing force and moment of inertia

Micro-Syllabus of Engineering Physics

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

Ia. Interference	Principle of Superposition &Interference of light	Principle of superposition
		Coherence
		Conditions for sustained Interference
	Interference in thin films	Interference in thin films by reflection (cosine's law)
		Complementary nature
		Colours of thin film
	Newton's Rings	Newton's Rings(reflected geometry)
		Experimental arrangement & conditions for diameters
		Applications: determination of wavelength of monochromatic source and refractive index of the given transparent liquid.
Ib.Diffraction	Fraunhofer Diffraction - Diffraction due to single slit	Differences between Fresnel's and Fraunhofer's diffraction
		Differences between interference and diffraction
		Fraunhofer diffraction due to single slit(quantitative)
		Fraunhofer diffraction due to circular aperture (qualitative)
	double slit (qualitative) & N –slits(qualitative)	Fraunhofer diffraction due to double slit (qualitative)
		Fraunhofer diffraction due to grating (N- slits) (qualitative)
		Intensity distribution curves
		Grating spectrum, missing orders and maximum number of orders possible with a grating

	Diffraction grating& Resolving powers	Rayleigh’s criterion for resolving power
		Resolving power of grating, Telescope and Microscope (qualitative)

Unit– II: LASERs and Holography

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

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

Unit	**Module**	**Micro content**
IIa.LASERs	Interaction of radiation with matter	Introduction to LASERS
		Spontaneous emission
		Stimulated emission
	Einstein’s coefficients	Einstein'scoefficients
		Populationinversion
		Pumping mechanisms
	LASERS construction and working	Rubylaser
		Helium-Neon laser
		Applications of Lasers
IIb.Holography	Principle of holography	Introduction and Principle of holography
		Differences between photography and holography
	construction and reconstruction of hologram	Construction of hologram
		Reconstruction of hologram
		Applications of holography

Unit-III: Magnetism and Dielectrics

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

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

Unit	**Module**	**Micro content**
IIIa. Magnetism	Introduction& Origin of permanent magnetic moment	Introduction to Magnetism, Definitions of Magnetic dipole moment, Magnetization, Magnetic susceptibility and Permeability
		Originofmagneticmoment
		Bohr magneton
	Classification of magnetic materials	Dia magnetic materials
		Para magnetic materials
		Ferro magnetic materials
	Domain concept of Ferromagnetism & Hysteresis	Domain concept of Ferromagnetism
		Hysteresis Curve
		Soft and hard magnetic materials classification based on Hysteresis Curve
		Applications of magnetic materials
IIIb. Dielectrics	Introduction& definitions	Introduction to dielectrics
		Dielectric polarization, Dielectric polarizability, susceptibility
		Dielectric constant
	Types of polarizations	Electronic polarization (Quantitative)
		Ionic polarization (Quantitative)

IIIb.Dielectrics		Orientational polarizations (Qualitative)
	Internal field& Claussius –Mossotti's equation	Lorentz Internalfieldsinsolids
		Clausius-Mossotti'sequation
		Frequency dependence of polarization
		Applications of Dielectrics

Unit-IV: ACOUSTICS AND ULTRASONICS

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

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

Unit	**Module**	**Micro content**
IVa.Acoustics	Introduction&Reverberation	Introduction to acoustics
		Definition of Reverberation
		Definition of Reverberation time
	Sabine's formula&absorption	Sabine's formula derivation
		Absorption coefficient
		Determination of Absorption coefficient
	Factors affecting acoustics of buildings	Basic requirements for acoustically good halls
		Factors affecting acoustics of buildings and their remedies
IVb.Ultrasonics	Properties &Production of ultrasonics	Introduction and Properties of Ultrasonics
		Production of ultrasonics by Magnetostriction method
		Production of ultrasonics by Piezoelectric method
		Non-Destructive Testing using Pulse echo system

IV b.Ultrasonics	Non-Destructive Testing	Non-Destructive Testingthrough transmission and reflection modes
	Different scanning techniques	A - Scan
		B - Scan
		C - Scan
		Applications of Ultrasonics

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

Unit	**Module**	**Micro content**
V.ELASTICITY	Stress & strain	Introduction to Elasticity, Stress & Strain
		Stress & Strain curve (Behaviour of a wire under increasing load)
		Generalized Hooke's law
	Different types of moduli and their relations	Young's modulus, Bulk modulus, Rigidity modulus and Poisson's ratio
		Relations among Young's, Bulk and Rigidity moduli
	Bending of beams	Bending of beams
		Bending moment of a beam
		Cantilever and depression of cantilever (Cantilever supported at its ends and loaded in the middle)

I-Year-I Semester		L T P C
ES1101	PROGRAMMING FOR PROBLEM SOLVING USING C	3 1* 0 3

(Common to All Branches)

Course Objectives:

- ➢ To familiarize to notion of an algorithm, editing and executing programs in Linux.
- ➢ To Understanding branching, iteration.
- ➢ To represent Data using arrays.
- ➢ To use Modular programming and recursive solution formulation.
- ➢ To familiarize pointers and dynamic memory allocation.
- ➢ 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, Multi-way selection: switch, else-if, examples. **Repetition**: Basic Loop Structures, Pre-test and Post-test Loops, Counter-Controlled andCondition-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: After completing this course, Students will be able to-

CO 1: Understand algorithms and basic terminology of C

CO 2: Solve problems using control structures and modular approach

CO 3: Make use of 1D and 2D arrays along with strings for linear data handling

CO 4: Determine the use of pointers and structures

CO 5: Implement various operations on data files.

Micro-Syllabus of Programming for Problem Solving Using C

UNIT I: Introduction to Computers: Hardware, Memory hierarchy, Types of Computers, Types of Software – Operating Systems, Translators, Device drivers and packages. Algorithms and its characteristics, Program development steps. Structure of a C program, Features of C, The main () Function, Standard I/O functions. **Programming Style** - Indentation, Comments, Identifiers, Data Types**,** Operators, Precedence and Associativity. Variables and Declarations, Format Modifiers, Escape Sequences, Types of Statements **Casting -** Implicit Type Conversions, Explicit Type Conversions, Mathematical Library Functions		
Unit	**Module**	**Micro content**

Introduction to C	Introduction to Computers	Components of Computer: Hardware & Software
		Algorithm and its characteristics
		Program development steps
		Structure of a C Program
		Features of C
		The main () function and standard I/O functions
	Programming Style	Indentation, Comments, Identifiers, Data Types
		Operators, Precedence and Associativity. Variables and Declarations
		Format Modifiers, Escape Sequences
		Types of Statements
	Casting	Implicit Type Conversions
		Explicit Type Conversions
		Mathematical Library Functions

UNIT II: Selection: if-else Statement, nested if, examples, Multi-way selection: switch, else-if, examples. **Repetition**: Basic Loop Structures, Pre-test and Post-test Loops, Counter-Controlled andCondition-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	**Module**	**Micro content**
	Selection Statements	if else, nested if examples
		Multi Way Selection: switch, else if examples
	Iterative Statements	Counter Controlled Loops
		Logic Controlled Loops

Control Flow & Modular Programming	Unconditional Branching	Break & Continue
	Modular Programming	Function and Parameter Declarations
		Returning a Value
		Types of parameters. Parameter – scalar data as argument.
	Recursion	Definition, Base condition for recursion
		Mathematical Recursion
		Recursion versus Iteration

UNIT III: Arrays: Introduction to Arrays, Input and Output of Array Values, Array Initialization, Arraysas Function Arguments, Two-Dimensional Arrays, Larger Dimensional Arrays- Matrices, 1D & 2D arrays as arguments.

Strings: String Fundamentals, String Input and Output, String Processing, Library Functions, Strings as arguments.

Unit	**Module**	**Micro content**
Arrays & Strings	Arrays	Introduction to Arrays, Input and Output of Array Values, Array Initialization
		Arraysas Function Arguments
		Two-Dimensional Arrays, Larger Dimensional Arrays
		Matrices, 1D & 2D arrays as arguments
	Strings	String Fundamentals, String Input and Output
		String Processing, Library Functions
		Strings as arguments

UNIT IV: Pointers: Concept of a Pointer, Initialization of Pointer variables, Pointers as function arguments,Passing by address, Dangling memory, Pointer Arithmetic, Character pointers, Pointers to Pointers, Array of pointers & Pointer to array, Dynamic memory management functions, Command line Arguments.

Structures: Derived types, Structures declaration, Initialization of structures, accessing structures,nested structures, arrays of structures, structures and functions, pointers to structures, self-referential structures, unions, typedef, enum, bit-fields.

Unit	Module	Micro content
Pointers and Structures	Pointers	Concept of a Pointer, Initialization of Pointer variables
		Pointers as function arguments,Passing by address
		Dangling memory, Pointer Arithmetic, Character pointers
		Pointers to Pointers
		Dynamic Memory Allocation
		Pointer to Arrays and Array of Pointers
	Command line Arguments	Command line Arguments
	Structures	Derived types, Structures declaration, Initialization of structures
		Accessing structures,nested structures, arrays of structures
		structures and functions, pointers to structures, self-referential structures
		Unions, typedef, enum, bit-fields.

UNIT V: Storage classes – auto, static, extern, register. Preproessor statements

Data Files: Declaring, Opening, and Closing File Streams, File handling functions, Reading from and Writing to TextFiles, File copy, merge, Writing and reading records, Random File Access.

Unit	Module	Micro content
Storage Classes and Files	Storage Classes	auto, static, extern and register
	Preprocessor Statements	Preprocessor Statements
	Data Files	Declaring, Opening, and Closing File Streams
		File handling functions, Reading from and Writing to TextFiles
		File copy, merge, Writing and reading records

		Random File Access

I-Year-I Semester		L T P C
ES1102	**ENGINEERING GRAPHICS & DESIGN**	1 0 0 2.5

Course Objectives:

- ➢ Expose the students to use Drafting packages for generating Engineering curves and conventions followed in Preparation of engineering drawings.
- ➢ Make the students to understand the concepts of orthographic projections of Lines and Plane Surfaces.
- ➢ To understand the concepts of orthographic projections of Regular Solids.
- ➢ Develop the ability of understanding sectional views and Development of Solid Surfaces.
- ➢ 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

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

Websites

1 .https://www.autodesk.com.au/campaigns/autocad-tutorials

2. https://nptel.ac.in/courses/112104172

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

CO1:	Prepare erinngineeg 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}

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

Course Objectives

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

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

Course Outcomes

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

1. identify the context, topic, and pieces of specific information from social or transactional dialogues spoken by native speakers of English and speak clearly on a specific topic using suitable discourse markers in informal discussions (L3)
2. take notes while listening to a talk/lecture; to answer questions in English; formulate sentences using proper grammatical structures and correct word forms; and use language effectively in competitive examinations (L3)
3. write summaries based on global comprehension of reading/listening texts; produce a coherent write-up interpreting a figure/graph/chart/table; and use English as a successful medium of communication. (L3)

Detailed Syllabus

CALL based activity. English course books selected for classroom teaching will be used for practice in the computer-based language labs. However, a brief introduction to the English Phonetics will be given to the students. Activities that encourage individual learning of the students based on the suggested texts and web resources will be used in the practical sessions.

Introduction to Sound System of English

Articulation - Airstream mechanism, Manners of Articulation, Places of Articulation, English phonetic symbols.Accent - Syllabification, word stress and accent, stress rules and stress shift, exceptions to rules.Intonation - Stress and accent in connected speech. Types and functions of Intonation in English.
Pair work, Role play, conversational practice and Individual speaking activities based on following essays from ***University of Success.***

- "How to Fashion Your Own Brand of Success" by Howard Whitman
- "How to Recognize Your Failure Symptoms" by Dorthea Brand
- "How to Conquer the Ten Most Common Causes of Failure" by Lois Binstock
- "How to Develop Your Strength to Seize Opportunities" by Maxwell Maltz
- "How to Make the Most of Your Abilities" by Kenneth Hildebrand
- "How to Raise Your Self-Esteem and Develop Self-Confidence" by James W. Newman

- ➢ "How to Win Your War Against Negative Feelings" by Dr Maxwell Maltz
- ➢ "How to Find the Courage to Take Risks" by Tom Rust and Randy Reed
- ➢ "How to Become a Self-Motivator" by Charles T Jones
- ➢ "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 (to be released)

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

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

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

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

Sample Web Resources

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

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

Course Objectives:

The Applied Physics Lab is designed to:

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

Course Outcomes:

The students will be able to:

- Operate optical instruments like microscope and spectrometer
- Determine thickness of a paper with the concept of interference
- Estimate the wavelength of differentcolours using diffraction grating and resolving power
- Plot the intensity of the magnetic field of circular coil carrying current with distance
- Calculate the band gap of a given semiconductor

LIST OF EXPERIMENTS

(Any 10 of the following listed 15 experiments)

- Determination of wavelength of a source-Diffraction Grating-Normal incidence.

- Newton’s rings – Radius of Curvature of Plano - Convex Lens.
- Determination of thickness of a spacer using wedge film and parallel interference fringes.
- Magnetic field along the axis of a current carrying coil – Stewart and Gee’s apparatus.
- Energy Band gap of a Semiconductor p - n junction.
- Characteristics of Thermistor – Temperature Coefficients
- Determination of dielectric constant by charging and discharging method
- Variation of dielectric constant with temperature
- Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
- LASER - Determination of wavelength by plane diffraction grating
- Verification of laws of vibrations in stretched strings – Sonometer.
- Determine the radius of gyration using compound pendulum
- Rigidity modulus of material by wire-dynamic method (torsional pendulum)
- Dispersive power of diffraction grating.
- Determination of Hall voltage and Hall coefficients of a given semiconductor using Hall Effect.

I-Year-I Semester		L T P C
ES1101L	PROBLEM SOLVING USING C LAB	0 0 3 1.5

Course Objectives:

- ➢ Apply the principles of C language in problem solving.
- ➢ To design flowcharts, algorithms and knowing how to debug programs.
- ➢ To design & develop of C programs using arrays, strings pointers & functions.
- ➢ 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

- **Comprehend** the various concepts of a C language
- **Develop** algorithms and flowcharts
- **Design** and development of C problem solving skills.
- **Acquire** modular programming skills.

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I-Year-I Semester		L T P C
MC1101	CONSTITUTION OF INDIA	3 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

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

Course Objectives:

- To elucidate the different numerical methods to solve nonlinear algebraic equations
- To disseminate the use of different numerical techniques for carrying out numerical integration
- 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: (10 hrs)

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: (12 hrs)

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: (10 hrs)

Trapezoidal rule–Simpson's $1/3^{rd}$ and $3/8^{th}$ rule–Solution of ordinary differential equations by Taylor's series–Picard's method of successive approximations–Euler's method–Modified Euler's method–Runge-Kutta method (second and fourth order).

UNIT–4: Laplace Transforms: (14 hrs)

Laplace transforms of standard functions – Shifting theorems – Transforms of derivatives and integrals – Unit step function – Dirac's delta function –Periodic function - Inverse Laplace transforms – Convolution theorem (without proof)

Applications: Evaluation of integrals using Laplace transforms - Solving ordinary differential equations (Initial value problems) using Laplace transforms.

UNIT 5: Fourier series and Fourier Transforms: (14 hrs)

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

- ➢ Evaluate approximate in the roots of polynomial and transcendental equations by different algorithms (EVALUATE)
- ➢ 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)
- ➢ 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)
- ➢ Find or compute the Fourier series of periodic signals (SOLVE ,APPLY, FIND, ANALYSE)
- ➢ Know and be able to apply integral expressions for the forwards and inverse Fourier transform to range of non-periodic waveforms (SOLVE , APPLY, FIND)

Micro-Syllabus of MATHEMATICS-II

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

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

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

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

Unit	Module	Micro content
2a. Equal-Spaced difference tables	Finite difference tables	Forward, backward & central difference tables
		Errors in polynomials
	Finding functional values for given data	Newton's forward and backward difference interpolation formula
		Gauss forward and backward difference interpolation formula
2b. Unequal spaced data & relation between various operators	Unequal spaced data & relation between various operators	Lagrange's interpolation formula
		Relation between various operators (Shift, forward, backward, central, average & differential operators)

UNIT-3: Numerical integration and solution of ordinary difference equations:

Trapezoidal rule–Simpson's $1/3^{rd}$ 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	Module	Micro content
3a. **Numerical integration**	Numerical Integration	Trapezoidal rule
		Simpson's $1/3^{rd}$ rule
		Simpson's $3/8^{th}$
3b. **Numerical solution of ordinary differential equations for single variable**	Numerical solution of ordinary differential equations for single variable	Taylors series method
		Picard's method
		Euler's method
		Modified Euler's method

UNIT – 4: Laplace Transforms: Laplace transforms of standard functions – Shifting theorems – Transforms of derivatives and integrals – Unit step function – Dirac's delta function –Periodic function - Inverse Laplace transforms – Convolution theorem (without proof)

Applications: Evaluation of integrals using Laplace transforms - Solving ordinary differential equations (Initial value problems) using Laplace transforms.

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

UNIT 5: Fourier series and Fourier Transforms:

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

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

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

I-Year-II Semester		
BS1202	**MATHEMATICS-III**	**L T P C** **3 1* 0 3**

Course Objectives:

1. To instruct the concept of Matrices in solving linear algebraic equations
2. To familiarize the techniques in partial differential equations
3. To furnish the learners with basic concepts and techniques at plus two level to lead them into advanced level by handling various real-world applications

UNIT-I:Solving system of linear equations, Eigen values and Eigen Vectors (12 hrs)

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

UNIT-II: Cayley-Hamilton theorem and quadratic forms: (12 hrs)

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: (10 hrs)

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: (12 hrs)

Line integral – Work done – Circulation- Surface integral- Volume integral Vector integral theorems (without proof): Greens theorem in a plane- Stokes theorem- Gauss Divergence theorem.

UNIT– V: Solutions of Partial differential Equations (14 hrs)

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:

2. **B.S. Grewal,** Higher Engineering Mathematics, 44th Edition, Khanna Publishers.

Reference Books:

4. **B.V. Ramana,** Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

5. **H.K.Das,** Advanced Engineering Mathematics, 22nd Edition, S. Chand & Company Ltd.

6. **Erwin Kreyszig**, Advanced Engineering Mathematics, 10th Edition, Wiley-India.

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

- ➢ develop the use of matrix algebra techniques that is needed by engineers for practical applications (L6)
- ➢ solve system of linear algebraic equations using Gauss elimination, Gauss Jordan (L3)
- ➢ to interpret the physical meaning of different operators such as gradient, curl and divergence (L5)
- ➢ estimate the work done against a field, circulation and flux using vector calculus (L5)
- ➢ identify the solution methods for partial differential equation that model physical processes (L3)

Micro-Syllabus of MATHEMATICS – III

UNIT-I: Solving system of linear equations, Eigen values and Eigen Vectors

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

Unit	**Module**	**Micro content**
1a. Solving system of linear equations	Rank of the given matrix	Find rank of the given matrix by reducing into Echelon form.
		Find rank of the given matrix by reducing into Normal form.(Canonical form)
	System of linear equations	Solve the system of homogeneous linear equations.
		Solve the system of Non- homogeneous linear equations.
		Solve the given system of linear equations using Gauss Elimination method.
		Solve the given system of linear equations using Gauss Jordan method.
1b.Applications	Eigen values and Eigen vectors	Find eigen values and Eigen vectors of given matrix.
	Properties of Eigen values and Eigen	If λ is an eigen value of Matrix A then find eigen values of A^m or A^{-1} or $B = A^2+k_1A+K_2I$ or ….

	values and Eigen vectors	The eigen vectors corresponding to distinct eigen values of real symmetric matrix are orthogonal.

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.

Unit	**Module**	**Micro content**
	Cayley-Hamilton theorem	Verify Cayley-Hamilton theorem for given matrix A and hence find A^{-1} or A^4.
	Quadratic Forms	Reduce the given matrix into diagonal form.
		Reduce the quadratic form into canonical form using orthogonal transformation method.

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	**Module**	**Micro content**
3a. Vector Differential operator	Divergent, Curl and Gradient	Find Gradient of given scalar function.
		Find Unit normal vector at given point on given surface.
		Find divergent or Curl of given vector function.
3b. Vector identities	Vector identities	Find Scalar potential function.
		Problems on Laplacian second order operator.
		Prove the given vector identity.

UNIT– IV: Vector Integration:

Line integral – Work done – Circulation- Surface integral- Volume integral Vector integral theorems (without proof): Greens theorem in a plane- Stokes theorem- Gauss Divergence theorem.

Unit	**Module**	**Micro content**
4a. Vector integration	Line integraton, surface integration & volume integration	Evaluate given line integration along the given curve.
		Find work done by force in moving a particle from A to B along curve C.
		Find surface integral of vector function.
		Find volume integral of vector function.

4b. **Vector integration theorems**	Green's theorem ,Stoke's theorem and Gauss Divergence throem.	Verify Green's theorem.
		Evaluate using stoke's theorem.
		Evaluate using 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 $e^{ax+by}, \sin(ax+by), \cos(ax+by), x^m y^n$.

Unit	Module	Micro content
5a. First order PDE	Formation of PDE	Form PDE by eliminating arbitrary constants.
		Form PDE by eliminating arbitrary functions.
	Solve First order PDE	Solve first order linear PDE.
		Solve first order non linear PDE.
5b. Higher order PDE	Solve Second order PDE.	Solve Second order linear PDE with constant coefficients with RHS terms $e^{ax+by}, \sin(ax+by), \cos(ax+by), x^m y^n$.

I-Year-II Semester	ENGINEERING CHEMISTRY	L T P C
BS1203		3 1* 0 3

Knowledge of basic concepts of chemistry for Engineering students will help them as professional engineers later in design and material selection as well as utilizing the available resources.

Learning Objectives:

➢ Significance and use of plastics in household appliances and composites (FRP) in aerospace and automotive industries.

➢ Outline the basics for the construction of electrochemical cells, batteries and fuel cells.Understand the mechanism of corrosion and how it can be prevented.

➢ Importance of advanced materials and their engineering applications.

➢ 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.

➢ Essentiality of fuel technology.

➢ Need of water purification and importance of various water purification methods.

UNIT-I: POLYMER TECHNOLOGY 14 HRS

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

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

***Elastomers**:* Natural rubber-Drawbacks-Vulcanization-Preparation-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 12 HRS

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

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

UNIT-III: CHEMISTRY OF MATERIALS 12 HRS

***Nano materials**:* Introduction, sol-gel method, characterization by BET, SEM and TEM methods, applications of graphene- carbon nanotubes and fullerenes: Types, preparation of carbon nanomaterials by carbon-arc, laser ablation method, and applications.

Refractories: Definition , classification, properties (refractoriness, refractoriness under load, porosity and thermal spalling), failure of refractories.

Lubricants: Definition, mechanism of lubricants and properties (definition and importance).

Cement: Constituents, manufacturing, parameters to characterize the Clinker formation: lime saturation factor (LSF), silica ratio (SR), and alumina ratio (AR). Chemistry of setting and hardening, deterioration of cement.

UNIT-IV: FUELS 12 HRS

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

UNIT-V: WATER TECHNOLOGY 12 HRS

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

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.

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.

Course Outcomes:

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

1. explain the preparation, properties and applications of thermoplastics, thermosettings, elastomers and conducting polymers.
2. know the importance of various materials and their uses in the construction of batteries and fuel cells.
3. to acquire the knowledge of nanomaterials, refractories, lubricants and cement.
4. assess the quality of various fuels.
5. understand the importance of water and its usage in various industries.

Micro-Syllabus of Engineering Chemistry

<u>UNIT-I:</u> POLYMER TECHNOLOGY **14 HRS**

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

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

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

Composite Materials: Fiber reinforced plastics-CFRP and GFRP.

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

Bio degradable polymers: Biopolymers and biomedical polymers.

Unit	**Module**	**Micro content**
Ia. Polymerization	Introduction, Methods of Polymerization And Properties of Polymers	Introduction - Polymer, monomer, functionality and polymerization. Methods of polymerisation - Emulsion and suspension Physical and mechanical properties of polymers.
Plastics	Compounding of plastics, fabrication of polymer articles, preparation, properties and applications of some polymers, e-plastic and disposal of e-plastic waste	Compounding of plastics Fabrication of polymer articles – compression, injection, blowing, extrusion Preparation, properties and applications of PVC, ploycarbonates and Bakelite Mention some examples of plastic materials used in electronic gadgets, recycling of e-plastic waste.
Elastomers	Natural Rubber, vulcanization, synthetic rubbers	Natural rubber – Drawbacks – Vulcanization Preparation – Properties and applications of synthetic rubbers – Buna S, thiokol and polyurethane rubbers.
Composite materials	Fiber reinforced plastics	Fiber Reinforced Plastics (FRP) – CFRP and GFRP.
Conducting polymers	Polyacetylene polymer, p-type and n-type doping	Polyacetylene, doped conducting polymers- p-type and n-type doping.
Biodegradable polymers	Biopolymers and biomedical polymers	Biopolymers and biomedical polymers – polylactic acid polyglycolic acid polymers

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

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

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

Unit	**Module**	**Micro content**
Introduction	Single electrode potential	Oxidation potential
		Reduction potential
Concentration cells	Electrode concentration cell and electrolyte concentration cell	Electrode concentration cell and electrolyte concentration cell
Electro chemical series	Electro chemical series	Definition – Electro chemical series
		Significances of Electro chemical series
		Differences between Electro chemical series and galvanic series
Reference electrodes	Standard Hydrogen Electrode	Working Principle and Construction of a – Standard Hydrogen Electrode – Calomel Electrode – Glass Electrode
	Calomel Electrode	
	Glass Electrode	
Corrosion	Introduction	Definition – Corrosion
	Theories of Corrosion	Chemical Theory of Corrosion / Dry Corrosion Electro Chemical Theory of Corrosion / Wet Corrosion
	Types of Corrosion	Galvanic corrosion, Differential aeration corrosion, Stress corrosion, Water-line corrosion
	Passivity of metals	Passivity, Examples for passive metals
Factors affecting	(a) Nature of metal	*(a) Nature of metal:* (i) Position of metal in the Galvanic series (ii) Purity of metal (iii) Relative surface area of anodic and cathodic metal (iv) Nature of oxide film (v) Physical state of metal (vi) Solubility and volatility of corrosion products

rate of Corrosion	(b) Nature of environment	*(b) Nature of environment:* (i) Temperature (ii) Humidity (iii) pH of the medium (iv) Establishment of oxygen concentration cell (v) Impurities of the atmosphere (vi) Polarization of electrodes
Corrosion control methods	Cathodic protection	Sacrificial anodic protection, impressed cathodic current
	|Cathodic and Anodic coatings	Galvanizing and Tinning
	Electroplating	Electroplating with example
	Electroless plating	Nickel Electroless plating
	Paints	Constituents of paints and its functions

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

Nano materials*:* Introduction, sol-gel method, characterization by BET, SEM and TEM methods, applications of graphene- carbon nanotubes and fullerenes: Types, preparation of carbon nanomaterials by carbon-arc, laser ablation method, and applications.

Refractories: Definition , classification, properties (refractoriness, refractoriness under load, porosity and thermal spalling), failure of refractories.

Lubricants: Definition, mechanism of lubricants and properties (definition and importance).

Cement: Constituents, manufacturing, parameters to characterize the Clinker formation: lime saturation factor (LSF), silica ratio (SR), and alumina ratio (AR). Chemistry of setting and hardening, deterioration of cement.

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

UNIT-IV: FUELS **12 HRS**

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

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

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

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

Unit	Module	Micro content
Hardness of water	Introduction, Determination of Hardness	Temporary hardness, Permanent hardness and Total hardness
		Determination of Hardness by complexometry
Boiler troubles	Boiler troubles	Priming and foaming, scale formation, boiler corrosion, caustic embrittlement
Internal	Softening of hard water	Zeolite process and ion exchange process

treatments	Softening of hard water	Treatment of industrial waste water
Potable water	Potable water and its specifications	Potable water and its specifications
Purification of water	Purification of water, Reverse osmosis and Electro dialysis.	Steps involved in purification of water – chlorination, break point chlorination – reverse osmosis and electro dialysis.

I-Year-II Semester		L T P C
ES1201	**ENGINEERING MECHANICS**	**3 1* 0 3**

Course Objectives:

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

UNIT- I: INTRODUCTION TO ENGINEERING MECHANICS (14 hours)

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

UNIT-II: ANALYSIS OF STRUCTURES AND FRICTION (12 hours)

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

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

UNIT-III: CENTROID AND CENTRE OF GRAVITY, AREA MOMENT OF INERTIA AND MASS MOMENT INERTIA (16 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 (12 hours)

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

Kinetics: Analysis as a Particle and Analysis as a Rigid Body in Translation – Central Force Motion – Equations of Plane Motion – Fixed Axis Rotation – Rolling Bodies.

UNIT – V: WORK -ENERGY METHOD (10 hours)

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

REFRENCE 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

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

e-Resources:

1. http://nptel.ac.in/
2. http://mhrd.gov.in/e-contents
3. http://spoken-tutorial.org

Course Outcomes:

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

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

Micro-Syllabus of ENGINEERING MECHANICS

<table>
<tr><td colspan="3">UNIT- I: INTRODUCTION TO ENGINEERING MECHANICS (14 hours)
Force systems: Basic Concepts, Resultant of coplanar concurrent forces, Components of force in space, Moment of force and its applications, couples and resultant of force systems, Equilibrium of Force Systems, Free body diagram, Equations of equilibrium, Equilibrium of planar and spatial system.</td></tr>
<tr><td>Unit</td><td>Module</td><td>Micro content</td></tr>
<tr><td rowspan="5">1a. Force systems</td><td rowspan="3">INTRODUCTION</td><td>Basic Concepts</td></tr>
<tr><td>Resolving forces into rectangular components</td></tr>
<tr><td>Classification of force system</td></tr>
<tr><td rowspan="2">Resultant of forces</td><td>Resultant of coplanar concurrent forces.
Parallelogram law of method
(Simple problems on analytical method only)</td></tr>
<tr><td>Components of force in space
(Simple problems using vector method for finding resultant)</td></tr>
</table>

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

UNIT-II: ANALYSIS OF STRUCTURES AND FRICTION (12 hours)

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

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

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

UNIT-III:

CENTROID AND CENTRE OF GRAVITY, AREA MOMENT OF INERTIA AND MASS MOMENT INERTIA (16 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	Module	Micro content
3. CENTRE OF GRAVITY & MOMENT OF INERTIA	*Centroid*	Derivation of Centroid for simple figures such as Triangle, sector and semi circle from basic principles
		Centroid of composite sections
		Simple problems on *Centroid* of composite sections
	Centre of Gravity	Derivation of Center of gravity for simple body such as cylinder and cone from the basic principles
		Pappus theorems
	Area moments of Inertia	Definition, Parallel axis theorem and Perpendicular axis theorem
		Simple problems on ***Area moments of Inertia***
	Mass Moment of Inertia	Mass Moment of Inertia importance and its Derivation for simple bodies such as cylinder and cone

UNIT IV: INTRODUCTION TO KINEMATICS AND KINETICS (12 hours)

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

Kinetics: Analysis as a Particle and Analysis as a Rigid Body in Translation – Central Force Motion – Equations of Plane Motion – Fixed Axis Rotation – Rolling Bodies.

Unit	Module	Micro content

4a. ***Kinematics***	Rectilinear motion	Equations of motion in linear motion **Simple problems on linear motion**
		Projectile motion **Simple problems on Rectilinear motion**
	Curvilinear motion	Equations of motion in Curvilinear motion
		Relation between Linear and curvilinear moton (**Simple problems)**
	Motion of Rigid Body	Types and their Analysis in Planar Motion. (**Finding Instantaneous center)**
4b. ***Kinetics***	Analysis as a Particle	D Alembert's principle
		Simple problems on Translatory motion using D Alembert's principle
	Analysis as a Rigid Body	Central Force Motion
		Equations of Plane Motion – Fixed Axis Rotation
		Rolling Bodies
		Simple problems on Rolling Bodies

UNIT – V: WORK -ENERGY METHOD (10 hours)

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

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

I-Year-II Semester	BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING	L T P C
ES1202		3 1* 0 3

Course Objectives:

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

Unit 1 DC & AC Circuits:

DC Circuits:

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

AC Circuits:

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

Unit 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.
2. Electronic Devices and Circuits, R. L. Boylestad and Louis Nashelsky, 9th edition, PEI/PHI 2006.

References:

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

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

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

BL – Bloom's Taxonomy Levels (1- Remembering, 2- Understanding, 3 – Applying, 4 – Analyzing, 5 – Evaluating, 6 - Creating);

PO – Program Outcomes (PO 1: Engineering knowledge, PO 2: Problem analysis, PO 3: Design/ Development of Solutions, PO 4: Conduct investigations of complex problems, PO 5: Modern tool usage, PO 6: The engineer and society, PO 7: Environment and sustainability, PO 8: Ethics, PO 9: Individual and team work, PO 10: Communication, PO 11: Project management and finance, PO 12: Life-long learning)

Micro-Syllabus of Basics of Electrical & Electronics Engineering

UNIT-I: DC & AC Circuits:

DC Circuits:

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

AC Circuits:

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

Unit	**Module**	**Micro content**
1.a **DC Circuits**	Definitions & circuit elements	Definitions of Voltage, Current, Power & Energy
		Types and Classification of circuit elements: R, L, C elements Active, Passive; unilateral, bilateral; linear, nonlinear; lumped, distributed elements
	Ohm's law, KCL, KVL, Voltage & Current Division rules	Ohm's Law. Active elements -Representation of Voltage and current sources in ideal and Practical cases and Passive elements –Voltage & Current relationship of R - L and C elements
		Kirchhoff's Voltage and current laws –series and parallel circuits of R, L & C elements, Voltage and Current division rules for resistive circuit only
	STAR-DELTA transformation	star-delta and delta-star transformations of resistive circuit only [Elementary treatment only]

1.b **AC Circuits**	Phasor representation & AC fundamentals	Representation of sinusoidal waveforms –Phase difference and phasor representation of sinusoidal waveforms
		Peak, Average and RMS values for sinusoidal waveforms only
	AC circuits & Power	Definitions of reactance and Impedance, real power - reactive power - apparent power - power factor. [Elementary treatment only]

UNIT-II: DC Machines:

DC Generator:

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

DC Motor:

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

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

	DC motor Speed control techniques	speed control (armature and field control methods)
	Testing of DC machines	Brake test procedure-Swinburne's test procedure [Elementary treatment only]

UNIT-III: AC Machines:

Single Phase Transformer:

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

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

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

UNIT – IV: Semiconductor Devices

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

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

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

UNIT V: Bipolar Junction Transistors

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

Unit	Module	Micro content
5.a BJT	BJT construction & working	Periodic functions Construction, Configuration and models
		Working of BJT, Definitions of α, β and γ
	BJT CB,CE characteristics	CB characteristics: Input, output characteristics , current relation, dynamic input and output resistances and base-width modulation
		CE characteristics: Input, output characteristics , current relation, dynamic input and output resistances

	BJT Amplifier	Transistor as an amplifier
5.b OP-Amp basic	Basics of OP-amp & characteristics	Block diagram of OP-AMP (Qualitative treatment)
		Ideal characteristics of OP-AMP
	Basic OP-amp circuits	Inverting amplifier circuit
		Non-inverting amplifier circuit

*****

I-Year-II Semester		L T P C
HS1201L	**COMMUNICATIVE ENGLISH LAB (Common to All Branches)**	0 0 3 1.5

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

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

Course Outcomes

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

1. prioritize information from reading texts after selecting relevant and useful points and paraphrase short academic texts using suitable strategies and conventions (L3)

2. make formal structured presentations on academic topics using PPT slides with relevant graphical elements (L3)
3. participate in group discussions using appropriate conventions and language strategies (L3)
4. prepare a CV with a cover letter to seek internship/ job (L2)
5. collaborate with a partner to make presentations and Project Reports (L2)

Detailed Syllabus

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

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

Speaking: JAM, Oral Presentations, Group Discussions

Writing: Different types of reports

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

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

- “How to Get Yourself Organized” by Michael LeBeouf
- “How to Turn Your Desires into Gold” by Napoleon Hill
- “How to Look Like a Winner How to Increase Your Value” by OgMandino
- “How to Swap a Losing Strategy” by Auren Uris and Jack Tarrant
- “How to Bounce Back from Failure” by OgMandino
- “How to Prevent Your Success from Turning into Ashes” by Allan Fromme
- “How to Have a Happy Life” by Louis Binstock
- “How to Keep the Flame of Success Shining Brightly” by Howard Whitman

Any ten Supplementary Language Activities from ***UN Global Goals***document

- “Developing children’s understanding of the Global Goals” by Carol Read

- “End poverty in all its forms everywhere” by SylwiaZabor-Zakowska
- “End hunger, achieve food security and improved nutrition and promote sustainable agriculture” by Linda Ruas
- ‘Ensure healthy lives and promote well-being for all at all ages” by Carmen Flores
- “Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all” by Daniel Xerri
- “Achieve gender equality and empower all women and girls” by Jemma Prior and Tessa Woodward
- “Ensure availability and sustainable management of water and sanitation for all” by Wei KeongToo
- “Ensure access to affordable, reliable, sustainable and modern energy for all” by Phil Wade
- “Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all” by Nik Peachey
- “Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation” by MaluSciamarelli
- “Reduce inequality within and among countries” by Alan Maley
- “Make cities and human settlements inclusive, safe, resilient and sustainable” by David Brennan
- “Ensure sustainable consumption and production patterns” by Laszlo Katona and Nora Tartsay
- “Take urgent action to combat climate change and its impacts” by Maria Theologidou
- “Conserve and sustainably use the oceans, seas and marine resources for sustainable development” by Jill Hadfield and Charlie Hadfield
- “Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss” by ChrysaPapalazarou

➢ "Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels" by Rebeca Duriga

➢ "Strengthen the means of implementation and revitalise the global partnership for sustainable development" by Jennifer Verschoor and Anna Maria Menezes

➢ "Content and the Sustainable Development Goals: going beyond language learning" by AdrianTennant

➢ "Using extensive reading creatively to raise awareness of issues of equality and justice" by SueLeather

➢ "Storytelling for a better world" by David Heathfield

➢ "Using the Sustainable Development Goals in the EAP classroom" by Averil Bolster and PeterLevrai

Text Books

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

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

Reference Books

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

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

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

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

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

AICTE Recommended Books

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

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

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

Sample Web Resources

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

I-Year-II Semester		**L T P C**
ES1203L	**ENGINEERING WORK SHOP**	**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 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		**L**

BS1203L	**ENGINEERING CHEMISTRY LAB**	**T P** **0 0 3**	**C** **1.5**

Course objectives:

The main objectives are

- ➢ To furnish the students with a solid foundation in Chemistry Laboratory required to solve the Engineering problems.
- ➢ To expose the students in practical aspects of the theoritical concepts like pH, hardness of water etc.
- ➢ 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	**BASIC ELECTRICAL & ELECTRONICS ENGINEERING LAB**	**L T P**	**C**
ES1202L		**0 0 3**	**1.5**

Course Objectives:

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

Course Outcomes: Verify Kirchhoff's Laws and voltage and current division rules for DC supply.

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

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).

Text Books:

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

References:

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

I-Year-II Semester		L T P C
MC1201	**ENVIRONMENTAL SCIENCE (Common to CE, CSE & IT)**	3 0 0 0

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:

LEARNING OUTCOMES

Students will be able to

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

- Forest ecosystem.
- Grassland ecosystem
- Desert ecosystem
- 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

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

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

- demonstrate knowledge and understanding of theories in the field of Biodiversity and Systematics in the broad sense.
- conduct basic conservation biology research.
- explain endangered and endemic species of India.
- 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

- understand Cause, effects and control measures of air pollution.
- understand soil, noise & water pollution.
- explain the enforcement of Environmental legislation
- 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

- ➢ knowledge about watershed management and environmental ethics.
- ➢ explain the reasons for global warming
- ➢ explain principles and impact of disasters on environment.
- ➢ 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.

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II-Year-I Semester		L T P C
BS2101	COMPLEX VARIABLES AND STATISTICAL METHODS	3 1* 0 3

Pre-Requisites :

1. Calculus
2. Partial Differentiation
3. Multiple Integration
4. Basics of Probability

Course objectives: The student should be able to

1. Familiarize the complex variables.
2. Familiarize the students with the foundations of probability and statistical methods
3. Equip the students to solve application problems in their disciplines.

Unit No	Contents
I	**Functions of complex variable and complex integration:** Introduction – Continuity – Differentiability – Analyticity – Properties – Cauchy-Riemann equations in Cartesian and polar coordinates – Harmonic and conjugate harmonic functions – Milne-Thompson method. **(05 hrs)** Complex integration: Line integral – Cauchy's integral theorem – Cauchy's integral formula. (all without proofs). **(05 hrs)**
II	**Series expansions and Residue Theorem:** Radius of convergence – Expansion in Taylor's series, Maclaurin's series - Laurent's series. **(05 hrs)** Types of singularities: Isolated – pole of order m – Essential – Residues – Residue theorem (without proof)**(05hrs)**

III	**Probability, Distributions and Sampling Theory:** Probability-Baye's theorem-Random variables-Discrete and Continuous random variables-Distribution function-Mathematical Expectation and Variance-**Application approach:**Binomial, Poisson and Normal distributions. **(07 hrs)** Population and samples-Sampling distribution of Means -Point and Interval estimations **Applications: Maximumerrorofestimate – Bayesian estimate#.(07 hrs)**
IV	**Test of Hypothesis:** Introduction–Hypothesis-Null and Alternative Hypothesis-Type I and Type II errors-Level of significance-One tail and two-tail tests-Tests concerning one mean and two means (Large and Small samples)-Tests on proportions,**Applications:Chi-square test and F-test on small samples#.** **(14 hrs)**
V	**Curve fitting and Correlation:** Method of least squares-Straight line-Parabola-Exponential-Power curves-Correlation-Correlation coefficient-Rank correlation-Regression coefficient and properties-Regression lines-**Multiple regressions#.(12 hrs)**

extra topics extension of existing syllabus

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 based on small and large sampling tests. (L4)
CO5:	**Interpret** the association of characteristics and through correlation and regression tools (L4)
Text books:	
1.	**B.S. Grewal,** Higher Engineering Mathematics, 44^{th} Edition, Khanna Publishers.

2.	**S. C. Gupta and V. K. Kapoor,** Fundamentals of Mathematical Statistics, 11/e (Reprint) 2019, Sultan Chand & Sons Publications.	
3.	**B.V. Ramana,** Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.	
Reference books:		
1.	**Miller and Freund's,** Probability and Statistics for Engineers, 7/e, Pearson, 2008.	
2.	**T. K. V. Iyenger**, Probability and Statistics, S. Chand & Company Ltd, 2015.	
3.	**Jay I. Devore,** Probability and Statistics for Engineering and the Sciences, 8th Edition, Cengage.	
4.	**Erwin Kreyszig,** Advanced Engineering Mathematics, 10th Edition, Wiley-India.	
5.	**H. K. Das,** Advanced Engineering Mathematics, 22nd Edition, , S. Chand &Company Ltd.	
e- Resources & other digital material:		
1.	https://www.youtube.com/watch?v=Mwpz1zjPlzI&list=PLbMVogVj5nJS_i8vfVWJG16mPcoEKMuWT(For Complex Variables)	
2.	https://www.youtube.com/playlist?list=PLiUVvsKxTUr66oLF6Pzirc1EgSstMbRZR(For Complex Variables from 1-13)	
3.	https://www.youtube.com/watch?v=COI0BUmNHT8&list=PLyqSpQzTE6M_JcleDbrVyPnE0PixKs2JE(For Probability and Statistics)	
4.	https://www.youtube.com/watch?v=VVYLpmKRfQ8&list=PL6C92B335BD4238AB(For Probability and Statistics)	
5.	https://www.mathsisfun.com/data/standard-normal-distribution-table.html(Information about Normal distribution)	
6.	https://www.statisticshowto.com/tables/t-distribution-table/ (Information about T- distribution)	
Statistical Tables to be allowed in examinations:		
1.	Normal distribution table	
2.	T- distribution table	

Micro-Syllabus of Complex Variables and Statistical Methods

II B.Tech I Semester

Unit-1: Functions of a complex variable and complex integration: Introduction – Continuity – Differentiability – Analyticity – Properties – Cauchy-Riemann equations in Cartesian and polar coordinates – Harmonic and conjugate harmonic functions – Milne-Thompson method.

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

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

Unit-2: Series expansions and Residue Theorem: Radius of convergence – Expansion in Taylor's series, Maclaurin's series - Laurent's series.

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

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

Unit-3: Probability, Distributions and Sampling Theory: Probability-Baye's theorem-Random Variables-Discrete and Continuous random variables-Distribution Function-Mathematical Expectation and Variance-Binomial, Poisson and Normal distributions.

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

Unit	Module	Micro content
3. Probability, Distributions and Sampling Theory	Probability	Find probability using Baye'e theorem
		Write probability distribution for given random variable. And find mean , variance and S.D. of random variable.
	Probability distributions	Mean and variance of Binomial, Poisson and normal distributions.
		Find probability of Binomial event.
		Find probability of Poisson event.
		Find probability of Normal event.
	Sampling theory	Write sampling distribution of sample mean. And find mean of sampling distribution and S.D. of sampling distribution.

Unit 4: Test of Hypothesis:

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

Unit	**Module**	**Micro content**
4a. Test of Hypothesis	Test significance of large samples	Test significance of single mean or proportions.
		Test significance of two means or proportions.
4b. Test of hypothesis	Test significance of small samples	Test significance of single mean
		Test significance of two means.

Unit 5: Curve fitting and Correlation:

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

Unit	**Module**	**Micro content**
5 a) Curve fitting	By least square approximation method fit the data in to given curve	Fit the data in to line equation.
		Fit the data into a second degree polynomial or parabola.
		Fit the data into power curve $y = a\,x^b$
		Fit the data into power curve $y = a\,b^x$
		Fit the data into power curve $y = a\,e^{bx}$
5 b) Correlation and regression	Correlation	Find correlation coefficient
		Find Karl Pearson’s coefficient of correlation.
	Regression	Find regression coefficient and lines.

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II-Year-I Semester		L T P C
PC2101	**MECHANICS OF SOLIDS**	3 1* 0 3

Pre-Requisites :

1) Engineering Mathematics

   I.Calculus

   II.Differential

2) Engineering Mechanics

Course objectives: The student should be able to

The students completing this course are expected to understand the basic terms like stress, strain, Poisson's ratio etc., and different stresses and deflections induced in beams, thin cylinders, thick cylinders, and columns. Further, the student shall be able to understand the shear stresses due to torsion in circula

Unit No	Contents
I	**SIMPLE STRESSES & STRAINS:** Elasticity and plasticity – Types of stresses & strains–Hooke's law – stress – strain diagram for different materials –Working stress–Factor of safety.**(4hrs)** Lateral strain, Poisson's ratio & volumetric strain – composite bars–Temperature stresses-Relation between elastic constants. **(6hrs)**

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.**(3hrs)** 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. **(7hrs)**
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.**(5hrs)** **TORSION:** Introduction-Derivation- Torsion of Circular shafts -Pure Shear-Transmission of power by circular shafts, Shafts in series, Shafts in parallel.**(5hrs)**
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*** **(6hrs)** **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. **(4hrs)**
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.**(6hrs)** **COLUMNS:** Buckling and Stability, Columns with Pinned ends, Columns with other support Conditions, Limitations of Euler's Formula, Rankine'sFormula. **(4hrs)**

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

CO 1: **Compute** the stresses & deformations of a member due to axial loading under uniform and non uniform conditions. **(Apply level)**

CO 2: **Analyze** the variation of SF & BM in determinate beams. **(Analyze level)**

CO 3: **Examine** the structural members subjected to flexural and torsion loads. **(Apply level)**

CO 4: **Analyze** the biaxial stresses developed at a point of stressed member and analyze the thin Pressure vessels. **(Analyze level)**

CO 5: **Find** deflections for statically determinate beams and buckling of Columns. **(Apply level)**

Text books:

1. Mechanics of Materials/Gere and Timoshenko, CBS Publications.
2. Strength of materials by R.K. Bansal , Laxmi Publications

Reference books:

1. Strength of materials by B.C. Punmia-lakshmi publications Pvt. Ltd, New Delhi.
2. Strength of materials /GH Ryder/ Mc Millan publishers IndiaLtd
3. Strength of Materials -By Jindal, UmeshPublications
4. Solid Mechanics, byPopov
5. Strength of materials by S. Ramamrutham- Dhanpat Rai Publishing Co Pvt. Ltd.

e- Resources & other digital material:

1. https://swayam.gov.in/nd1_noc20_ce50/preview
2. https://swayam.gov.in/nd2_nou20_cs16/preview
3. https://swayam.gov.in/nd1_noc20_me46/preview

https://youtu.be/e1CL-OPWTX8

Micro-Syllabus of MECHANICS OF SOLIDS

(Mechanical Engineering)II B.Tech I Semester

Unit 1: SIMPLE STRESSES & STRAINS : Elasticity and plasticity – Types of stresses & strains–Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio & volumetric strain – composite bars – Temperature stresses- Relation between elastic constants.

Definitions and Associated numericals.

Unit Module Micro content

Unit 1 STRESSES & STRAINS

(Definitions and Associated numerical) Types of stresses & strains

Elasticity and plasticity

Hooke's law

stress – strain diagram for mild steel

Working stress – Factor of safety

Lateral strain, Poisson's ratio

volumetric strain

Analysis of bars of varying cross section

Analysis of uniformly tapering rods

Analysis of bars subjected to self weight

Analysis of composite bars

Relation between elastic constants.

Temperature stresses

Unit 2: 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 a beam. 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 2 **2.a.Beams** Definition of beam

II-Year-I Semester		L T P C
PC2102	**MATERIAL SCIENCE& METALLURGY**	3 1* 0 3

Pre-Requisites :

1. Engineering Chemistry
2. Engineering Physics

Course objectives: The student should be able to

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

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

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

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

CO1: Able to know the basic concepts of bonds in metals and alloys. To understand the basic requirements for the formation of solid solutions and other compounds.

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

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

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.

Text books:

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

Reference books:

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

e- Resources & other digital material:

1. http://nptel.ac.in/courses/113105024/

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

NPTEL VIDEO COURSES

8. https://www.youtube.com/watch?v=PVnftOMxl6w&list=PLbMVogVj5nJQbjE_u2KZhUmCypfLunj G4
9. https://www.youtube.com/watch?v=FrhvKcjKdPo&index=5&list=PLbMVogVj5nJQbjE_u2KZhUm CypfLunjG4

MICRO-SYLLABUS

Unit-1:

Introduction, Crystallography, Miller's indices, Packing Efficiency, Density calculations, Grains and Grain Boundaries, Effect of grain size on the properties, Determination of grain size by different methods,

Constitution of Alloys: Necessity of alloying, Types of solid solutions, Hume - Rothery rules, Intermediate alloy phases

Unit	Module	Micro content
1. a or 2a Crystallography	Crystallography	Crystallography,
	Crystallography	Miller's indices,
		Packing Efficiency, Grains and Grain Boundaries
Crystallography		Density calculations
1.b.or 2.b Constitution of Alloys	Constitution of Alloys	Effect of grain size on the properties
		Determination of grain size by different methods,
		Necessity of alloying, Types of solid solutions
		Hume - Rothery rules

		Intermediate alloy phases

Unit-2:

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

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

Unit-3:

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

Unit	Module	Micro content
5.a or 6.a **Steels** **Heat Treatment**	Different types of Steels and Cast-iron	Composition, Application
	TTT diagrams	Construction of TTT diagrams
	Heat Treatment	Annealing
		Normalizing
		Hardening and Tempering of steels
		Harden ability of Alloy steels
5.b or 6.b	**Iron-Carbon Phase**	Construction of phase diagram.
		Temperature, composition.

<table>
<tr><td rowspan="2">Iron-Carbon Phase Diagram</td><td rowspan="2">Diagram</td><td>Phase changes.</td></tr>
<tr><td>Micro content</td></tr>
<tr><td colspan="3">Unit-4:
Introduction - Cast Irons, Structure and properties of White Cast iron, Malleable Cast iron, Grey cast iron, Non-ferrous Metals and Alloys, Structure and properties of copper and its alloys, Aluminium and its alloys, Al-Cu phase diagram, Titanium and its alloys</td></tr>
<tr><td>Unit</td><td>Module</td><td>Malleable Cast iron</td></tr>
<tr><td rowspan="3">7.a.or 8.a
Cast Irons</td><td rowspan="3">Types of Cast Irons</td><td>Grey cast iron.</td></tr>
<tr><td>Structure and properties of copper and its alloys</td></tr>
<tr><td>Aluminum and its alloys</td></tr>
<tr><td rowspan="4">7.b.or 8.b
Non-ferrous Metals and Alloys</td><td rowspan="4">Types of Non-ferrous Metals and Alloys</td><td>Al-Cu phase diagram</td></tr>
<tr><td>Titanium and its alloys</td></tr>
<tr><td>Titanium and its alloys</td></tr>
<tr><td>Micro content</td></tr>
<tr><td colspan="3">UNIT-5
Introduction to Ceramics, Polymers, Composites, Crystalline ceramics structure, properties & Applications, Glasses, cermets structure, properties & applications, Classification, properties & applications of composites, Classification, Properties and Applications of Polymers.</td></tr>
<tr><td>Unit</td><td>Module</td><td>properties & Applications</td></tr>
<tr><td rowspan="2">9.a. or 10.a
Ceramics, Polymers</td><td rowspan="2">Types of Ceramics, Polymers</td><td>Glasses, cermets structure, properties & applications, Classification</td></tr>
<tr><td>properties & applications of composites</td></tr>
<tr><td>9.b.or 10.b
Glasses, Composites</td><td>Types of Glasses, Composites</td><td>Classification, Properties and Applications of Polymers</td></tr>
</table>

Learning Resources

Text books:
1) Material Science and Metallurgy/ Kodgire **2)** Essentials of Materials Science and engineering / Donald R.Askeland / Thomson
Reference books
3) Elements of Material science / V. Rahghavan 4) Engineering Material and Metallurgy – Er Amandeep Singh Wadhva 5) Materials Science and engineering / William and callister.

e- Resources & other digital material

i http://nptel.ac.in/courses/113105024/

ii http://nptel.ac.in/courses/113105024/1

Iii http://nptel.ac.in/courses/113105024/2.

iv http://nptel.ac.in/courses/113105024/3

v http://nptel.ac.in/courses/113105024/4

vi http://nptel.ac.in/courses/113105024/5

vii http://nptel.ac.in/courses/113105024/6

NPTEL VIDEO COURSE:

- https://www.youtube.com/watch?v=PVnftOMxl6w&list=PLbMVogVj5nJQbjE_u2KZhUmCypfLunj G4

  https://www.youtube.com/watch?v=FrhvKcjKdPo&index=5&list=PLbMVogVj5nJQbjE_u2KZhUm CypfLunjG4

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

Pre-Requisites :

Ability to observe and understand various processes applied to metals from surroundings.

Course objectives: The student should be able to

- ➢ To impart basic knowledge and understanding about basic casting processes.
- ➢ To impart basic knowledge and understanding about metal forming processes such as rolling, forging and extrusion.
- ➢ To impart basic knowledge and understanding about Sheet metal forming operations.
- ➢ To impart basic knowledge and understanding about various metal joining processes.
- ➢ To impart basic knowledge and understanding about powder metallurgy and high energy rate forming processes.

Unit No	Contents

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

III	**SHEET METAL FORMING** Principle, Effect of clearance on shearing load and edge characteristics, Classification of Press tool operations based on typed of stress introduce into the component, Types of sheet metal cutting operations. Drawing, Spinning, Bending, Stretch forming, Embossing, Coining, Ironing **Shear** - Effect of shear on maximum load on punch, Effect of shear on punch with resultant distortion of slug. Press tool and its terminology **Stock strip layout :**Scrap-strip Terminology, Scrap-strip layout for (i) Contoured blanks (ii)Parallel blank edges **Centre line of pressure**.**(13Hrs)**
IV	**METAL JOINING PROCESSESS** Classification of joining processes, Define Autogenous, Heterogeneous and homogeneous joining processes. Principles of solid phase welding .liquid phase welding (fusion) Types of joints, Types of welding positions, Butt-joint edge preparation methods, Weld terminology. **Gas welding :**Principle, Characteristics of different fuels, Oxy- Acetylene welding equipment, Acetylene generator, Different types of flames, Fore hand and back hand welding techniques, Gas cutting . **Electric-Arc welding: Principle**, Types of Arc welding equipment (AC, DC), Characteristic curves of (i) Constant current (ii) Constant voltage arc welding machine. Weld penetration as affected by the polarity of workpiece (DCSP/DCEN ,DCRP/DCEP) Specification of arc welding machines- max rated open circuit voltage, rated current in ampere, Duty cycle **Electrodes:** Consumable and Non-consumable electrodes. Purpose of coatings on electrodes. Arc blow in DC Arc welding. Modes of metal transfer in Arc welding. **Different types of Arc welding :**(i) Gas Metal Arc Welding (GMAW) (ii) TIG Welding, (iii) MIG Welding, (iv) Submerged Arc welding (SAW) **Resistance Welding :**Principle, Heat balance, electrodes, Types of Resistance Welding Electro slag welding, Thermit welding, Electron beam welding, laser beam welding, forge welding, Friction welding, Friction stir welding, Explosion welding, Brazing, Braze welding, Soldering, Advantages and Disadvantages,**(15Hrs)**

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

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
CO2:	Understand principles involved in Different types of Metal Forming Processes
CO3:	Understand principles of different types of Sheet Metal Forming processes
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.
CO5:	Understand principles of different types high energy rate forming processes and powder metallurgy techniques

Text books:	
1.	Manufacturing Technology-P.N.Rao- Tata McGraw-Hill Education-Volume1-5e, 2018.
2.	Manufacturing Science-Ghosh & Mallik-2nd edition,2012, East-West Press Pvt. Ltd
Reference books:	
1.	Process and Materials of Manufacturing- Roy A Lindberg- Pearson,2015; 4e edition
3.	Production Technology - P.C .Sharma -S.Chand & Co,8th edition, 2014
4.	Manufacturing Processes for Engineering Materials - Kalpakjian.S& S.R Schmid-Pearson Publications,6th edition,2018.
5.	Production Technology -R.K Jain –Khanna Publications, 10th edition,1997.

e- Resources & other digital material:	
1.	https://swayam.gov.in/nd1_noc20_me35
2.	https://onlinecourses.nptel.ac.in/noc20_me67
3.	https://nptel.ac.in/courses/112/106/112106153/
4.	https://onlinecourses.nptel.ac.in/noc20_me23
5.	https://nptel.ac.in/courses/112/107/112107144/

Micro-Syllabus of Production Technology

(Mechanical Engineering)

II B.Tech I Semester

Unit-1: METAL CASTING PROCESSES

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

(i) Single piece pattern

(ii) Split -piece pattern

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

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

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

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

Casting defects & Remedies.

Unit	Module	Micro content
	Introduction to casting	Introduction to casting, steps involved in casting
		limitations, applications Casting Terms
		Sand Mould making process and different types of patterns
		Definition, Pattern Allowances, Pattern color code

1:METAL CASTING PROCESSES	Patterns& 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
	Special Casting Process	(i) Die casting, (ii) Investment casting, casting process, (iii) Centrifugal casting, (iv) Continuous casting process
	Casting Defects	Various Casting defects
		Remedies of casting defects

Unit-2: METAL FORMING PROCESSES

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

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

Unit	**Module**	**Micro content**
	Introduction to Metal	Definition, Types of metal forming, Nature of plastic deformation

	Introduction to Metal forming Process	Hot working, Coldworking
	Rolling Process	Principle, Roll stand arrangements, Roll passes
		Tube making-Rollpiercing
		Plugmill,Threadrolling
2. METAL FORMING PROCESSES	Forging Process	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 Process	Types of Extrusion : Forward , Backward , Impact and Hydro static Extrusion
		Wire drawing, Rod & Tube drawing, swaging

Unit-3: SHEET METAL FORMING

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

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

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

Press tool and its terminology

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

Unit	Module	Micro content
3: SHEET METAL FORMING	Introduction to sheet Metal Operations	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
	Shear	Effect of shear on maximum load on punch
		Effect of shear on punch with resultant distortion of slug.
	Press tool and its terminology	Different Types of Press tools and terminology
	Stock strip layout	Scrap-strip Terminology
		Scrap-strip layout for (i) Contoured blanks (ii)Parallel blank edges

Unit-4: METAL JOINING PROCESSES

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

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

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

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

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

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

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

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

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

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

Unit	Module	Micro content
	Introduction on Welding	Classification of joining processes, Define Autogenous, Heterogeneous and homogeneous joining processes. Principles of solid phase welding.
		liquid phase welding (fusion) Types of joints, Types of welding positions, Butt-joint edge preparation methods, Weld terminology
	Gas Welding	Principle, Characteristics of different fuels, Oxy- Acetylene welding equipment, Acetylene generator

4:METALJOINING PROCESSES	Gas Welding Flames	Different types of flames, Fore hand and back hand welding techniques, Gas cutting
	Electric-Arc welding: Principle	Types of Arc welding equipment (AC, DC), Characteristic curves of (i) Constant current (ii) Constant voltage arc welding machine.
		Weld penetration as affected by the polarity of work piece (DCSP/DCEN ,DCRP/DCEP) Specification of arc welding machines- max rated open circuit voltage, rated current in ampere, Duty cycle
	Electrodes	Consumable and Non-consumable electrodes.
		Purpose of coatings on electrodes.
		Arc blow in DC Arc welding. Modes of metal transfer in Arc welding
	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
	Types of Welding Process	Electro slag welding
4:METAL JOINING PROCESSES		Thermit welding, Electron beam welding, laser beam welding, forge welding
		Friction welding, Friction stir welding, Explosion welding,
		Brazing, Braze welding Soldering, Advantages and Disadvantages

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

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

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

Unit	**Module**	**Micro content**
Unit-5: POWDER METALLURGY	Introduction on Powder Metallurgy	Definition, Flow diagram indicating various operations involved in powder metallurgy processing
		Production of metallic powder, Mixing, Blending, compacting - Single level component, Two level component Sintering, Pre sintering
	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

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II-Year-I Semester		**L T P C**
PC2104	**THERMODYNAMICS**	**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.

Unit No	**Contents**

I	**BASIC CONCEPTS AND DEFINITIONS:** Macroscopic and Microscopic viewpoints, Thermodynamic System, Surrounding, Boundary, Universe, Control Volume, Control Surface, Classes of Systems, State, Thermodynamic Properties, Process and Cycles, Thermodynamic Equilibrium, Reversibility, Quasi static Process, Concept of Continuum, Specific heat at constant volume, Enthalpy, Specific heat at constant pressure. **(05 hrs)** **ZEROTH LAW OF THERMODYNAMICS:** Concept of Temperature, Measurement of temperature, Scales of Temperature, Constant Volume Gas Thermometer,Advantages of gas thermometers over liquid thermometers. **(02 hrs)** **WORK AND HEAT TRANSFER:** Work transfer, P-dv work, Path and Point Functions,P-dv work in various Quasi-Static Processes, Types of Work Transfer, Free expansion with zero work transfer, Heat Transfer-a path function, specific heat and Latent heat. **(03hrs)**
II	**FIRST LAW OF THERMODYNAMICS:** First law for a closed system undergoing a cycle(Joule's experiment) and a change of state, Energy- a property of the system,Energy in Stored and in Transition, Different forms of stored energy, limitations of the first law,PMMI. **(05hr)** **THERMODYNAMIC ANALYSIS OF CONTROL VOLUME:** Conservation of Energy Principle-Flow work, The Steady Flow Process-Steady Flow Energy Equation, Steady Flow Engineering Devices-Nozzles, Diffuser, Turbine, Throttling Valves and Heat Exchangers **(05hrs)**
III	**SECOND LAW OF THERMODYNAMICS:** Introduction, Thermal Energy, Reservoirs, Heat Engines, Refrigerators, Heat Pumps, Kelvin-Planck & Clausius Statements of Second law of Thermodynamics, Equivalence of Kelvin-Plank and Clausius Statements, PMM II, Differences between reversible and Irreversible Process, Carnot Cycle and its specialties, Carnot Theorem, Corollary of Carnot's theorem, Thermodynamic scale of Temperature. **(07hrs)** **ENTROPY:** Clausius Inequality, Entropy - Principle of Entropy Increase, Entropy Change for Ideal gases, Availability and Irreversibility(only definitions), Elementary Treatment of the Third Law of Thermodynamics. ***Second-law analysis of heat engines, Refrigerators and heat pumps.*** **(03hrs)**
IV	**PROPERTIES OF PURE SUBSTANCES:** Pure Substances, Phases of Pure Substance, Properties of steam, p-v, p-T, T-s and h-s diagrams, P-V-T- surfaces, Dryness Fraction, Steam tables, Measurement of Steam Quality. **(05 hrs)** **PERFECT GAS LAWS:** Avogadro's law, Equation of State of a ideal gas, specific heats, Internal energy and Enthalpy of an ideal gas, Reversible Adiabatic Process, Reversible Isothermal process, Polytropic Process, entropy change of an ideal gas, Deviations from perfect Gas Model, Compressibility factor, Vander walls Equation of state ,Compressibility charts.**(05 hrs)**

V	**MIXTURES OF PERFECT GASES:** Composition of a gas mixture: Mass and Mole Fraction, Gravimetric and volumetric Analysis, Dalton's Law of partial pressure, Amagat`s Laws of additive volumes, Equivalent Gas constant and molecular Internal Energy, Enthalpy, Specific heats and Entropy of mixture of perfect Gases. **(05 hrs)** **PSYCHROMETRY:** Atmospheric air - Psychrometric Properties – Dry bulb Temperature, Wet Bulb Temperature, Dew point Temperature, Thermodynamic Wet Bulb Temperature, Specific Humidity, Relative Humidity, Saturated Air, Vapour pressure, Degree of saturation – Adiabatic Saturation , Carrier's Equation – Psychrometric chart.**(05 hrs)**

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}**
CO5:	**Envisage** the P-v-T behavior of gas mixtures based on Dalton's law of additive pressures and Amagat's law of additive volumes; use the psychrometric chart as a tool to **Compute** the properties of atmospheric air. **{Apply level, KL3}**

Text books:

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

Reference books:

1. J.P.Holman, Thermodynamics, McGraw Hill Publications -2003.
2. Richard E.Sonntag,ClausBorgnakke,GordonJ.VanWylen,Fundamentals of Thermodynamics, Six Edition, Wiley-India Edition.
3. E.Rathakrishnan, Fundamentals of Engineering Thermodynamics‖, PHI, 2nd Edition, 2010.

4. Prasanna Kumar ,Thermodynamics, First Edition, Pearson Publications.
5. R.K. Rajput, S.Chand& Co., Thermal Engineering, 6/e, Laxmi publications, 2010

e- Resources & other digital material:

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

Data books to be allowed in examinations:

1. S.C. Jain, Steam Tables, Birla Publications Pvt. Ltd – 2011
2. R.S. Khurmi& N. Khurmi, Steam Tables, S.Chand Publications – 2014

MICRO-SYLLABUS:

II B.Tech I Semester

Unit-1:

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

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

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

Unit	Module	Micro content
1a. Basic Concepts and Definitions	Macroscopic and Microscopic viewpoints	General structure of matter
		Events occurring at molecular level
		Concept of Continuum
	Thermodynamic System, types and its vocabulary	System, Surrounding, Boundary, Universe,
		Control Volume, Control Surface,
		Classes of Systems, State
	Description of State of the System, System undergone by Process and Cycle.	Thermodynamic Properties, Process and Cycles, Thermodynamic Equilibrium
		Reversibility, Quasi static Process
	Concept of specific heats under various process.	Specific heat at constant volume
		Enthalpy, Specific heat at constant pressure
1b.Zeroth Law of Thermodynamics	Concept of Temperature, scales and its measurement	Scales of Temperature
		Constant Volume Gas Thermometer and advantages of gas thermometers over liquid thermometer.
1c. Work and Heat transfer	Concept of Work in various process, its types	Path and Point Functions ,Constant Volume, pressure, temperature, entropy, Polytropic Process and types of work transfer.
		Free expansion with zero work transfer
	Concept of heat transfer	Heat , sensible and latent heat

Unit-2:

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

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

Unit	Module	Micro content
2. a **First Law of Thermodynamics**	First law for a closed system.	Joule's experiment
		First law for closed system
		First law for various process
		Limitations of First Law
		PMM1
	Concept of Energy	Energy- a property of a system
		Stored energy and types
		Transition energy and types
2.b Thermodynamic Analysis of Control Volume	First law for a open system	Conservation of Energy Principle,Flow work
		Steady Flow process, Steady Flow Energy
		S.F.E. equation for Nozzles, Diffuser, Turbine, Throttling Valves and Heat Exchangers.

Unit-3:

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

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

Unit	Module	Micro content
3.a	Thermal Energy Reservoirs	Energy source and sink
	Second law of Thermodynamics	Kelvin-Planck & Clausius Statements
		Heat engine – line diagram
		Heat Pump – line diagram
		Refrigerator – line diagram

Second Law of Thermodynamics		Equivalence of Kelvin-Plank and Clausius Statements
		PMM II
	Carnot Cycle	Carnot Cycle and its specialties,
		Carnot Theorem, Corollary of Carnot's theorem
		Thermodynamic scale of Temperature.
3.b Entropy	Entropy	Entropy and its introduction
		Clausius Inequality
		Entropy - Principle of Entropy Increase
		Entropy - Change for Ideal gases
		Elementary Treatment of the Third Law of Thermodynamics
	Concepts of available energy	Availability and Irreversibility

Unit-4:

Properties of Pure Substances: Pure Substances, Phases of Pure Substance, Properties of steam, p-v, p-T, T-s and h-s diagrams, P-V-T- surfaces, Dryness Fraction, Steam tables, Measurement of Steam Quality.

Perfect Gas Laws: Avogadro's law, Equation of State of a ideal gas, specific heats, Internal energy and Enthalpy of an ideal gas, Reversible Adiabatic Process, Reversible Isothermal process, Polytropic Process, entropy change of an ideal gas, Deviations from perfect Gas Model, Compressibility factor, Van der walls Equation of state, Compressibility charts.

Unit	**Module**	**Micro content**
4a. Properties of Pure Substances	Pure substance	Pure Substances and its Phases
		p-v, p-T, T-s and h-s diagrams
		Properties of steam
		Dryness fraction, Measurement of Steam Quality and Steam tables.
		Avogadro's law

4b.Perfect Gas Laws	Properties of ideal gas	Equation of State of a ideal gas
		specific heats, Internal energy and Enthalpy of an ideal gas
	Deviations from perfect Gas Model	Compressibility factor
		Vander walls Equation of state
		Compressibility charts

Unit-5:

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

Psychrometry: Atmospheric air -Psychrometric Properties – Dry bulb Temperature, Wet Bulb Temperature, Dew point Temperature, Thermodynamic Wet Bulb Temperature, Specific Humidity, Relative Humidity, Saturated Air, Vapour pressure, Degree of saturation – Adiabatic Saturation , Carrier’s Equation – Psychrometric chart.

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

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II-Year-I Semester		L T P C
ES2101	**COMPUTER AIDED ADVANCED ENGINEERING DRAWING**	1 0 3 2.5

Pre-Requisites:

1) Engineering Graphics / Drawing

2) Basic Computer Knowledge

CAD Package:

Any one of the CAD Tool i.e.**CATIA / CREO / Solid Edge / Siemens PLM software / IRON CAD /Auto- CAD** isused to learn the above course.

Course objectives: The student should be able to

1. Impart knowledge related to principles, methods and techniques of 3D modeling in parametric CAD software. for Ex: CATIA / CREO / Solid Edge / Siemens PLM software / IRON CAD /Auto- CAD
2. To provide basic understanding of 2D drawing practice for various Engineering curves or simple mechanical parts.
3. The student will acquire knowledge of Basic 3D modeling & Advanced Solid Features for simple mechanical parts
4. To provide basic understanding of part design and Assembly design for various Engineering applications.
5. The student will be able to draw the assembly from the individual part drawing.

Unit No	Contents

I	**Introduction** to 3D Experience and Siemens Product Design Lab, software's used and Basic Introduction of CAD Tools and various levels of 3D Experience Lab such as CATIA/ Delmia /Simulia**(03hr)** **SKETCHER**: Workbench Introduction, Types of Sketches, Creating profiles, Practice of Profile tool bar, Sketcher constraints, sketcher operations, Transformation of profiles, Projection from 3D elements, Practice of transform tools with suitable sketches, Sketch analysis, Sketch modifications ,Create Basic Sketches with ISO Constraints **(12hr)**
II	**PART DESIGN:** Workbench Introduction, Reference Elements, Practice on types of points, lines and planes, Basic Solid Features, Practice on conversion of basic 2D to 3D parts. **(12hrs)**
III	**Advanced Solid Features:** Practice of Ribs ,Slots& Multi- sections Dress up features , Practice of Fillets, chamfers, shell, Transformation of solids Practice of Pattern, mirror & Scaling Surface based features ,Practice of Splitting solids with surfaces , Maintenance of Specification tree. Introduction to Body concept, Practice 3D models using Booleans Creation of complex parts using body concept, Power copy, Practice of Power copy tool. **(12hrs)**
IV	**ASSEMBLY DESIGN**: Introduction to Workbench, Importing of Parts & Products, Types of Assembly –approach, Practice with Top Down assembly and Bottom Up assembly Approaches, Assembly Constraints and Practice of Product structure tools with basic Assembly. **INTERPENETRATION OF RIGHT REGULAR SOLIDS**: Intersection of Cylinder Vs Cylinder, Cylinder Vs Prism, Cylinder Vs Cone, Prism Vs Cone. **(12hrs)**
V	**DRAFTING:** Introduction to Workbench, Drafting Approach, View Creation, Dimensioning, Geometry modification, Editing Option and Developing sectional views with detailed dimensions. **Introduction of Perspective Projections(12 hrs)**

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

CO1:	Gain the knowledge in basic modeling concepts using CAD tools such as CATIA / CREO / Solid Edge / Siemens PLM software / IRON CAD /Auto- CAD{Understand level, KL2}
CO2:	Draw 2D sketches for Basic Engineering applications. {Apply level, KL3}
CO3:	Create 3D modeling of various mechanical parts using Solid based features and Boolean operations. {Apply level, KL3}
CO4:	Develop Assembly and Disassembly of various mechanical components. {Apply level, KL3}

CO5: Provide an experiential learning environment, while applying CAD tools to design of simple parts, assemblies, mechanisms and structures. {Analyze level, KL4}

Text books:

1. Engineering drawing by N.D Bhatt, Charotar publications.
2. Engineering Graphics, K.C. john, PHI Publications.

Reference books:

1. Engineering Drawing – RK Dhawan, S Chand
2. Engineering Drawing – KL Narayana, P Kannaiah, Scitech
3. Engineering Drawing – Agarwal and Agarwal, Mc Graw Hill
4. Engineering Graphics – PI Varghese, Mc Graw Hill
5. Engineering Drawing + AutoCAD – K Venugopal, V. Prabhu Raja, New Age
6. Engineering Drawing and Graphics using Auto Cad – T Jeyapoovan, vikas
7. Engineering Drawing with auto-CAD, K.Venkata Reddy/B.S . Publications.
8. Toogood Roger Ph.D., P. Eng., Zecher Jack P.E., Creo Parametric 1.0 Tutorial and MultiMedia DVD, SDC Publications, USA (2012), ISBN: 978-1-58503-692-9, ISBN (Book + Software on Disk): 978-1-58503-730-8

e- Resources & other digital material:

1. http://www.maruf.ca/files/catiahelp/CATIA_P3_default.htm
2. CATIA V5 Design Fundamentals A Step by Step Guide,ISBN-13: 978-1477689028, Author:Jaecheol Koh Publisher: ONSIA Inc. (www.e-onsia.com)
3. http://www.staff.city.ac.uk/~ra600/Presentations/CATIA%20V5%20Lectures.pdf
4. https://www.scribd.com/doc/12516072/eBook-Catia-Tutorial-PDF
5. https://www.academia.edu/37546347/NX_12_for_Engineering_Design
6. https://www.youtube.com/playlist?list=PLkMYhICFMsGbYCvbGrrygtqGiBGguIzbf
7. Kelley David S., Pro/ENGINEER Wildfire 5.0 Instructor, Tata McGraw Hill (2011).

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

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

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

CO1: Apply the knowledge in testing mould sand properties and making different Patterns use in casting

CO2: Understand and Analyze various welding process working principles and its Applications.

CO3: Apply the sheet metal forming knowledge to get various shapes by sheet metals.

II-Year-I Semester		L T P C
PC2105L	MECHANICS OF SOLIDS & METALLURGY LAB	0 0 3 1.5

Course objectives: The student should be able to

To impart practical exposure on the microstructures of various materials and their hardness evaluation. Also 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)MECHNICS OF SOLIDS LAB

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

(B)METALLURGY LAB:

1. Preparation and study of the Micro Structure of pure metals like Iron, Cu andAl.
2. Preparation and study of the Microstructure of Mild steels, low carbonsteels, high – Csteels.
3. Study of the Micro Structures of Cast Irons.
4. Study of the Micro Structures of Non-Ferrous alloys.
5. Study of the Micro structures of Heat treated steels.
6. Hardenability of steels by Jominy End QuenchTest.
7. To findout the hardness of various treated and untreated steels.

II-Year-I Semester	**L**

MC2101	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	T P 2 0 0	C 0

Pre-Requisites :

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

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

Unit No	**Contents**
I	Introduction to traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-à-vis formal knowledge
II	Protection of traditional knowledge: the need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.
III	Legal framework and TK: A: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmers Rights Act, 2001 (PPVFR Act);B:The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016. Geographical indications act 2003.

IV	Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional Knowledge.
V	Traditional knowledge in different sectors: Traditional knowledge and engineering, Traditional medicine system, TK and biotechnology, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK

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

CO1: understand the concept of Traditional knowledge and its importance

CO2: know the need and importance of protecting traditional knowledge

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

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

Text books:

1. V. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material, Bharatiya Vidya Bhavan, Mumbai, 5thEdition,2014
2. SwamiJitatmanand,ModernPhysicsandVedant,BharatiyaVidyaBhavan
3. Fritzof Capra, Tao ofPhysics
4. Fritzof Capra, The wave ofLife
5. VNJha(Eng.Trans,),TarkasangrahaofAnnamBhatta,InernationalChinmayFoundation,Velliarnad, Amaku,am
6. YogaSutraofPatanjali,RamakrishnaMission,Kolkatta
7. G N J h a (E n g . T r a n s .) E d . R N J h a , Y o g a - darshanamwithVyasaBhashya,VidyanidhiPrakasham,Delhi, 2016
8. RNJha,ScienceofConsciousnessPsychotherapyandYogaPractices,VidyanidhiPrakasham,Delhi,2016
9. PRSharma(Englishtranslation),ShodashangHridayam
10. Traditional Knowledge System in India, by Amit Jha, 2009.

e- Resources & other digital material:

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

II-Year-II Semester		L T P C
PC2201	**KINEMATICS OF MACHINERY**	3 1* 0 3

Pre-Requisites :

5. Engineering Mathematics
6. EngineeringMechanics

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

Unit No	Contents	Mapped CO
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'scriterion ,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.	**CO1**
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.	**CO2**

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.	**CO3**
IV	**BELT, ROPE AND CHAIN DRIVES**: Introduction - Selection of belt drive-Types of belt drives- materials-Velocityratio-Slip-Creep-Tensions for flat belt drives & V-belt drive-Angle of contact- Centrifugal tension- Maximum tension – Rope drives. Terminology of Chain drives.	**CO4**
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.	**CO5**

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

CO1: Distinguish different mechanisms with their applications**.** **(Analyze level)**

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

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

CO4: Analyze belt and rope drives for the rated conditions of the machines.**(Analyze level)**

CO5: Demonstrate kinematic analysis of gears and gear trains. **(Apply level)**

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. ShigleyJ. E.AndUickerJ.J.”TheoryofMachinesand Mechanisms", 2ndEdition,McGraw-Hill,Inc., 1995

2. RaoJ.SandDukkipatiR.V,MechanismandMachineTheory,2nd Edition, NewAgeInternational, New Delhi, 2007.

3. SadhuSingh—TheoryofMachines,13rdEdition,PearsonEducation, 1997.

4. Ballaney.P.L—TheoryofMachines,20th Edition,KhannaPublishers, 1996.

ThomasBevan,"TheoryofMachines", 3rdEdition, CBSPublishersandDistributors, 2013.

e- Resources & other digital material:

1. https://swayam.gov.in/nd1_noc20_ce50/preview
2. https://www.youtube.com/watch?v=MJeRFzs4oRU&list=PLBEA57F7E7560C8E8
3. https://www.youtube.com/watch?v=yDEJxYGAoso&list=PLbRMhDVUMngdCkMipemSKP_dCgZLLfOe8

MICRO SYLLABUS

Unit-1:

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

(Theory and simple problems on degrees of freedom)

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.

(Definitions, descriptions of straight line motion mechanisms and derivations of steering mechanisms

Unit	Module	Micro content
		Classification – Rigid Link, flexible and fluid link

1.a.or 2.a **MECHANISMS**	MECHANISMS	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
	Mechanism and machines	kinematic chain – inversion of mechanism – inversions of quadric cycle
		chain – single and double slider crank chains. Kinematic structure of robot
		Exact and approximate copiers and generated types – Peaucellier, Hart and Scott Russel – Grasshopper – Watt T. Chebicheff and Robert Mechanisms and straight line motion, Pantograph
1.b or 2.b. **Elements or Links**	Exact and approximate copiers and generated types	Exact and approximate copiers and generated types – Peaucellier, Hart and Scott Russel – Grasshopper – Watt T. Chebicheff and Robert Mechanisms and straight line motion, Pantograph

Unit-2:

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.

(Only theory and graphical methods)

Unit	**Module**	**Micro content**
3. a or 4.a **Velocity and acceleration**	**Velocity and acceleration**	Motion of a link in machine Determination of Velocity and acceleration diagrams – Graphical method
3.b or 4.b. **Velocity and acceleration**	analysis of for a given mechanism	Kleins construction,
		Coriolis acceleration,
		determination of Coriolis component of acceleration

Unit-3:

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

(Definitions, cam profiles and associated numerical)

Unit	Module	Micro content
5.a or 6.a **Definitions of cam and followers**	Definitions of cam and followers	Types of followers and cams
		Terminology Knife edge, Roller and Flat faced followers during Uniform velocity
		Simple harmonic motion and uniform acceleration and retardation.
5.b or 6.b **Maximum velocity and maximum acceleration**	Maximum velocity and maximum acceleration	during outward and return strokes in the above 3 cases Analysis of motion of followers

Unit-4:

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.

(Definitions, derivations and simple numerical on belt drives)

Unit	Module	Micro content
		Introduction - Selection of belt drive-
		Types of belt drives- materials-

7.a.or 8.a **BELT, ROPE DRIVES**	BELT, ROPE DRIVES	Velocity ratio-Slip-Creep-Tensions for flat belt drives
		V-belt drive-Angle of contact- Centrifugal tension
7.b.or 8.b **ROPE CHAIN DRIVES**	ROPE CHAIN DRIVES	Maximum tension – Rope drives.
		Terminology of Chain drives.

Unit-5

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

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

Unit	**Module**	**Micro content**
9.a or 10.a GEARS	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, types
		Introduction to gear Trains, Train value

9.b or 10.b **GEAR TRAINS**:	GEAR TRAINS	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.

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II-Year-II Semester		L T P C
PC2202	**APPLIED THERMODYNAMICS**	3 1* 0 3

Pre-Requisites :

1. Engineering Thermodynamics
2. Engineering Physics
3. Engineering Chemistry

Course objectives: The student should be able to

1. To familiarize with the various engine systems along with their function and necessity.
2. To perform testing on S.I and C.I Engines for the calculations of performance.
3. To provide basic knowledge of components being used in steam and gas power plant cycles and also analyze the energy transfers and transformations in these components.
4. To make students learn about different types of compressors, calculate the power and efficiency of air compressors.

Unit No	Contents
I	**AIR STANDARD CYCLES:** Otto, Diesel and Dual cycles, its comparisons. **(02 hrs)** **I. C. ENGINES :** Classification - Working principles, Valve and Port Timing Diagrams, - Engine systems –Fuel, Carburettor, Fuel Injection System, Ignition, Cooling and Lubrication, principles of supercharging and turbo charging. **(08 hrs)**
II	**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)**

III	**VAPOUR POWER CYCLE:** Performance parameters of vapour power cycle, Carnot vapour power cycle, Rankine cycle - schematic layout, thermodynamic analysis, effect of operating variables on Rankine cycle, methods to improve cycle performance – regeneration &reheating. ***Second law analysis of an ideal Rankine cycle, Cogeneration, Mercury-water binary vapour power cycle.*** **(05 hrs)** **Boilers:** Classification – working principles of L.P & H.P boilers with sketches. **(02 hrs)** **STEAM TURBINES:** Classification, Working Principle of Simple Impulse Turbine, Vector diagrams of velocities, Compounding of Impulse Turbine, Working Principle of Reaction Turbine, Velocity Diagram for Reaction Turbine, Degree of Reaction. **(03 hrs)**
IV	**GAS TURBINES:** Simple gas turbine plant, applications, ideal cycle, essential components, classification of gas turbines, comparison between close cycle and open cycle gas turbines, parameters of performance, actual cycle, regeneration, inter cooling and reheating , types of combustion chambers. **(10 hrs)*****Combined Gas-Vapour Power cycles***
V	**COMPRESSORS** – Classification, Reciprocating, Principle of operation, work required, Isothermal efficiency, volumetric efficiency and effect of clearance, multi stage compression, undercooling, saving of work, minimum work condition for two stagecompression. **(04hrs)** **ROTARY (POSITIVE DISPLACEMENT TYPE):** Roots Blower, vane type compressor, mechanical details and principle of working, efficiency considerations.**(02hrs)** **DYNAMIC COMPRESSORS:** Centrifugal compressors, mechanical details and principle of operation, velocity and pressure variation, Energy transfer, velocity diagrams, Axial Flow Compressors, Mechanical details and principle of operation – velocity triangles and energy transfer per stage degree of reaction. **(04hrs)**

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

CO1:	Understand about the IC Engines systems like fuel supply, cooling, lubricant and ignition. {Understand level, KL2}
CO2:	Compute the performance of IC Engines {Apply level, KL3}
CO3:	Apply the thermodynamic laws and compute the performance of Rankine Cycle and also understand about the working of Boilers and Steam turbines. {Apply level,KL3}

CO4: Apply the Thermodynamic analysis of Brayton cycle and its applications including methods to improve the thermal efficiency of open cycle gas turbine. {Apply level, KL3}

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

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. ThermalEngineering – R.S.Khurmi&J.S.Gupta- S.chand Publications, 1997.
7. Thermal Engineering / PL Ballaney, Khanna Publishers

e- Resources & other digital material:

1. http://nptel.ac.in/courses/112105123/
2. http://nptel.ac.in/courses/112108148/
3. http://nptel.ac.in/courses/112104113/
4. http://nptel.ac.in/courses/112104033

Data books to be allowed in examinations:

1. S.C. Jain, Steam Tables, Birla Publications Pvt. Ltd – 2011
2. R.S. Khurmi& N. Khurmi, Steam Tables, S.Chand Publications – 2014

MICRO-SYLLABUS

Unit-1:

AIR STANDARD CYCLES: Otto, Diesel and Dual cycles, its comparisons.

I. C. ENGINES : Classification - Working principles, Valve and Port Timing Diagrams, - Engine systems –Fuel, Carburettor, Fuel Injection System, Ignition, Cooling and Lubrication, principles of supercharging and turbo charging.

Unit	**Module**	**Micro content**
1.a.or 2.a AIR STANDARD CYCLES & I. C. Engines	Air Standard Cycles	Otto, Diesel and Dual cycles, its comparisons. (Theory and derivations only)
	Fundamentals of I.C.Engines	Classification.
		Working principles.
		Valve and Port Timing Diagrams.
1.b.or 2.b I.C.Engines Systems	I.C.Engines Systems	Fuel Supply Systems in SI and CI Engines.
		Ignition Systems.
		Cooling Systems.
		Lubrication Systems.
		Principles of Supercharging and Turbo charging.

Unit-2:

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

Unit	**Module**	**Micro content**
3. a or 4.a Measurement of	Measurement of Performance	Parameters of performance.
		Measurement of cylinder pressure **(Theory, derivations and associated simple Problems)**
		Measurement of fuel consumption **(Theory, derivations and associated simple Problems)**

Measurement of Performance Parameters	Parameters of IC Engines	Measurement of air intake **(Theory, derivations and associated simple Problems)**
		Measurement of exhaust gas composition.
		Measurement of Brake power **(Theory, derivations and associated simple Problems)**
3.b or 4.b **Performance Testing of IC Engines**	Performance Testing of IC Engines	Determination of frictional losses and indicated power**(Theory, derivations and associated simple Problems**
		Performance test – Heat balance sheet and chart **(Theory and associated simple Problems)**

Unit-3:

VAPOUR POWER CYCLE: Performance parameters of vapour power cycle, Carnot vapour power cycle, Rankine cycle - schematic layout, thermodynamic analysis, effect of operating variables on Rankine cycle, methods to improve cycle performance – regeneration & reheating.

BOILERS: Classification – working principles of L.P & H.P boilers with sketches.

STEAM TURBINES: Classification, Working Principle of Simple Impulse Turbine, Vector diagrams of velocities, Compounding of Impulse Turbine, Working Principle of Reaction Turbine, Velocity Diagram for Reaction Turbine, Degree of Reaction.

Unit	**Module**	**Micro content**
5.a or 6.a **Vapour Power Cycle**	Performance Parameters	Performance parameters of vapour power cycle.
	Carnot Vapour Power Cycle	Carnot vapour power cycle **(Theory, derivation and simple problems)**
	Rankine Cycle	Schematic layout.
		Thermodynamic analysis.
		Effect of operating variables on Rankine cycle.
		Methods to improve cycle performance – regeneration & reheating. **(Theory, derivations and simple problems)**
5.b or 6.b		Classification.

Boilers & Steam Turbines	Boilers	Working principles of L.P boilers.
		Working principles of H.P boilers.
	Steam Turbines	Classification.
		Working Principle of Simple Impulse Turbine.
		Vector diagrams of velocities.
		Compounding of Impulse Turbine.
		Working Principle of Reaction Turbine.
		Velocity Diagram for Reaction Turbine.
		Degree of Reaction **(Theory only no problems on Steam Turbines)**

Unit-4:

GAS TURBINES: Simple gas turbine plant, applications, ideal cycle, essential components, classification of gas turbines, comparison between close cycle and open cycle gas turbines, parameters of performance, actual cycle, regeneration, inter cooling and reheating , types of combustion chambers

Unit	Module	Micro content
7.a.or 8.a **Gas Turbines**	Fundamentals of Gas Turbine	Simple gas turbine plant.
		Applications.
		Ideal cycle**(Theory, derivation and simple Problems)**
		Essential components.
		Classification of gas turbines.
		Comparison between close cycle and open cycle gas turbines.
		Parameters of performance.
		Actual cycle.
7.b.or 8.b	Methods to Improve the performance of Open	Regeneration **(Theory, derivation and simple Problems)**
		Inter cooling**(Theory, derivation and simple Problems)**

Gas Turbines	Cycle Gas Turbine	Reheating **(Theory, derivation and simple Problems)**
		Types of combustion chambers.

Unit-5:

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

ROTARY (POSITIVE DISPLACEMENT TYPE): Roots Blower, vane type

compressor, mechanical details and principle of working, efficiency considerations.

DYNAMIC COMPRESSORS: Centrifugal compressors, mechanical details and principle of operation, velocity and pressure variation, Energy transfer, velocity diagrams, Axial Flow Compressors, Mechanical details and principle of operation – velocity triangles and energy transfer per stage degree of reaction.

Unit	**Module**	**Micro content**
9.a. or 10.a **AIR COMPRESSORS**	Reciprocating Type	Classification.
		Principle of operation.
		Work required- Isothermal efficiency.
		Volumetric efficiency**(Theory, derivation and simple Problems)**
		Effect of clearance**(Theory, derivation and simple Problems)**
		Multi stage compression- under cooling-saving of work**(Theory, derivation and simple Problems)**
		Minimum work condition for two stage compression**(Theory, derivation and simple Problems)**
9.b.or 10.b	Rotary Positive Displacement Type	Mechanical details and principle of working, efficiency considerations of Roots Blower Compressor **(Theory, derivation and simple Problems)**
		Mechanical details and principle of working, efficiency considerations of vane type compressor. **(Theory, derivation and simple Problems)**

Rotary Positive Displacement Type & Dynamic Type	Dynamic Type	Centrifugal compressors- mechanical details and principle of operation.
		Velocity and pressure variation.
		Energy transfer.
		Velocity diagrams **(Theory Only)**
		Axial Flow Compressors- Mechanical details and principle of operation
		Velocity triangles and energy transfer per stage degree of reaction **(Theory Only)**

Learning Resources
Text books:
1. I.C. Engines / V. Ganesan- Tata McGraw- Hill,4th edition. 2. Thermal Engineering by Mahesh Rathore, Tata McGraw- Hill,2012
Reference books:
1.Thermal Engineering / RK Rajput/ Lakshmi Publications 2.Thermal Engineering by Sadhu Singh, Sukumar Pati, Pearson Publications. 3. IC Engines – M.L.Mathur &R.P.Sharma – Dhanpath Rai & Sons. 4. I.C.Engines–AppliedThermosciences–C.R.Ferguson&A.T.Kirkpatrick-2ndEdition-Wiley Publ 5. I.C. Engines - J.B.Heywood /McGraw- HIll. 6. Thermal Engineering – R.S.Khurmi & J.S.Gupta- S.chand Publ 7. Thermal Engineering / PL Ballaney, Khanna Publishers
e- Resources & other digital material
1.http://nptel.ac.in/courses/112105123/
2. http://nptel.ac.in/courses/112108148/
3. http://nptel.ac.in/courses/112104113/
4. http://nptel.ac.in/courses/112104033
Data books to be allowed in examinations:
1. S.C. Jain, Steam Tables, Birla Publications Pvt. Ltd – 2011 2. R.S. Khurmi & N. Khurmi, Steam Tables, S.Chand Publications – 2014

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II-Year-II Semester		L T P C
PC2203	FLUID MECHANICS & HYDRAULIC MACHINES	3 1* 0 3

Pre-Requisites:

3. Engineering Physics
4. Engineering Mathematics

Course objectives: The student should be able to

1. 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.
2. Formulate and Analyze simple problems related to Bernoulli's equation, different flow measuring devices and pipe flows.
3. 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.
4. Describe briefly hydraulic turbines and its performance characteristic curves.
5. Formulate and Analyze simple problems related to centrifugal and reciprocating pumps.

Unit No	Contents

I	**FLUID STATICS:** Definition of fluid, differences between a solid and fluids, physical properties of fluids- specific gravity, viscosity , surface tension, capillarity, vapor pressure, Pascal's law for pressure at a point, pressure variation in a fluid at rest, Absolute, gauge, Atmospheric and vacuum pressures, measurement of pressure, Manometers- Piezometer, U-tube, inverted and differential manometers.**(05hrs)** **FLUID KINEMATICS:** Introduction, classification of flows, steady & un steady, uniform & non uniform, laminar & turbulent, rotational & irrotational flows, equation of continuity for one dimensional flow, Stream line, path line, streak lines and stream tube, Stream function ,velocity potential function, differences and relation between them, condition for irrotational flow. **(05hrs)**
II	**FLUID DYNAMICS:** Surface & body forces, Euler's & Bernoulli's equations for flow along a stream line, momentum equation and its applications on force on pipe bend, Measurement of flow: pitot tube, venture meter and orifice meter, flow nozzle. **(05hrs)** **CLOSED CONDUIT FLOW:** Reynold's experiment, Darcy Weisbach equation, Minor losses in pipes, pipes in series and pipes in parallel, total energy line-hydraulic gradient line, power transmission through pipes. **(05hrs)**
III	**BOUNDARY LAYER CONCEPTS:** Definition, thicknesses, characteristics along thin plate, Definition of displacement, momentum, energy thickness, separation of boundary layers, ***Fluid flow around submerged objects, concepts of drag and lift, expression for drag and lift, types of drag, Streamlined body and bluff body.(05hrs)*** **Impact of Jets:** hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes.**(05hrs)**
IV	**Hydraulic Turbines:** classification of turbines, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design –draft tube- theory functions and efficiency. **(05hrs)** **Performance of hydraulic turbines:** Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer. **(05hrs)**
V	**Centrifugal pumps:** classification, working principle, work done, different heads in a pumping system, different efficiencies of a centrifugal pump, specific speed, pumps in series and parallel, performance characteristic curves, cavitation , NPSH. **(05hrs)** **Reciprocating pumps:** Working principle, types, Discharge and power requirement, slip, coefficient of discharge, effect of acceleration on indicator diagram.**(05hrs)**

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

CO1: **Depict** briefly the concepts of different fluid properties, **Understand** the variation of pressure in a fluid, measurement of pressure and also **illustrate** the flow field. **{Understand level, KL2}**

CO2: **Apply** the Bernoulli's equation for various flow measurement devices and also **compute** the losses in pipe flows.**{Apply level, KL3}**

CO3: **Estimate** the lift and drag on different geometrical bodies and also **compute** the force exerted by jet on vanes. **{Apply level, KL3}**

CO4: **Compute** the performance of Hydraulic turbines. **{ Apply level, KL3}**

CO5: **Analyze** the performance of centrifugal and reciprocating pumps. **{Analyze level, KL4}**

Text books:

1. Hydraulics and Fluid mechanics including Hydraulic machinery MODI and SETH, Standard Book house publications.
2. Fluid Mechanics: Fundamentals and Applications by Y.A. Cengel&J.M.Cimbala, 6th Edn, McGrawHill

Reference books:

1. Fluid Mechanics and Hydraulic Machines by R.K.Rajput,S.Chand Publications, Sixth Edition.
2. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria& Sons, Nineth Edition
3. Fluid Mechanics and Machinery by D. Rama Durgaiah, New Age International,2007.
4. Hydraulic Machines by Banga & Sharma, Khanna Publishers,Eighth Edition.
5. Fluid Mechanics & Turbo machinery by Dixon, 7th Edn, Elesvier
6. Fluid Mechanics and Hydraulic Machines by Domkundwar&Domkundwar, Dhanpatrai& Co

e- Resources & other digital material:

1. https://nptel.ac.in/courses/112/105/112105171/
2. https://nptel.ac.in/courses/112/105/112105183/
3. https://nptel.ac.in/courses/105/101/105101082/
4. https://nptel.ac.in/courses/105/103/105103095/

MICROSYLLABUS

Unit-1: **FLUID STATICS:** Definition of fluid, differences between a solid and fluids, physical properties of fluids- specific gravity, viscosity , surface tension, capillarity, vapor pressure, Pascal's law for pressure at a point, pressure variation in a fluid at rest, Absolute, gauge, Atmospheric and vacuum pressures, measurement of pressure, Manometers- Piezometer, U-tube, inverted and differential manometers **FLUID KINEMATICS:** Introduction, classification of flows, steady & un steady, uniform & non uniform, laminar & turbulent, rotational & irrotational flows, equation of continuity for one dimensional flow, Stream line, path line, streak lines and stream tube, Stream function ,velocity potential function, differences and relation between them, condition for irrotational flow.

Unit	Module	Micro content
1.a.or 2.a **FLUID STATICS**	Fluid and its Properties	Definition of fluid.
		Differences between a solid and fluids.
		Physical properties of fluids- specific gravity, viscosity , surface tension, capillarity, vapor pressure**(Theory, derivations and associated simple Problems)**
	Fluid Statics	Pascal's law for pressure at a point. **(Theory, derivation and associated simple Problems)**
		Pressure variation in a fluid at rest. **(Theory, derivation and associated simple Problems)**
	Fluid Pressure	Absolute, gauge, Atmospheric and vacuum pressures **(Simple Problems)**
1.b or 2.b. **Fluid Pressure measurement**	Fluid Pressure measurement	Measurement of pressure, Manometers- Piezometer, U-tube, inverted and differential manometers . **(Theory, derivations and associated simple Problems)**
		Classification of flows, Steady & Unsteady, Uniform & Nonuniform, Laminar & Turbulent, Rotational & Irrotational flows
		Equation of continuity for one dimensional flow.

& Fluid Kinematics	Fluid Kinematics	Stream line, Path line, Streak lines and Stream tube.
		Stream function, Velocity potential function, differences and relation between them. **(Theory, derivations and associated simple Problems)**
		Condition for irrotational flow **(Simple Problems)**

Unit-2:

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

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

Unit	**Module**	**Micro content**
3. a or 4.a **Fluid Dynamics**	Fluid Dynamics	Surface & body forces.
		Euler's & Bernoulli's equations for flow along a stream line, **(Theory, derivations and associated simple Problems)**
		Momentum equation and its applications on force on pipe bend **(Theory, derivations and associated simple Problems)**
	Measurement of flow	Pitot tube, Venture meter ,Orifice meter and Flow nozzle.**(Theory, derivations and associated simple Problems)**
3.b or 4.b. **Closed Conduit Flow**	Flow through Pipes	Reynold's experiment.
		Darcy Weisbach equation.**(Theory, derivation and associated simple Problems)**
		Minor losses in pipes.**(Theory, derivation and associated simple Problems)**
		Pipes in series and pipes in parallel. **(Theory, derivations and associated simple Problems)**
		Total energy line-hydraulic gradient line. **(Theory, derivations and associated simple Problems)**.

		Power transmission through pipes.**(Simple Problems)**

Unit-3:

BOUNDARY LAYER CONCEPTS: Definition, thicknesses, characteristics along thin plate, Definition of displacement, momentum, energy thickness, separation of boundary layers, Fluid flow around submerged objects, concepts of drag and lift, expression for drag and lift, types of drag, Streamlined body and bluff body.

Impact of Jets: hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes.

Unit	**Module**	**Micro content**
5.a or 6.a **Boundary Layer Concepts**	Boundary Layer Concepts	Definition.
		Characteristics along thin plate.
		Definition of displacement, momentum and energy thickness.
		Separation of boundary layers. **(simple Problems)**
	Flow over bodies	Fluid flow around submerged objects.
		Concepts of drag and lift.
		Expression for drag and lift.**(Simple Problems)**
		Types of drag.
		Streamlined body and bluff body.
5.b or 6.b **Impact of Jets**	Impact of Jets	Hydrodynamic force of jets on stationary flat, inclined, and curved vanes, jet striking centrally and at tip.
		Velocity diagrams, work done and efficiency. **(Theory, derivations and associated simple Problems)**
		Hydrodynamic force of jets on moving flat, inclined, and curved vanes, jet striking centrally and at tip.
		Velocity diagrams, work done and efficiency. **(Theory, derivations and associated simple Problems)**

		Flow over radial vanes. **(Theory, derivation and associated simple Problems)**

Unit-4:

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

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

Unit	**Module**	**Micro content**
7.a.or 8.a Hydraulic Turbines	Hydraulic Turbines	Classification.
		Impulse Turbine (Pelton wheel)- working proportions- work done- efficiencies- hydraulic design. (**Theory, derivation and simple Problems)**
		Reaction Turbines(Francis and Kaplan)- working proportions- work done- efficiencies- hydraulic design **(Theory, derivation and simple Problems)**
		Draft tube- theory functions and efficiency. (**Theory, derivation and simple Problems)**
7.b.or 8.b **Performance of hydraulic turbines**	Performance of hydraulic turbines	Unit and Specific quantities**.(Simple Problems)**
		Characteristic curves.
		Governing of turbines.
		Selection of type of turbine
		Cavitation.
		Surge tank.
		Water hammer.

Unit-5:

Centrifugal pumps: classification, working principle, work done, different heads in a pumping system, different efficiencies of a centrifugal pump, specific speed, pumps in series and parallel, performance characteristic curves, cavitation , NPSH.

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

Unit	Module	Micro content
9.a or 10.a Centrifugal pumps	Centrifugal pumps	Classification.
		Principle of operation.
		Work done.
		Different heads in a pumping system
		Different efficiencies of a centrifugal pump **(Theory, derivation and simple Problems)**
		Specific speed. **(Theory, derivation and simple Problems)**
		Pumps in series and parallel. **(Theory, derivation and simple Problems)**
		Performance characteristic curves.
		Cavitation.
		NPSH**(Simple Problems)**
9.b or 10.b **Reciprocating pumps**:	Reciprocating pumps	Working principle.
		Types.
		Discharge and Power requirement. **(Theory, derivation and simple Problems)**
		Slip, coefficient of discharge. **(Simple Problems)**
		Effect of acceleration on indicator diagram. **(Theory only)**

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II-Year-II Semester	DESIGN OF MACHINE MEMBERS-I	L T P C
PC2204		3 1* 0 3

Pre-Requisites:

1. Engineering Mathematics
2. Mechanics of Solids
3. Engineering Mechanics
4. Material Science

Course objectives: The student should be able to

1. To introduce the fundamental knowledge of design, this deals about the shape, size and material of particular machine elements.
2. To implement the failure theory in designing and predicting the behavior of machine components.
3. To introduce the basic principles for design of some machine elements such as riveted joints, welded joints, bolted joints, cotter join and springs.

Unit No	Contents

I	**DESIGN FOR STATIC STRENGTH:** Basic Procedure of Machine Design, Classifications of Machine design, Factors to be considered in Machine Design, Preferred numbers and significance.**(3hrs)** Simple Stresses - stresses - Torsion and Bending stresses - stress strain relations, Theories of elastic failure – Maximum Principal stress theory, maximum shear stress theory, Distortion energy theory.**(7hrs)**
II	**DESIGN FOR FATIGUE STRENGTH:** Variable Stresses, Fatigue Failure, Fatigue strength, Endurance limit - Approximate estimation. Design for variable stresses – Gerber's Method, Goodman's Method, Soderberg's Method**.(7hrs)** Stress concentration –stress concentration factors – Reduction of Stress Concentration. ***Cumulative damage in fatigue*****(3hrs)**
III	**RIVETED JOINTS:** Types of riveted joints, Modes of Failure, efficiency of riveted joint, Design of Joints for boiler Shell.**(5hrs)** **WELDED JOINTS:** Types of welded joints, Strength of Parallel Fillet welds, Strength of Transverse Fillet welds, Axially Loaded unsymmetrical welded Joints**.(4hrs)** **BOLTED JOINTS:** Stresses in bolts due to initial tightening, external loading and combined loading, eccentrically loaded bolted joints in shear, Eccentric loadperpendicular to axes of bolts**.(4hrs)**
IV	**SHAFTS:** Transmission shafts- Shaft design on strength basis- Shaft design on torsional rigidity basis-ASME code for shaft design-Design of hollow shaft on strength and torsional rigidity basis. **(5hrs)** **KEYS & COUPLINGS:** Types of keys- Design of square and flat keys - Requirements – Rigid couplings-Muff coupling-Clamp coupling Flange coupling-Bushed pin flexible coupling.**(5hrs)**
V	**COTTER JOINTS:** cotter joints-spigot and socket, sleeve and cotter, jib and cotter joints- **SPRINGS:**Types of springs, Terminology of Helical Springs, End conditions, Stress and Deflection equations, Series and parallel Connections, Design of Helical springs.Introduction to Leaf springs, nipping of Leaf Spring.(**7hrs)**

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

CO1: Sketch the design Procedure and determine the dimensions of simple mechanical components subjected to static loads considering static theories of failure. KL-3

CO2: Apply the knowledge in designing mechanical components subjected to stress concentration and Fatigue loads considering fatigue theories of failure. KL-3

CO3: Design and analyze permanent joints such as riveted and welded joints under differentloading conditions. KL-4

CO4: Design and analyze temporary joints such as bolted and cotter joints under different loading conditions. KL-4

CO5: Design and analyze springs for the given loading. KL-4

Text books:

1. Design of Machine Elements, (3rd Edition) by V.B. Bhandari, Tata McGraw Hill Publishers, New Delhi, 2014.
2. Machine Design an Integrated Approach, (5th Edition) Robert L. Norton, Pearson Education Limited, New Delhi, 2013.

Reference books:

1. A Textbook of Machine Design (SI Units) (12th Edition) by P. C. Sharma, Dr. D. K. Aggarwal, S. K. Kataria& Sons, New Delhi, 2012.
2. Mechanical Engineering Design, (8th Edition) by Joseph Shigley, Charles R Mischke, Tata McGraw Hill Publishers, New Delhi, 2008.
3. Design of Machine Elements, by C. S. Sharma, Kamlesh Purohit, Prentice Hall of India Private Limited (PHI), New Delhi, 2009.
4. A Textbook of Machine Design by R S Khurmi, J K Guptha, S Chand & Company Ltd., New Delhi., (25th Edition), 2005.
5. Design of Machine Elements, (2ndEdition) by P. Kannaiah, ScitechPublications India Private Limited, Chennai, 2009.

e- Resources & other digital material:

1. https://swayam.gov.in/nd1_noc20_me46/preview
2. https://swayam.gov.in/nd1_noc20_ce50/preview
3. https://www.youtube.com/watch?v=-rZPnpzHutE&t=32s
4. https://www.youtube.com/watch?v=oBGzuZXBoQY&list=PLbjTnjt5GklgyqPw1ULGpWPPpvXWKioU

Micro-Syllabus

<table>
<tr><td colspan="3"><u>UNIT-I</u>

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.</td></tr>
<tr><td>Unit</td><td>Module</td><td>Micro content</td></tr>
<tr><td>1.a.or 2.a Introduction to Machine Design</td><td>Introduction to Machine Design</td><td>Basic Procedure of Machine Design, Classifications of Machine design, Factors to be considered in Machine Design,Preferred numbers & their significance(only theory)</td></tr>
<tr><td rowspan="3">1.b.or 2.bTheories of elastic failure</td><td rowspan="3">Theories of elastic failure</td><td>Types of stresses (only theory)</td></tr>
<tr><td>Factor of safety (Definition & concepts)</td></tr>
<tr><td>Maximum Principal stress theory, maximum shear stress theory & distortion energy theory (Definitions & simple problems)</td></tr>
<tr><td colspan="3"><u>UNIT-II</u>

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</td></tr>
<tr><td>Unit</td><td>Module</td><td>Micro content</td></tr>
<tr><td rowspan="3">3. a or 4.a

Design for variable stresses</td><td rowspan="3">Design for variable stresses</td><td>Variable Stresses, Fatigue Failure, Fatigue strength, Endurance limit(Definitions & concepts)</td></tr>
<tr><td>Design for variable stresses by Gerber’s method (simple problems)</td></tr>
<tr><td>Design for variable stresses by Goodman’s method (simple problems)</td></tr>
</table>

<table>
<tr><td></td><td></td><td>Design for variable stresses by Soderberg's method (simple problems)</td></tr>
<tr><td rowspan="3">3.b or 4.b
Cumulative damage in fatigue</td><td rowspan="3">Stress concentration & cumulative damage in fatigue</td><td>Stress concentration and stress concentration factors (only theory)</td></tr>
<tr><td>Methods of reducing stress concentration (only theory)</td></tr>
<tr><td>Cumulative damage in fatigue
(simple problems)</td></tr>
</table>

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 loadperpendicular to axes of bolts

<table>
<tr><th>Unit</th><th>Module</th><th>Micro content</th></tr>
<tr><td rowspan="5">5.a or 6.a
Design of Riveted& welded joints</td><td rowspan="3">Design of riveted joints</td><td>Types of riveted joints(only theory)</td></tr>
<tr><td>Modes of failure and Efficiency of riveted joint (Theory and associated problems)</td></tr>
<tr><td>Design of joints for boiler shell (simple problems)</td></tr>
<tr><td rowspan="2">Design of welded joints</td><td>Types of welded joints (only theory)</td></tr>
<tr><td>Strength of parallel fillet and transverse fillet welds (Concepts & simple problems)</td></tr>
<tr><td rowspan="4">5.b or 6.b
Design of welded & bolted joints</td><td>Design of welded joints</td><td>Axially Loaded unsymmetrical welded Joints (Associated problems)</td></tr>
<tr><td rowspan="3">Design of bolted joints</td><td>Stresses in bolts due to initial tightening, external loading and combined loading. (Definitions & concepts)</td></tr>
<tr><td>Eccentrically loaded bolted joints in shear(Simple problems)</td></tr>
<tr><td>Eccentric loadperpendicular to axes of bolts (Associated Problems)</td></tr>
</table>

Unit-IV

SHAFTS: Transmission shafts- Shaft design on strength basis- Shaft design on torsional rigidity basis-ASME code for shaft design-Design of hollow shaft on strength and torsional rigidity basis.

KEYS & COUPLINGS:

Types of keys- Design of square and flat keys - Requirements – Rigid couplings-Muff coupling-Clamp coupling Flange coupling-Bushed pin flexible coupling

Unit	Module	Micro content
7.a.or 8.a **Design of shafts**	Design of shafts	Torsion equation in shafts **(Derivation)**
		Shaft design on strength basis **(Simple problems)**
		Shaft design on torsional regidity basis **(Simple problems)**
		Design of hollow shaft on strength and torsional rigidity basis**(Associated numericals)**
7.b.or 8.b **Keys & Couplings**	Design of keys	Types of keys (Only theory)
		Design of square key **(Associated problems)**
		Design of flat key **(Simple problems)**
	Design of Couplings	Design of flange coupling (Simple problems)
		Design of muff coupling **(Associated simple problems)**

Unit-V

COTTER JOINTS: cotter joints-spigot and socket, sleeve and cotter, jib and cotter joints

SPRINGS: Types of springs, Terminology of Helical Springs, End conditions, Stress and Deflection equations, Series and parallel Connections, Design of Helical springs.Introduction to Leaf springs, nipping of Leaf Spring.

Unit	Module	Micro content
9.a. or 10.a **Cotter joints**	Design of Cotter joints	Design procedures of Spigot and Socket joint, Sleeve and Cotter joint, Jib and Cotter joint **(Design procedures and associated simple problems)**
		Types and Terminology of Springs **(Only theory)**

9.b.or 10.b **Design of Springs**	Design of Springs	Stress and deflection equations of helical springs **(Associated simple problems)**
		Springs in series and parallel connections (**Simple problems)**
		Design of helical springs **(Design procedure and simple problems)**

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II-Year-II Semester		L T P C
ES2201	**PYTHON PROGRAMMING**	3 1* 0 3

Pre-Requisites : Nil

Course objectives: The student should be able to

1. Introduction to Scripting Language
2. Use various data handling mechanisms
3. Exposure to various problems solving approaches of computer science

Unit No	Contents
I	**Introduction (8 hrs)** History of Python, Need of Python Programming, differences between C and Python, Applications Basics of Python Programming Using the REPL(Shell), Running Python Scripts, Variables, Assignment, Keywords, Input-Output, Indentation. **Types, Operators and Expressions**: Types - Integers, Strings, Booleans; Operators- Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators, Expressions.
II	**Flow Control & Data Structures (14 hrs)** **Control Flow** - Order of Evaluations Control Flow- if, if-elif-else, for, while, break, continue, pass **Data Structures**- Lists - Operations, Slicing, Methods; Tuples, Sets, Dictionaries, Sequences. Comprehensions.

III	**Functions, Modules & Packages (10 hrs)** **Functions** - Defining Functions, Calling Functions, Passing Arguments, Types of arguments, Anonymous Functions, Fruitful Functions (Function Returning Values), Scope of the Variables in a Function - Global and Local Variables. **Modules:** Creating modules, import statement, from. Import statement, name spacing. **Python packages**, Introduction to PIP, Installing Packages via PIP, Using Python Packages
IV	**OOPs (12 hrs)** **Object Oriented Programming in Python**: Definition, advantages of OOPs, OOPs principles, Data abstraction, Encapsulation, Classes, 'self variable', Methods, Constructor Method. **Inheritance:** Introduction to Inheritance, Types of Inheritance, Overriding Methods, and Data hiding.
V	**STL (8 hrs)** **Error and Exceptions**: Difference between an error and Exception, Handling Exception, try except block, Raising Exceptions, User Defined Exceptions **Data Handling:** Math, Numpy Library, Matplotlib

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

CO1: **Understand** the need and the Jargon of Python language at its core. { Understand level, KL2}

CO2: **Experiment** with various Data structures in interpreted Language. Also develop codes using the control structures in Python. **{Apply level, KL3}**

CO3: **Build** different types of functions, modules and packages for real software needs. **{Apply level, KL3}**

CO4: **Implement** Object Oriented Principles in Python. Able to understand advanced programming paradigm. **{ Apply level, KL3}**

CO5: **Analyze** solutions using numpy& matplotlib library. Data visualization is experience by the students. **{Apply level, KL3}**

Text books:

1. Python Programming: A Modern Approach, Vamsi Kurama, Pearson
2. Learning Python, Mark Lutz, Orielly

Reference books:

1. Think Python, Allen Downey, Green Tea Press
2. Core Python Programming, R Nageswara Rao, Dreamtech
3. Introduction to Python, Kenneth A. Lambert, Cengage

e- Resources & other digital material:

1. OOPS: https://www.youtube.com/watch?v=qiSCMNBIP2g
2. matplotlib: https://www.youtube.com/watch?v=0v7EMLNEAko
3. numpy: https://www.youtube.com/watch?v=oHaYdfWlgCg
4. Recursion: https://www.youtube.com/watch?v=FaEFpSJqsvk&list=PLqftY2uRk7oXvERQEgATSr-KzAh8WLW_D&index=113

Micro-Syllabus of Python programming (CSE& IT)

I B.Tech II Semester

UNIT I

Introduction: History of Python, Need of Python Programming, differences between C and Python, Applications Basics of Python Programming Using the REPL(Shell), Running Python Scripts, Variables, Assignment, Keywords, Input-Output, Indentation.

Types, Operators and Expressions: Types - Integers, Strings, Booleans; Operators- Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators, Expressions.

Unit	**Module**	**Micro content**
Introduction to Python Language	Introduction	History of Python
		Need of Python Programming
		Differences b/w C and Python, Applications
		Python Shell, Running Python Scripts
		Variables
		Input-Output
		Indentation
	Types & Operators	Integers, Strings, Booleans
		Operators

	Types & Operators	Membership operators
		Expressions

UNIT – II

Control Flow - order of evaluations Control Flow- if, if-elif-else, for, while, break, continue, pass

Data Structures- Lists - Operations, Slicing, Methods; Tuples, Sets, Dictionaries, Sequences. Comprehensions.

Unit	**Module**	**Micro content**
Control Statements and Data Structures	Control Flow	Order of Evaluations
		if and if else statement
		for , While loop, break, continue, pass
	Data Structures	Lists, Tuples
		Dictionaries
		Comprehensions

UNIT III

Functions - Defining Functions, Calling Functions, Passing Arguments, Keyword Arguments, Default Arguments, Variable-length arguments, Anonymous Functions, Fruitful Functions (Function Returning Values), Scope of the Variables in a Function - Global and Local Variables.

Modules: Creating modules, import statement, from. Import statement, name spacing.

Python packages, Introduction to PIP, Installing Packages via PIP, Using Python Packages

Unit	**Module**	**Micro content**
Functions and Modules	Functions	Defining, Calling and Passing Arguments to functions
		Types of Arguments
		Scope and life time of variables
		Global and Local Variables
	Modules and Python Packages	Creating Modules
		Import statements, from and name spacing
		Introduction to PIP
		Installing packages using PIP
		Packages and their usage.

UNIT IV Object Oriented Programming in Python: Definition, advantages of OOPs, OOPs principles, Classes, 'self-variable', Methods, Constructor Method, Inheritance, Overriding Methods, and Data hiding.Error and Exceptions: Difference between an error and Exception, Handling Exception, try except block, Raising Exceptions, User Defined Exceptions		
Unit	**Module**	**Micro content**
Object Oriented Programming and Exception Handling	Object Oriented Programming	Advantages of OOP, self-variable
		Methods, constructors, inheritance, Data hiding and Overriding Methods
	Error and Exceptions	Difference between error and exceptions
		Handling Exception, Raising exception
		User defined Exception

UNIT V Brief Tour of the Standard Library - Operating System Interface - String Pattern Matching, Mathematics, Internet Access, Dates and Times, Data Compression, Multithreading, GUI Programming, Turtle Graphics Testing: Why testing is required? Basic concepts of testing, Unit testing in Python, Writing Test cases, Running Tests.		
Unit	**Module**	**Micro content**
GUI and Programming Testing	Standard Library	OS Interface, Pattern Matching
		Internet Access, Dates and Times
		Data Compression
		Multithreading, GUI and Turtle Graphics
	Testing	Why Testing is required.
		Basic Concepts of Testing, Unit Testing
		Writing Test cases, Running Test Cases

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II-Year-II Semester		**L T P C**
PC2202L	**THERMAL ENGINEERING LAB**	**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.

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

CO1: Compute the property of fuels using suitable tests. **(Apply Level)**

CO2: Analyze the performance characteristics of Internal Combustion Engines. **(Analyze Level)**

CO3: Compute the performance of multistage air compressor unit. **(Apply Level)**

CO4: Identify the accessories and mountings of various boilers and its working principles **(Understand Level)**

Reference books: Lab Manual

II-Year-II Semester		L T P C
PC2205	MACHINE DRAWING	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.**CATIA / CREO / Solid Edge / Siemens PLM software / IRON CAD /Auto- CAD** isused to learn the above course.

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
4. arrangements simple mechanical parts.
5. The student will be able to draw the assembly from the individual part drawing.
6. The student also is enabled to prepare the assembly of various machine or engine components and miscellaneous machine components.

Unit No	Contents
I	Machine Drawing Conventions: Need for drawing conventions – introduction to IS conventions a) Conventional representation of materials, common machine elements and parts such as screws, nuts, bolts, keys, gears, webs, ribs. b) Types of sections – selection of section planes and drawing of sections and auxiliary sectional views. Parts not usually sectioned. c) Methods of dimensioning, general rules for sizes and placement of dimensions for holes, centers, curved and tapered features. d) Title boxes, their size, location and details - common abbreviations & their liberal usage. e) Types of Drawings – working drawings for machine parts. **(2 Sessions)**
II	**Drawing of Machine Elements and simple parts:** Selection of Views, additional views for the following machine elements and parts with every drawing Proportions. a) Popular forms of Screw threads, bolts, nuts, stud bolts, tap bolts, set screws. b) Keys, cotter joints and knuckle joint. c) Riveted joints for plates d) Shaft coupling, spigot and socket pipe joint. e) Journal, pivot and collar and foot step bearings **(4 Sessions)**
III	**Assembly Drawing I:** Drawings of assembled views for the part drawings of the following using conventions and easy drawing Proportions. Engine parts: a) Gear pump. b) Fuel pump. c) Petrol Engine connecting rod. f) Piston assembly. **(4 Sessions)**

IV	**Assembly Drawings II:** Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportions. <u>Other machine parts</u>: a) Screws jacks. b) Machine Vices. c) Plummer block. d) Tailstock. **(4 Sessions)**
V	**Assembly Drawings III:** Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportions. <u>Valves</u>: 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.

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. Machine Drawing – Gowtham and Gowtham, Pearson
9. Manuals & Tutorials on CAD/CAE packages like Pro/Engineer, Pro/Mechanica, ANSYS, etc latest available in the lab.
10. Kelley David S., Pro/ENGINEER Wildfire 5.0 Instructor, Tata McGraw Hill (2011).
11. Toogood Roger Ph.D., P. Eng., Zecher Jack P.E., Creo Parametric 1.0 Tutorial and MultiMedia DVD, SDC Publications, USA (2012), ISBN: 978-1-58503-692-9, ISBN (Book + Software on Disk): 978-1-58503-730-8

e- Resources & other digital material:

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

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II-Year-II Semester		L T P C
ES2201L	PYTHON PROGRAMMING LAB	0 0 3 1.5

Pre-Requisites: Awareness of any IDE for 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 for GUI

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 a 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

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

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. Arithmetic operations using Functions.

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. 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

Demonstrate Modules in python with necessary example.

Exercise - 13 OOP

Class variables and instance variable and illustration of the self variable

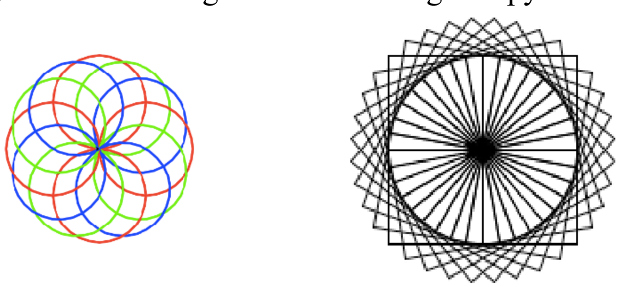
i) Robot

ii) ATM Machine

Exercise - 14

a)Matrix multiplication using numpy.

i) Inverse of a given matrix using numpy.



ii) Generate a matrix of size nxn using random.

b) Demonstrate Subplots, Lineplots& Bar plots using matplotlib.

Course Outcomes:

After completing this course, Students will be able to-

CO1: Comprehend how software easily to build right out of the box.

CO2: Demonstrates the use of an interpreted language for problem solving through control statements including loops and conditionals.

CO3: Practice with data structures for quick programming solutions.

CO4: Demonstrates software building for real needs by breaking out code into reusable functions and modules.

CO5: Comprehend the software reliability through exception handling.

CO6: Use of python standard library for problem solving and Identifies the necessity of testing software.

II-Year-II Semester		L T P C
PR2201	SOCIALLY RELEVANT PROJECT	0 0 2 0

Pre-Requisites: Nil

COURSE OBJECTIVES

1. To apply the concepts of basic sciences and fundamentals of engineering in the benefit for the society.
2. To increase the social consciousness in the students.
3. To understand practical social relevant technical problems.
4. To apply effort to solve social relevant technical problems.

Student can choose any one of the given below / any other socially relevant problem and work on it to produce a project document.

1. Water Conservation Related Works
2. Swatch Bharath (Internal External)
3. Helping police
4. Traffic monitoring
5. Teaching Rural Kids (Sarvasiksha Abhiyan)
6. Street light monitoring
7. Electricity Conservation
8. Solar panel utilization
9. E- policing & cyber solution
10. Pollution
11. Any social related

COURSE OUTCOMES:

Upon successfully completion of the social relevant project, the student will have:

1. Hands on learning to execute a project.
2. Social responsibility.
3. Training in team work / to work individually.
4. Improvement in communication skills.

III-Year-I Semester	DYNAMICS OF MACHINERY	L	T	P	C
PC3101		3	1*	0	3

Pre-requisites:

1. Engineering Mathematics

2. Engineering Mechanics

3. Kinematics of Machinery

Course Objectives: The Students will acquire the knowledge

1. To solve frictional losses, torque transmission of mechanical systems.

2. To analyze dynamic forces of slider crank mechanism and design of flywheel

3. To analyze stabilization of sea vehicles, aircrafts and automobile vehicles and understand the working of various governors.

4. To understand the methods of balancing reciprocating and rotary masses.

5. To understand the concept of vibrations and its significance on engineering design.

Unit No	Contents

I	**FRICTION:** **BEARINGS:** Pivot and collar bearings, uniform pressure, uniform wear, friction circle and friction axis: lubricated surfaces, boundary friction, film lubrication. **CLUTCHES:** Friction clutches- single disc or plate clutch, multiple disc clutch, cone clutch, centrifugal clutch. **BRAKES AND DYNAMOMETERS:** Simple block brakes, internal expanding brake, bandbrake of vehicle. General description and operation of dynamometers: Prony, Rope brake, Epicyclic, Bevis Gibson and belt transmission.
II	Static and dynamic force analysis of planar mechanisms. **TURNING MOMENT DIAGRAMS:** Dynamic force analysis of slider crank mechanism, inertia torque, angular velocity and acceleration of connecting rod, crank effort and turning moment diagrams – fluctuation of energy – fly wheels and their design.
III	**PRECESSION:** Gyroscopes, effect of precession motion on the stability of moving vehicles such as motor car, motor cycle, aero planes and ships, **GOVERNERS:** Watt, porter and proell governors, spring loaded governors – Hartnell and Hartung-sensitiveness, isochronism and hunting.
IV	**BALANCING:** Balancing of rotating masses single and multiple – single and different planes, use analytical and graphical methods. Primary, secondary, and higher balancing of reciprocating masses- analytical and graphical methods, unbalanced forces and couples – examination of "V" multi cylinder in line and radial engines for primary and secondary balancing, locomotive balancing, hammer blow, swaying couple, variation of tractive effort.
V	**VIBRATIONS:** Free Vibration of spring mass system –Natural frequency-types of damping– damped free vibration, Simple problems on forced damped vibration-critical speeds-torsional vibrations.

Text Books:

1. Theory of Machines / S.S Rattan/ Mc. Graw Hill

2. Mechanism and machine theory /Ashok G. Ambedkar/PHI Publications.

References:

1. Mechanism and Machine Theory / JS Rao and RV Dukkipati / New Age

2. Theory of Machines / Shigley / MGH

3. Theory of Machines / Thomas Bevan / CBS Publishers

4. Theory of machines / Khurmi/S.Chand.

e- Resources & other digital material:

1. https://www.youtube.com/watch?v=ty9QSiVC2g0
2. https://www.youtube.com/watch?v=devo3kdSPQY
3. https://www.youtube.com/watch?v=m4UmBbS7mfI
4. https://www.youtube.com/watch?v=7nJ0mnHXfxw

Course outcomes:

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

1. Solve frictional losses, torque transmission of mechanical systems **(Apply level, KL-3)**

2. Determine dynamic forces of slider crank mechanism and design of flywheel

(Apply level, KL-3)

3. Judge the stabilization of sea vehicles, aircrafts and automobile vehicles and illustrate the working of various governors **(Apply level, KL-3)**

4. Execute the methods of balancing reciprocating and rotary masses **(Apply level, KL-3)**

5. Illustrate the concept of vibrations and its significance on engineering design **(Understand level, KL-2)**

Micro Syllabus

UNIT-I		
BEARINGS: Pivot and collar bearings, uniform pressure, uniform wear, friction circle and friction axis: lubricated surfaces, boundary friction, film lubrication. **CLUTCHES:** Friction clutches- single disc or plate clutch, multiple disc clutch, cone clutch, centrifugal clutch. **BRAKES AND DYNAMOMETERS:** Simple block brakes, internal expanding brake, bandbrake of vehicle. General description and operation of dynamometers: Prony, Rope brake, Epicyclic, Bevis Gibson and belt transmission.		
Unit	**Module**	**Micro content**
1.a. or 2.a	Bearings & Clutches	Uniform pressure and uniform wear conditions **(Only theory)**
		Problems on bearings & clutches
1.b. or 2.b	Brakes & dynamometers	Numericals On Brakes
		Explanation on dynamometers **(Only theory)**

UNIT-II		
Static and dynamic force analysis of planar mechanisms. **TURNING MOMENT DIAGRAMS:** Dynamic force analysis of slider crank mechanism, inertia torque, angular velocity and acceleration of connecting rod, crank effort and turning moment diagrams – fluctuation of energy – fly wheels and their design.		
Unit	**Module**	**Micro content**
3. a or 4.a	Static & dynamic force analysis	Static and dynamic force analysis of planar mechanisms **(Only theory)**
		dynamic force analysis of slider crank mechanism **(Simple numericals)**

3.b or 4.b	Turning Moment Diagrams & fly wheels	Different turning moment diagrams **(Theory & numericals)**
		Numericals on fly wheels

UNIT-III

PRECESSION:

Gyroscopes, effect of precession motion on the stability of moving vehicles such as motor car, motor cycle, aero planes and ships,

GOVERNERS:

Watt, porter and proell governors, spring loaded governors – Hartnell and Hartung- sensitiveness, isochronism and hunting.

Unit	**Module**	**Micro content**
5.a or 6.a	Precession	Stability of aeroplanes & ships **(Numericals)**
		Stability of two-wheelers & four-wheelers **(Numericals)**
5.b or 6.b	Governers	Porter and proell governors **(Only problems)**
		Hartnell and Hartung governors **(Only problems)**
		sensitiveness, isochronism and hunting of a governer **(Only theory)**

Unit-IV

BALANCING:

Balancing of rotating masses single and multiple – single and different planes, use analytical and graphical methods. Primary, secondary, and higher balancing of reciprocating masses- analytical and graphical methods, unbalanced forces and couples –examination of “V” multi cylinder in line and radial engines for primary and secondary balancing, locomotive balancing, hammer blow, swaying couple, variation of tractive effort.

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

7.a. or 8.a	Balancing of rotating masses	Balancing of rotating masses **(Analytical & graphical methods)**
7.b. or 8.b	Balancing of reciprocating masses	Primary & secondary balancing, examination of v-multi cylinder inline and radial engines **(Only numericals)**
		Locomotive balancing: hammer blow, swaying couple, variation of tractive effort. **(Only theory)**

Unit-V

VIBRATIONS:

Free Vibration of spring mass system –Natural frequency-types of damping– damped free vibration, Simple problems on forced damped vibration-critical speeds-torsional vibrations.

Unit	Module	Micro content
9.a. or 10.a	Free vibration	Free Vibration of spring mass system **(Theory & problems)**
		Types of damping, damped free vibrations **(Theory and associated problems)**

III-Year-I SemesterDESIGN OF MACHINE MEMBERS-II L T P C

3 1* 0 3

PC3102

Pre-requisites:

1. Engineering Mathematics

2. Mechanics of Solids

3. Design of Machine Members I

Course Objectives: The Students will acquire the knowledge

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, crank shaft 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

5. Design of the machine tool elements such as levers and brackets

Unit No	Contents
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.
II	**ENGINE PARTS I:** **Connecting Rod:** Thrust in connecting rod – stress due to whipping action on connecting rod ends. **Crankshaft:** Cranks and crank shafts, strength and proportions of over hung and center cranks – crank pins, crank shafts.

III	**ENGINE PARTS II:** Pistons, forces acting on piston – construction design and proportions of piston, cylinder, cylinder liners.
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.
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.

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

3. Design Data Hand Book/S. Md. Jalaluddin/Anuradha Publications

4. 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

e- Resources & other digital material:

1. https://nptel.ac.in/courses/112/106/112106137/

2. https://freevideolectures.com/course/3493/vibration-of-structures/31

3.https://www.youtube.com/watch?v=qgqQxIe6QIw

4.https://www.youtube.com/watch?v=qgqQxIe6QIw

5. https://nptel.ac.in/content/storage2/courses/112105125/pdf/mod14les2.pdf

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

1. Select the suitable bearings based on the application of the loads and predict the life of the bearing **(Apply level, KL-3)**

2. Sketch the design procedure for engine parts such as connecting rod, crank, crank shaft and engine parts such as piston, cylinder and cylinder liners **(Apply level, KL-3)**

3. Apply the knowledge in designing the curved beams with various cross sections and crane hooks **(Apply level, KL-3)**

4. Design the power transmission elements such as belts, chains, ropes and gear drives **(Apply level, KL-3)**

5. Interpret machine tool elements such as levers and brackets **(Understand level, KL-2)**

Micro Syllabus

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	**Module**	**Micro content**

1.a. or 2.a **Introduction to bearings**	Introduction to bearings	Types of bearings, bearing modulus & bearing characteristic number, lubrication, types of journal bearings**(only theory)**
1.b. or 2.bDesign of sliding & rolling contact bearings	Design of sliding & rolling contact bearings	Heat dissipation of bearings **(Simple numericals)**
		Design of ball and roller contact bearings **(Numericals)**
		Bearing life (**Definition & simple problems)**

UNIT-II

ENGINE PARTS I:

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

Crankshaft: Cranks and crank shafts, strength and proportions of over hung and center cranks – crank pins, crank shafts

Unit	**Module**	**Micro content**
3. a or 4.a **Design of connecting rod**	Design of connecting rod	Design procedure for connecting rod **(Only theory)**
		Design of connecting rod **(Simple numericals)**
3.b or 4.b **Design of crank shaft**	Design of crank shaft	Design of side crankshaft **(Simple problems)**
		Design of centre crankshaft **(Simple problems)**

UNIT-III

ENGINE PARTS II:

Pistons, forces acting on piston – construction design and proportions of piston, cylinder, cylinder liners.

Unit	Module	Micro content
5.a or 6.a	Design of piston	Design procedure for piston head, piston rings, piston ribs, piston cup **(Only theory)**
		Design of piston **(Simple numericals)**
5.b or 6.b **Design of Cylinder & cylinder liners**	Design of Cylinder & cylinder liners	Design of cylinder length and bore **(Simple problems)**
		Design of cylinder head **(Simple problems)**
		Stresses in cylinder liner **(simple problems)**
		Design of studs for cylinder cover **(simple problems)**

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.

Unit	Module	Micro content
7.a. or 8.a **Design of Curved beams**	Design of curved beams	Difference between straight and curved beam **(Only theory)**
		Design procedure for curved beams such as crane hook and C-clamps **(Only theory)**
		Design of curved beams with trapezoidal, rectangular and circular cross-sections **(Simple problems)**
		Types of flexible drives, advantages and disadvantages **(Only theory)**

7.b. or 8.b **Flexible drives**	Flexible drives	Selection of flat belt drive **(Associated problems)**
		Selection of v-belt drive **(Simple problem)**
		Chain drives **(Simple concepts and associated numericals)**

<u>Unit-V</u>

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.

Unit	Module	Micro content
9.a. or 10.a **Design of Spur gears**	Design of Spur gears	Design procedure for spur gears **(Only theory)**
		Design of spur gears (Associated numericals)
9.b. or 10.b **Design of Helical gears**	Design of Helical gears	Design procedure for helical gears **(Only theory)**
		Design of helical gears **(Simple numericals)**

III-Year-I SemesterMETAL CUTTING & MACHINE TOOLS L T P C

3 1* 0 3

PC3103

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.

6. To apply knowledge of basic mathematics to calculate the machining parameters for different machining processes.

Unit No	Contents
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. **(10 hrs)**
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.**(10 hrs)**
III	**SHAPING, SLOTTING AND PLANNING MACHINES:** Principles of working – principal parts – specifications, operations performed, machining time calculations.**(5 hrs)** **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. **(5 hrs)**

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.**(5 hrs)** **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.**(5 hrs)**
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.**(5 hrs)** **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.**(5 hrs)**

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 **{Operatelevel, KL3}**
CO3:	Operate Shaper, Slotter, Planer, Drill press, Boring machines, etc **{Operatelevel, KL3}**
CO4:	Select appropriate Finishing processes and conditions for different metals **{Select level, KL2}**
CO5:	Develop Jigs and Fixtures for simple parts and Apply the principles if CNC machines. **{Develop level, KL3}**

Learning Resources
Text books: 1. Manufacturing Processes / JP Kaushish/ PHI Publishers-2nd Edition 2. Manufacturing Technology Vol-II/P.N Rao/Tata McGraw Hill

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/ PearsonPublications 5th Edition

Micro Syllabus

Unit-1: 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	**Module**	**Micro content**
1a. & 2a. Fundamental of Machining	Elementary Treatment Of Metal Cutting Theory	Elements Of Cutting Process
		Geometry Of Single Point Cutting Tool
		Chip Formation
		Types Of Chips
		Built Up Edge And Its Effects
		Chip Breakers
1b. & 2b. Fundamental of Machining	Mechanics Of Orthogonal Cutting	Merchant's force diagram
		Cutting Forces, Cutting Speeds,
		Feed, Depth Of Cut, Tool Life, Tool Wear
		Economics Of Machining
		Coolants

		tool materials and properties

Unit-2 :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	Module	Micro content
3a. & 4a. Lathe Machines	Engine lathe	Principle Of Working
		Specification Of Lathe
		Types Of Lathe
		Work Holders Tool Holders
3b. & 4b. Lathe Machines	Engine lathe	Taper Turning Methods
		Thread Turning Methods
	Turret and capstan lathes.	Principle Of Working
		Difference Between Turret & Capstan Lathe

Unit-3: Reciprocating & Rotary Machine Tools

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	Module	Micro content
5a. & 6a. Shaping, Slotting and Planning Machines	Shaping, Slotting and Planning Machines	Principles Of Working
		Principal Parts
		Specifications
		Operations Performed
		Machining Time Calculations.
		Principles Of Working
		Specifications
		Types Of Machines,

5b. & 6b. Drilling & Boring Machines	Drilling & Boring Machines	Operations Performed
		Tool Holding Devices
		Twist Drill Nomenclature
		Fine Boring Machines
		Jig Boring Machine
		Deep Hole Drilling Machine

Unit 4: Finishing Operations

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	**Module**	**Micro content**
7a. & 8a. Milling Machines	Milling	Principles Of Working
		Specifications
		Classification Of Milling Machines
		Horizontal, Vertical And Universal Milling Machine,
		Machining Operations
		Types Of Cutters
		Geometry Of Milling Cutters
		Methods Of Indexing
		Accessories To Milling Machines
7b. & 8b. Finishing	Grinding	Theory of grinding
		classification of grinding machines
		cylindrical and surface grinding machines
		tool and cutter grinding machines
		different types of abrasives
		bonds

Processes	Grinding	specification
		selection of a grinding wheel
		Lapping
		Honing
		Broaching
		comparison to grinding

Unit 5: Work Holding devices and CNC Machines

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.

Unit	**Module**	**Micro content**
9a. &10a. Jigs & Fixtures	Jigs & fixtures	Principles Of Design Of Jigs And Fixtures
		Classification Of Jigs & Fixtures
		Principles Of Location And Clamping
		Types Of Clamping & Work Holding Devices
		Typical Examples Of Jigs And Fixtures
9b. & 10b. CNC Machine Tools	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

III-Year-I Semester FINITE ELEMENT METHODS L T P C

3 1* 0 3

PC3104

Pre-Requisites :

Numerical Methods, Strength of materials, Basic solid mechanics and Heat Transfer

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

1. To introduce the concepts of Mathematical Modeling of Engineering Problems.
2. To learn basic principles of finite element analysis procedure.
3. To learn the theory and characteristics of finite elements that represent engineering structures.
4. To learn and apply finite element solutions to structural, thermal, dynamic problem to develop the knowledge and skills needed to effectively evaluate finite element analyses performed by others.
5. To learn to model complex geometry problems and solution techniques.

Unit No	Contents
I	**Introduction:** stress and equilibrium, strain – displacement relations, stress – strain relations, plane stress and plane strain conditions, variational and weighted residual methods. **Finite Element Method:** Discretization, types of elements, interpolation functions, local and global coordinates, steps in finite element method, applications of finite element method
II	**Analysis of Trusses:** Finite element modeling, coordinates and shape functions, assembly of global stiffness matrix and load vector, finite element equations, treatment of boundary conditions, stress, strain and support reaction calculations. **Analysis of Beams:** Element stiffness matrix for Hermite beam element, derivation of load vector for concentrated and UDL, simple problems on beams.

III	**Axisymmetric loading:** Finite element modeling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions, formulation of axisymmetric problems.
IV	**Higher order and isoparametric elements:** One dimensional quadratic and cubic elements in natural coordinates, two dimensional four noded isoparametric elements and numerical integration.
V	**Steady state heat transfer analysis :** one dimensional analysis of a fin and two dimensional analysis of thin plate, analysis of a uniform shaft subjected to torsion. **Dynamic Analysis:** Formulation of finite element model, element consistent and lumped mass matrices, evaluation of eigen values and eigen vectors, free vibration analysis.

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

CO1: Formulate the different types mathematical Techniques used in FEM analysis **{Understand level, KL2}**

CO2: Solve the elements like Beam and Truss subjected to different loading conditions **{Apply level, KL3}**

CO3: Analyze 2-D structures with iso-parametric elements along with axisymmetric problems **{Apply level, KL3}**

CO4: Apply the finite element techniques for solving thermal problems **{Apply level, KL3}**

CO5: Develop consistent mass matrices for different elements by considering the mechanical vibrations **{Apply level, KL3}**

Text books:

1. Introduction to Finite Elements in Engineering / Chandraputla, Ashok and Belegundu / Prentice – Hall.
2. The Finite Element Methods in Engineering / SS Rao / Pergamon.

Reference books:

1. Finite Element Method with applications in Engineering / YM Desai, Eldho & Shah /Pearson publishers.
2. An introduction to Finite Element Method / JN Reddy / McGrawHill.
3. The Finite Element Method for Engineers – Kenneth H. Huebner, Donald L. Dewhirst, Douglas E. Smith and Ted G. Byrom / John Wiley & sons (ASIA) Pte Ltd.
4. Finite Element Analysis: Theory and Application with Ansys, Saeed Moaveniu, Pearson Education.

e- Resources & other digital material:

1. https://nptel.ac.in/courses/112/106/112106135/
2. https://nptel.ac.in/courses/112/104/112104116/
3. https://nptel.ac.in/courses/112/104/112104115/
4. https://nptel.ac.in/courses/112/103/112103295/

PSO1	1	It deals with the socially acceptable technical solutions with the application modern and appropriate techniques. Hence all CO's are mapped moderately with this PSO.
PSO2	2	It deals with the socially modern engineering hardware and software tools and adapt in multidisciplinary. Hence all CO's are mapped weak with this PSO.

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Micro-Syllabus

Unit-1:

Introduction: stress and equilibrium, strain – displacement relations, stress – strain relations, plane stress and plane strain conditions, variational and weighted residual methods.

Finite Element Method: Discretization, types of elements, interpolation functions, local and global coordinates, steps in finite element method, applications of finite element method

Unit	Module	Micro content
1.a.or 2.a		stress and equilibrium, strain – displacement relations
		stress – strain relations

Introduction	Introduction	plane stress and plane strain condition
		variational and weighted residual methods
1.b.or 2.b **Finite Element Method**	Finite Element Method	Discretization, types of elements
		interpolation functions
		local and global coordinates
		steps in finite element method
		applications of finite element method

Unit-2:

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

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

Unit	**Module**	**Micro content**
3. a or 4.a **Analysis of Trusses**	Analysis of Trusses	Finite element modeling, coordinates and shape functions
		assembly of global stiffness matrix and load vector
		finite element equations, treatment of boundary conditions
		stress, strain and support reaction calculations
3.b or 4.b **Analysis of Beams**	Analysis of Beams	Element stiffness matrix for Hermite beam element
		derivation of load vector for concentrated and UDL
		simple problems on beams

Unit-3:

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

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

5.a or 6.a **Axisymmetric loading**	Axisymmetric loading	Finite element modeling of two-dimensional stress analysis with constant strain triangles and treatment of boundary conditions
5.b or 6.b **Axisymmetric loading**		formulation of axisymmetric problems

Unit-4:

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

Unit	**Module**	**Micro content**
7.a.or 8.a **Higher order and isoparametric elements**	Higher order and isoparametric elements	One dimensional quadratic and cubic elements in natural coordinates,
7.b.or 8.b **Higher order and isoparametric elements**	Higher order and isoparametric elements	two dimensional four noded isoparametric elements and numerical integration

Unit-5:

Steady state heat transfer analysis: one dimensional analysis of a fin and two-dimensional analysis of thin plate, analysis of a uniform shaft subjected to torsion.

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

Unit	**Module**	**Micro content**
9.a. or 10.a **Steady state heat transfer analysis**	Steady state heat transfer analysis	one dimensional analysis of a fin and two-dimensional analysis of thin plate
		analysis of a uniform shaft subjected to torsion
9.b.or 10.b **Dynamic Analysis**	Dynamic Analysis	Formulation of finite element model
		element consistent and lumped mass matrices
		evaluation of eigen values and eigen vectors, free vibration analysis

III-Year-I Semester		L T P C
ES3101	**FUNDAMENTALS & PRINCIPLES OF INTERNET OF THINGS**	3 1* 0 3

Pre-Requisites: Fundamentals of computers and its importance

Course objectives:

The student should be able to

1. study the introductory concepts, design procedures and enabling technologies of IoT
2. Learn the concepts of networking and building blocks of IoT.
3. Study changes in architectures of IoT and its challenges.
4. Know the procedure of IoT Design Methodology.
5. Learn about IoT solutions to different real time problems.

Unit No	Contents
I	**Unit – 1: Introduction to IoT** **(10 hrs)** Introduction to Internet of Things, Block diagram of IoT, Definition and characteristics of IoT, Physical Design of IoT, Logical Design of IoT, IoT Enabling Technologies, IoT levels. (Basic concepts only).
II	**Unit-2: IoT & M2M** **(10 hrs)** Machine to Machine, Difference between IoT & M2M, Software defined Networking, Network function virtualization, IoT Device and its basic building blocks

III	**Unit-3**: **Architecture and Challenges in IoT** **(10 hrs)** Three, Four, Five and Seven layer, Cloud and Fog based, Social IoT and its representative architecture, Design challenges, Development challenges, Security challenges, Other challenges, Need for IoT systems management.
IV	**Unit-4: IoT Platforms Design Methodology** **(10 hrs)** Introduction, Step by step procedure of IoT Design Methodology, Development of domain and Information model for IoT systems, Example case studies.
V	**Unit-5: Domain Specific IoTs** **(10 hrs)** Home automation, Smart cities, Environment, Energy, Retail, Logistics, Agricultural, Industry, Health and Lifestyle, Smart Automobile.

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

CO1	**Understand** the concepts and designing of IoT**{Understand level, KL2}**
CO2	**Explain** the concepts of networking and building blocks of IoT.**{Understand level, KL2}**
CO3	**Analyze** changes in architectures of IoT and its challenges **{Analyze level, KL4}**
CO4	**Explain** the procedure of IoT Design Methodology. **{Understand level, KL2}**
CO5	**Design** IoT solutions to different real time problems. **{Apply level, KL4}**

Text books:

1. **Internet of Things: A Hands-on Approach**, Arshdeep Bahga, Vijay Madisetti, Orient Blackswan Private Limited - New Delhi; First edition, ISBN: 8173719543
2. **The Internet of Things Key Applications and Protocols**, Olivier Hersent, David Boswarthick, Omar Elloumi, John Wiley & Sons Ltd, ISBN: 978-1-119-99435-0
3. **Architecting the Internet of Things**, Dieter Uckelmann, Mark Harrison, Florian Michahelles, Springer Heidelberg Dordrecht London New York, ISBN: 978-3-642-19156-5
4. **Fundamentals of Wireless Sensor Networks: Theory and Practice**, Waltenegus Dargie, Christian Poellabauer, John Wiley & Sons Ltd, ISBN: 978-0-470-97568-8

Reference books:

1. **Networks, Crowds, and Markets: Reasoning About a Highly Connected World**, David Easley, Jon Kleinberg, Cambridge University Press
2. **Rethinking the Internet of Things: A Scalable Approach to Connecting Everything**, daCosta Francis, Henderson Byron, Apress Publications, ISBN: 978-1-4302-5740-0CO4
3. **Getting Started with the Internet of Things**, CunoPfister, OReilly Media, ISBN: 97CO58-1-4493-9357-1

Micro Syllabus

Unit – 1: Introduction to IoT **(10 hrs)**

Introduction to Internet of Things, Block diagram of IoT , Definition and characteristics of IoT, Physical Design of IoT, Logical Design of IoT, IoT Enabling Technologies, IoT levels. (Basic concepts only).

Unit No	Module	Micro content
1a. Physical and Logical Design of IoT	Introduction	Introduction
		Block diagram of IoT
		Definition & characteristics of IoT
	Physical Design of IoT	Things in IoT, IoT Protocols
	Logical Design of IoT	IoT functional Blocks, IoT Communication Models, IoT communication APIs
1b. IoT Enabling Techniques & Levels	IoT Enabling Technologies	Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication Protocols, Embedded Systems
	IoT levels	IoT Leve-1 to IoT Leve-6

Unit-2:IoT & M2M **(10 hrs)**

Machine to Machine, Difference between IoT & M2M, Software defined Networking, Network function virtualization, IoT Device and its basic building blocks.

Unit No	Module	Micro content

2.a. Machine to Machine	Machine to Machine	Machine to Machine
		Difference between IoT & M2M
		Software defined Networking
		Network function virtualization
2.b. IoT Device building blocks	IoT basic building blocks	sensors,
		processors,
		gateways,
		applications

Unit-3:**Architecture and Challenges in IoT** **(10 hrs**

Three, Four, Five and Seven layer, Cloud and Fog based, Social IoT and its representative architecture, Design challenges, Development challenges, Security challenges, Other challenges, Need for IoT systems management.

Unit No	Module	Micro content
3.a. Architecture	Different Layers in IOT	Three, Four, Five and Seven layer
		Cloud and Fog based
		Social IoT and its representative architecture
3.b. Challenges in IoT	Challenges in IoT	Design challenges
		Development challenges
		Security challenges
		Other challenges
	IoT systems management	Need for IoT systems management

Unit-4: IoT Platforms Design Methodology **(10 hrs)**

Introduction, Step by step procedure of IoT Design Methodology, Development of domain and Information model for IoT systems, Example case studies

Unit No	Module	Micro content
4. Design Methodology	Step by step procedure	Introduction
		Step-1 to Step-10
	Models	Domain Model
		Information model
	case studies	Examples

Unit-5:Domain Specific IoTs **(10 hrs)**		
Home automation, Smart cities, Environment, Energy, Retail, Logistics, Agricultural, Industry, Health and Lifestyle.		
Unit No	**Module**	**Micro content**
5. Domain Specific IoTs	**Applications**	Home automation
		Smart cities
		Environment
		Energy
		Retail
		Logistics
		Agricultural
		Industry
		Health and Lifestyle

III-Year-I Semester		L T P C
ES3101L	**FUNDAMENTALS & PRINCIPLES OF INTERNET OF THINGS LAB**	0 0 3 1.5

S.No	List of Experiments
1	Familiarization with concept of IoT, Arduino/Raspberry Pi and perform necessary software installation.
2	To interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON/OFF motor.
3	To interface sensors* with Arduino/Raspberry Pi and write a program to displaysensors data on the computer screen.
4	To interface OLED with Arduino/Raspberry Pi and write a program to display sensor data on it.
5	To interface sensor with Arduino/Raspberry Pi and write a program to turn ON/ OFF Relay when sensor data is detected.
6	To interface sensor with Arduino/Raspberry Pi and write a program to turn ON/ OFF Solenoid valve when sensor data is detected.
7	To interface sensor with Arduino/Raspberry Pi and write a program to turn ON/ OFF Linear Actuator when sensor data is detected.
8	To interface sensor with Arduino/Raspberry Pi and write a program to turn ON/ OFF Starter Motor when sensor data is detected.
9	To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smart phone using Bluetooth.
10	To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn Actuators* ON/OFF when message is received from smart phone using Bluetooth.
11	Write a program on Arduino/Raspberry Pi to upload Sensor data to thingspeak cloud.

12	Write a program on Arduino/Raspberry Pi to retrieve sensors data from thingspeak cloud.
13	Develop IoT based smart lock system for Motor cycle/Car
14	Develop IoT based Smart water flow system
15	Develop IoT based home security system

Components required-

1. Arduino with cable

2. Raspberry Pi with cable and memory card

3. Node MCU

4. Sensors-IR, LDR, DHT11 sensor, Push button, Pressure senser, Temperature sensor, Vibration, Rotation, Location, Torque, Sound, Weight etc.

5. Actuators-LED, Buzzer, Relay Switch, Motors, Motor Drivers, OLED, Display, Linear Actuator, Solenoid Valve, Starter Motor etc.

6. Bluetooth Module, Wi-fi Module, Ethernet Module

7. Smart Phone 8. Computer 9. Power Supply-5V, 12V, 3.3V 10. Internet facility

The students will be able to

CO1 Understand Internet of Things and its hardware and software components

CO2 Interface I/O devices, sensors & communication modules

CO3 Remotely monitor data and control devices

CO4 Design prototype of IoT based smart system

CO5 Develop IoT based projects for real life problem

III-Year-I Semester THEORY OF MACHINES LAB L T P C

0 0 3 1.5

PC3101L

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 this course the student should be able to:

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

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

3. 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)**

4. 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		L T P C
PC3103L	**MACHINE TOOLS LAB**	**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.

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-II

SemesterMICRO ELECTRO MECHANICAL SYSTEMS (MEMS) L T P C

3 1* 0 3

OE320X

Pre-Requisites : -

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.

Unit No	Contents
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
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 .

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
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, dielectro phoresis (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
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, fluro scence detection ,calorimetric spectroscopy

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)**

Text books:

1. MEMS, Nitaigour Premchand Mahalik,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 Edwrd Lyshevski, 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.

e- Resources & other digital material:

1. http://www.csa.com/discoveryguides/mems/gloss_f.php
2. https://www.mems-exchange.org/MEMS/applications.html
3. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-777j-design-and-fabrication-of-microelectromechanical-devices-spring-2007/lecture-notes/

Micro-Syllabus

Unit 1: Mechatronics systems – Elements & levels of mechatronics system, Mechatronics design process, system, measurement systems, control systems, microprocessor-based controllers, advantages and disadvantages of mechatronics systems. Sensors and transducers, types, displacement, position, proximity, velocity, motion, force, acceleration, torque, fluid pressure, liquid flow, liquid level, temperature and light sensors.

Unit	Module	Micro content
1a. & 2a. Mechatronics systems	Introduction	Introduction to mechatronics and mechatronics systems
	Elements and levels of mechatronics system	different elements and classification of levels of mechatronics systems
	Design process	steps in design process of mechatronics systems
		traditional design vs mechatronics design
	Systems	measurement systems and its basic elements
		control systems and its types

1b. & 2b. Mechatronics systems	Systems	microprocessor-based controllers
		advantages and disadvantages of mechatronics systems
	Sensors and Transducers	definitions od sensor and transducer and their differences
		performance terminology
		static and dynamic characteristics
		different types of sensors and transducers and examples for each type
Unit 2: Solid state electronic devices - PN junction diode, BJT, FET, DIAC, TRIAC and LEDs. Analog signal conditioning, operational amplifiers, noise reduction, filtering.		
3a. & 4a. Solid state electronic devices	Solid state electronic devices	different types of solid state electronic devices
		principle and working of PN junction diode, BJT, FET, DIAC, TRIAC and LEDs
	Signal conditioning	Need for signal conditioning
		Process of signal conditioning
		Elements used in signal conditioning
3b. & 4b. Solid state electronic devices	Operational amplifiers	Brief introduction to amplifiers, operational amplifiers
		Different types of operational amplifiers
	Noise reduction and filtering.	Need for noise reduction and filtering
		Classification of filters
Unit 3: Hydraulic and pneumatic actuating systems - Fluid systems, Hydraulic systems, and pneumatic systems, components, control valves, electro-pneumatic, hydro-pneumatic, electro-hydraulic servo systems. Mechanical actuating systems and electrical actuating systems – basic principles and elements.		
5a. & 6a. Actuating systems	Hydraulic and pneumatic actuating systems	Introduction to actuating systems
		Different types of actuating systems
		Different components and working of hydraulic and pneumatic actuating systems
		Control valves and its types
5b. & 6b. Actuating systems	Hydraulic and pneumatic actuating systems	Electro-pneumatic, hydro-pneumatic, electro-hydraulic servo systems
	Mechanical and electrical actuating systems	Basic principles, elements and operations of Mechanical and electrical actuating systems

<table>
<tr><td colspan="3">Unit 4: Digital electronics and systems - digital logic control, microprocessors and micro controllers, programming, process controllers, programmable logic controllers, PLCs versus computers, application of PLCs for control.</td></tr>
<tr><td rowspan="7">7a. & 8a. Digital electronics and systems</td><td rowspan="5">Digital logic control</td><td>Introduction to digital electronics and systems</td></tr>
<tr><td>Difference between analog and digital system</td></tr>
<tr><td>Numbering systems and conversions</td></tr>
<tr><td>Boolean algebra</td></tr>
<tr><td>Different types of logic gates</td></tr>
<tr><td rowspan="2">Microprocessors and Micro controllers</td><td>Difference between microprocessor and microcontroller</td></tr>
<tr><td>Characteristics and important features of microprocessor</td></tr>
<tr><td rowspan="6">7b & 8b. Digital electronics and systems</td><td rowspan="2">Microprocessors and Micro controllers</td><td>Applications of microprocessors</td></tr>
<tr><td>Characteristics and applications of microcontrollers</td></tr>
<tr><td rowspan="4">Plc</td><td>Brief introduction to plc and its basic structure</td></tr>
<tr><td>Components of a PLC, and programming</td></tr>
<tr><td>PLCs versus computers</td></tr>
<tr><td>Application of PLCs for control.</td></tr>
<tr><td colspan="3">Unit 5: System and interfacing and data acquisition – Data Acquisition Systems, Analog to Digital and Digital to Analog conversions; Digital Signal Processing – data flow in DSPs, block diagrams, typical layouts, Interfacing motor drives. Design of mechatronics systems & future trends.</td></tr>
<tr><td rowspan="6">9a. & 10a. System and interfacing and data acquisition</td><td rowspan="4">Data acquisition systems (DAQ)</td><td>Introduction to Data Acquisition Systems</td></tr>
<tr><td>Objectives and components of DAQ</td></tr>
<tr><td>Block diagram of DAQ</td></tr>
<tr><td>Advantages and disadvantages of DAQ</td></tr>
<tr><td rowspan="2">Signal conversions</td><td>Analog to digital conversion</td></tr>
<tr><td>Digital to analog conversion</td></tr>
<tr><td rowspan="5">9b. &10b. System and interfacing and data acquisition</td><td rowspan="3">Digital signal processing</td><td>Data flow in DSPs</td></tr>
<tr><td>Block diagrams and typical layout of DSP</td></tr>
<tr><td>Interfacing motor drives</td></tr>
<tr><td rowspan="2">Design of mechatronics systems & future trends.</td><td>Design considerations of mechatronics systems</td></tr>
<tr><td>Different steps in design of mechatronics systems</td></tr>
</table>

		Future trends in the field of mechatronics and its applications

III-Year-II Semester	OPTIMIZATION METHODS	L T P C
OE320X		3 1* 0 3

PRE-REQUISITES:

1. Basic Engineering mathematical calculations.

Course objectives:

1. Formulate a design task as an optimization problem
2. Solve unconstrained optimization problems
3. Formulate constrained optimization problems and solve using corresponding methods
4. Solve geometric problems using special methods
5. Solve multi objective optimization problems with evolutionary methods

Syllabus	
Unit No	**Contents**
I	**UNIT I** **INTRODUCTION TO LPP** Concept of optimization – classification of optimization – Examples of linear programming problems – formulation simplex methods– solution of the transportation problem – assignment – shortest route
II	**UNIT II** **UNCONSTRAINED OPTIMIZATION** Maximization and minimization of convex functions. Necessary and sufficient conditions for local minima – speed and order of convegence – unibariate search – steepest and desent methods-metcher reeves method -conjugate gradient method.

III	**UNIT III** **CONSTRAINED OPTIMIZATION** Necessary and sufficient condition – equality constraints, inequality constraints -kuhu – tucker conditions – gradient projection method – penalty function methods – cutting plane methods of sibel directions.
IV	**UNIT IV:** **Geometric programming:** Evolutionary Optimization algorithm: Genetic algorithms, simulated annealing, Anti colony optimization, Particle swarm optimization.
V	**UNIT V:** **Multi-objective Optimization** Terminology and concepts, the concepts of Pareto optimality and Pareto optimal set, formulation of multi-objective optimization problem, NSGA.

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Design task as an optimization problem are formulated **{ APPLY LEVEL KL 3}**
CO2	Unconstrained optimization problems are solved **{ APPLY LEVEL KL 3}**
CO3	Constrained optimization problems and solve using corresponding methods are formulated **{ APPLY LEVEL KL 3}**
CO4	Geometric problems using special methods are solved **{ APPLY LEVEL KL 3}**
CO5	Multi objective optimization problems with evolutionary methods are solved **{ APPLY LEVEL KL 3}**

Learning Resources
Text books:
1. Rao S.S,"Optimization – Theory and applications", Wiley Easter Ltd., 1979. 2. Kalyanmoy Deb, Multi-Objective Optimization using Evolutionary Algorithms, Wiley, 2001.
Reference books
1. Jasbir Arora, Introduction to Optimum Design, Academic Press, 2004 2. Kalyanmoy Deb, Multi-Objective Optimization using EvolutionaryAlgorithms,Wiley,2001

Micro-Syllabus

UNIT I **INTRODUCTION TO LPP** Concept of optimization – classification of optimization – Examples of linear programming problems – formulation simplex methods– solution of the transportation problem – assignment –shortest route		
Unit	**Module**	**Micro content**
1.a.or 2.a Introduction	Introduction	Classification of optimization
		Linear programming problems: Simplex, Big-m, Two phases, Duality.
1.b.or 2.b Transportation problem	Transportation problem	Transportation problem
		Assignment models

UNIT II **UNCONSTRAINED OPTIMIZATION** Maximization and minimization of convex functions. Necessary and sufficient conditions for local minima – speed and order of convegence – unibariate search – steepest and desent methods- metcher reeves method -conjugate gradient method.		
Unit	**Module**	**Micro content**
3. a or 4.a UNCONSTRAINED OPTIMIZATION	UNCONSTRAINED OPTIMIZATION	Maximization of convex functions
		minimization of convex functions
3.b or 4.b UNCONSTRAINED OPTIMIZATION	UNCONSTRAINED OPTIMIZATION	Unibariate search
		Steepest and desent methods
		Metcher reeves method
		Conjugate gradient method

UNIT III **CONSTRAINED OPTIMIZATION** Necessary and sufficient condition – equality constraints, inequality constraints -kuhu – tucker conditions – gradient projection method – penalty function methods – cutting plane methods of sibel directions.		
Unit	**Module**	**Micro content**
5.a or 6.a CONSTRAINED OPTIMIZATION	CONSTRAINED OPTIMIZATION	Equality constraints
		Inequality constraints
		Kuhu – tucker conditions
5.b or 6.b		Gradient projection method
		Penalty function methods

CONSTRAINED OPTIMIZATION	CONSTRAINED OPTIMIZATION	Cutting plane methods of sibel directions.

UNIT IV:

Geometric programming:

Evolutionary Optimization algorithm: Genetic algorithms, simulated annealing, Anti colony optimization, Particle swarm optimization.

Unit	Module	Micro content
7.a.or 8.a Geometric programming	Geometric programming	Genetic algorithms
		Simulated annealing
7.b.or 8.b Geometric programming	Geometric programming	Anti colony optimization
		Particle swarm optimization

UNIT V:

Multi-objective Optimization

Terminology and concepts, the concepts of Pareto optimality and Pareto optimal set, formulation of multi-objective optimization problem, NSGA.

Unit	Module	Micro content
9.a. or 10.a Multi-objective Optimization	Multi-objective Optimization	Terminology and concepts
		Concepts of Pareto optimality
		Pareto optimal set
9.b.or 10.b Multi-objective Optimization	Multi-objective Optimization	formulation of multi-objective optimization problem
		NSGA

III-Year-II Semester	OPERATIONS MANAGEMENT	L T P C
OE320X		3 1* 0 3

PRE-REQUISITES:

1. Basic knowledge related towards management.

2. Basic mathematical calculations.

Course objectives:

This course aims to improve students understanding of the concepts, principles, problems, and practices of operations management. After completing this course, students should be able to:

- To develop an understanding of and an appreciation for the operations management function in any organization.
- To understand the importance of product and service design decisions and its impact other design decisions and operations.
- To understand the importance of material planning and productivity in an organization.
- To obtain an understanding of quality management practice in organizations and how total quality management and six-sigma facilitate organizational effectiveness.
- To understand the relationship of the various planning practices of capacity planning, aggregate planning, project planning and scheduling.

Syllabus	
Unit No	**Contents**

I	**Introduction to Operations Management –** Definition and its importance-History - Contribution of Henry Ford, Deming, Cross by, Taguchi-Functions and roles in operations management- Nature of International Operations Management.-The Relationship of Operations Management w.r.t. other departments-strategies-levels-principles-current priorities and recent trends-Automation - Services and Manufacturing: Integration and differences - Competitiveness Strategy and productivity -Supply Chain Management
II	**Process Selection, Facility Location and Facility Layout:** Process Selection - Types of manufacturing Processes- Overview of qualitative and quantitative methods- Product Design – Influencing factors Facility Location – Theories, Steps in Selection, Factors affecting location, Location Models. Facility Layout- Principles, Types, planning tools and techniques-Factors affecting layout.
III	**MATERIALS MANAGEMENT** Materials Management – Objectives, Planning, Budgeting and Control. Purchasing – Objectives, Functions, Policies, Vendor rating and Value Analysis. Stores Management – Nature, Layout, Classification and Coding. Inventory – Objectives, Costs and control techniques. Overview of JIT.
IV	**QUALITY ASSURANCE AND CONTROL** Inspection, Statistical process control, Control charts(X-R, n, p, c, np), acceptance sampling concept, risks, cost of quality control; ISO Quality Systems: ISO:9000, ISO:14000, Total Quality Control - concept, KAIZEN, six sigma concept.
V	**PROJECT PLANNING** Project Management – Scheduling Techniques, PERT, CPM, Crashing CPM networks .

Course Outcomes

Upon successful completion of the course, the student will be able to	
CO1	Understanding of and an appreciation for the operations management function in any organization is observed.**{Understand level, KL2}**
CO2	The importance of product and service design decisions and its impact other design decisions and operationsis understood.**{Understand level, KL2}**
CO3	The importance of material planning and productivity in an organization is clearly explained. **{Understand level, KL2}**
CO4	The quality management practice in organizations and how total quality management and six-sigma facilitate organizational effectiveness is explained.**{Understand level, KL2}**
CO5	The relationship of the various planning practices of capacity planning, aggregate planning, project planning and scheduling are clearly explained. **{Understand level, KL2}**

Learning Resources

Text books:

TEXT BOOKS:

1. Aswathappa K and Shridhara Bhat K, Production and Operations Management, Himalaya Publishing House, 6th Edition, 2010.

2. Pannerselvam R, Production and Operations Management, Prentice Hall India, 3 rd Edition, 2013.

3. Norman Gaither and Gregory Frazier, Operations Management, South Western Cengage Learning, 2006.

Reference books

1. Kanishka Bedi, Production and Operations Management, Oxford University Press, 2007.

2. Russel and Taylor, Operations Management, Wiley, 7 th Edition, 2010.

3. Chary S. N, Production and Operations Management, Tata McGraw Hill, 5 th Edition, 2008.

4. Chase Jacobs, Aquilano & Agarwal., Operations Management, Tata McGraw Hill, 11th edition, 2006.

5. Mahadevan B, Operations Management Theory and practice, Pearson Education, 2 nd edition, 2010.

e- Resources & other digital material
1. https://www.vssut.ac.in/lecture_notes/lecture1429900757.pdf
2. https://ebooks.lpude.in/management/mba/term_3/DMGT501_OPERATIONS_MANAGEMENT.pdf
3. http://www.himpub.com/documents/Chapter911.pdf

Micro-Syllabus

UNIT I:

Introduction to Operations Management –

Definition and its importance-History - Contribution of Henry Ford, Deming, Cross by, Taguchi-Functions and roles in operations management- Nature of International Operations Management.-The Relationship of Operations Management w.r.t. other departments-strategies-levels-principles-current priorities and recent trends-Automation - Services and Manufacturing: Integration and differences - Competitiveness Strategy and productivity -Supply Chain Management

Unit	Module	Micro content
1.a.or 2.a Introduction	Introduction to operations management.	Definition and its importance
		Contribution of Henry Ford
		Taguchi-Functions
		The Relationship of Operations Management w.r.t. other departments
1.b.or 2.bSupply chain management	Supply chain management	strategies-levels-principles
		Heat Loss Factor.
		current priorities and recent trends-Automation
		Services and Manufacturing: Integration and differences
		Competitiveness Strategy and productivity

UNIT II:

Process Selection, Facility Location and Facility Layout:

Process Selection - Types of manufacturing Processes- Overview of qualitative and quantitative methods- Product Design – Influencing factors

Facility Location – Theories, Steps in Selection, Factors affecting location, Location Models.

Facility Layout- Principles, Types, planning tools and techniques-Factors affecting layout.

Unit	Module	Micro content
3. a or 4.a Process Selection	Process Selection	Types of manufacturing Processes
		qualitative and quantitative methods
		Product Design – Influencing factors
3.b or 4.b Facility Location and Facility Layout	Facility Location and Facility Layout	Facility Location – Theories, Steps in Selection
		Factors affecting location
		Location Models.
		Facility Layout- Principles, Types

UNIT III:

MATERIALS MANAGEMENT

Materials Management – Objectives, Planning, Budgeting and Control. Purchasing – Objectives, Functions, Policies, Vendor rating and Value Analysis. Stores Management – Nature, Layout, Classification and Coding. Inventory – Objectives, Costs and control techniques. Overview of JIT.

Unit	Module	Micro content
5.a or 6.a Materials Management	Materials Management	Materials Management – Objectives, Planning, Budgeting and Control
		Purchasing – Objectives, Functions,
		Vendor rating and Value Analysis

5.b or 6.b Stores Management	Stores Management	Stores Management – Nature, Layout,
		Classification and Coding
		Inventory – Objectives, Costs and control techniques
		Overview of JIT.

UNIT IV:

QUALITY ASSURANCE AND CONTROL

Inspection, Statistical process control, Control charts(X-R, n, p, c, np), acceptance sampling concept, risks, cost of quality control; ISO Quality Systems: ISO:9000, ISO:14000, Total Quality Control - concept, KAIZEN, six sigma concept

Unit	**Module**	**Micro content**
7.a.or 8.a Statistical process control	Statistical process control	Control charts(X-R, n, p, c, np),
		Acceptance sampling concept
7.b.or 8.b ISO Quality Systems	ISO Quality Systems	ISO:9000
		Total Quality Control - concept
		Six sigma concept

UNIT V:

PROJECT PLANNING

Project Management – Scheduling Techniques, PERT, CPM, Crashing CPM networks – Simple Problems.

Unit	**Module**	**Micro content**
9.a. or 10.a Project Management	Project Management	Scheduling Techniques
		PERT, CPM
9.b.or 10.b Crashing	Displacement Type	Crashing CPM networks – Simple Problems.

III-Year-II Semester	**NANO TECHNOLOGY**	**L T P C**
OE320X		**3 1* 0 3**

PRE-REQUISITES:

1. Basic knowledge on materials.

Course objectives:

CO1	To have the knowledge of fundamentals of nano technology
CO2	To understand different structures of nano materials
CO3	To study the structures of nano carbon, nano thermal and nano semiconductor materials
CO4	To have a thorough knowledge of nano sensors
CO5	To study the applications of nano technology in different engineering fields

Syllabus	
Unit No	**Contents**
I	**Introduction and classification** Summary of electronic properties of atoms and solids, effects of Nano meter length scales, fabrication methods, preparation, safety and storage issues.
II	**Nano Structures** Importance of Nano-technology, Bottom-up and Top-down approaches, Zero Dimensional Nano-structures - Nano particles through homogenous nucleation and heterogeneous nucleation; One Dimensional Nano-structures - Nano wires and Nano rods, Spontaneous growth, Evaporation and condensation growth, Two dimensional Nano-structures - Fundamentals of film growth. Physical vapour Deposition (PVD) and Chemical Vapour Deposition (CVD):

III	**Carbon Nano Structures** DLCs, Fullerenes, C_{60}, C_{80} SWNT and MWNT; Properties: Mechanical, Optical and Electrical properties. **Thermo Electric Materials** Concept of phonon, Thermal conductivity, Specific heat, Exothermic & Endothermic processes. **Nano Semiconductors**: Nano scale electronic devices including CMOS, Potentiometric sensors etc., MRAM devices
IV	**Nano sensors** Introduction to sensors. Characteristics and terminology - Fundamentals of sensors, Sensors for aerospace and defense. Organic and inorganic Nano sensors. Sensor for bio-medical applications, Bioelectronics, Nanoparticle-biomaterial hybrid systems for sensing applications. Gas sensor. Biosensors: Principles, DNA and nucleotide-based biosensors, Protein-based biosensors,
V	**Application of Nanotechnology** Consumer goods, Cosmetics, Nano catalyst, paints, food and agriculture industries, Nanotechnology for waste reduction and improved energy efficiency, nanotechnology based water treatment strategies. Nano-toxicology. Use of Nano-particles for environmental remediation and water treatment.

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Know the fundamentals, properties and fabrication methods of Nano components
CO2	Know the structures of zero, one and two dimensional Nano components
CO3	Know the structures of carbon, thermal and semiconductor materials
CO4	Have the knowledge of Nano sensors and their applications
CO5	Apply the Nano technology in different engineering and other fields.

Learning Resources
Text books:
1. Encyclopedia of Nanotechnology- Hari Singh Nalwa 2. Introduction to Nano technology by Charles P. Poole Jr and Frank J. Owens, Wiley-Inter science, 2003
Reference books

1. Springer Handbook of Nanotechnology - Bharat Bhusan 2. Handbook of Semiconductor Nanostructures and Nanodevices Vol 1-5- A. A. Balandin, K. L. Wang. 3. Nanostructures and Nanomaterials - Synthesis, Properties and Applications - Cao, Guozhong.

Micro syllabus

UNIT-I

Introduction and classification: summery of electronic properties of atoms and solids, effects of nano meter length scales, fabrication methods, preparation, safety and storage issues.

Unit	Module	Micro content
1.a. or 2.a	**Introduction and classification**	Summary of electronic properties of atoms and solids
1.b. or 2.b	**Introduction and classification**	fabrication methods

UNIT II:

Nano Structures: Importance of Nano-technology, Bottom-up and Top-down approaches, Zero Dimensional Nano-structures - Nano particles through homogenous nucleation and heterogeneous nucleation; One Dimensional Nano-structures - Nano wires and nano rods, Spontaneous growth, Evaporation and condensation growth, Two dimensional nano-structures - Fundamentals of film growth. Physical vapour Deposition (PVD) and Chemical Vapour Deposition (CVD):

Unit	Module	Micro content
3. a or 4.a	**Nano Structures**	Importance of Nano-technology
		Nano particles through homogenous nucleation and heterogeneous nucleation;
3.b or 4.b	**Nano Structures**	One Dimensional Nano-structures
		Two dimensional nano-structures

<table>
<tr><td colspan="3"> UNIT III:
Carbon Nano Structures: DLCs, Fullerenes, C_{60}, C_{80} SWNT and MWNT; Properties: Mechanical, Optical and Electrical properties.
Thermo Electric Materials: Concept of phonon, Thermal conductivity, Specific heat, Exothermic & Endothermic processes.
Nano Semiconductors: Nanoscale electronic devices including CMOS, Potentiometric sensors etc., MRAM devices </td></tr>
<tr><td>Unit</td><td>Module</td><td>Micro content</td></tr>
<tr><td>5.a or 6.a</td><td>Carbon Nano Structures</td><td>Mechanical, Optical and Electrical properties.</td></tr>
<tr><td>5.b or 6.b</td><td>Thermo Electric Materials and
Nano Semiconductors</td><td>Exothermic & Endothermic processes.
Nanoscale electronic devices</td></tr>
<tr><td colspan="3"> UNIT IV
Nanosensors: Introduction to sensors. Characteristics and terminology - Fundamentals of sensors, Sensors for aerospace and defense. Organic and inorganic nanosensors. Sensor for bio-medical applications, Bioelectronics, Nanoparticle-biomaterial hybrid systems for sensing applications. Gas sensor. Biosensors: Principles, DNA and nucleotide-based biosensors, Protein-based biosensors, </td></tr>
<tr><td>Unit</td><td>Module</td><td>Micro content</td></tr>
<tr><td rowspan="2">7.a. or 8.a</td><td rowspan="2">Nanosensors</td><td>Fundamentals of sensors, Sensors for aerospace and defense.</td></tr>
<tr><td>Characteristics and terminology</td></tr>
<tr><td rowspan="2">7.b. or 8.b</td><td rowspan="2">Nanosensors</td><td>Protein-based biosensors</td></tr>
<tr><td>Nanoparticle-biomaterial hybrid systems for sensing applications</td></tr>
<tr><td colspan="3"> UNIT V
Application of Nanotechnology: Consumer goods, Cosmetics, Nano catalyst, paints, food and agriculture industries, Nanotechnology for waste reduction and improved energy efficiency, nanotechnology based water treatment strategies. Nano-toxicology. Use of Nano-particles for environmental remediation and water treatment. </td></tr>
<tr><td>Unit</td><td>Module</td><td>Micro content</td></tr>
</table>

9.a. or 10.a	Nanotechnology for waste reduction	Applications of Nano technology
9.b. or 10.b	Nano-toxicology	Use of Nano-particles for environmental remediation and water treatment.

III-Year-II Semester		L T P C
PC3201	HEAT TRANSFER	3 1* 0 3

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 No	**Contents**
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. **(2hrs)** **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. **(4hrs)** **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. **(6hrs)**

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. **(4hrs)** **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, Concept of Semi-infinite body. **(4hrs)**
III	**Dimensional Analysis:** Introduction, Buckingham Pi Theorem applied to Forced and Natural convection Significance of Non-Dimensional numbers. **(2hrs)** **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. **(4hrs)** **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. **(4hrs)**
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. **(5hrs)** **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. **(5hrs)**
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 infinite parallel plates, Radiation shields. **(10hrs)**

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

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}**

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.Necati Ozisik, 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.

e- Resources & other digital material
1.https://nptel.ac.in/courses/112/101/112101097/
2. https://nptel.ac.in/courses/112/101/112101001/
3. https://nptel.ac.in/courses/112/101/112101002/

Micro-Syllabus

Unit-1:

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	Module	Micro content
		Thermodynamics and Heat Transfer, Application Areas of Heat Transfer

1.a.or 2.a **Basics of Heat Transfer** **&** **Heat Conduction – Basic Equation**	Basics of Heat Transfer	Engineering Heat Transfer, Modes and mechanisms of heat transfer
		Basic laws governing heat transfer.
	Conduction –Basic Equation	Fourier's law of heat conduction ,Thermal Conductivity
		General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates and its simplification.
		steady, unsteady and periodic heat transfer
		Initial and boundary conditions.
1.b.or 2.b **One- Dimensional Steady State Conduction Heat Transfer**	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-2:

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, Concept of Semi-infinite body.

Unit	**Module**	**Micro content**
3. a or 4.a **Heat Transfer from Extended surface (fins)**	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
3.b or 4.b **Transient Heat Conduction**	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.

		Concept of Semi-infinite body

Unit-3

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	**Module**	**Micro content**
5.a or 6.a **Dimensional Analysis** **&** **Forced Convection**	Dimensional Analysis	Introduction -Buckingham Pi Theorem applied to Forced convection 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
5.b or 6.b **Forced Convection** **&** **Natural Convection**	Forced Convection	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-4:

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	Module	Micro content
7.a.or 8.a **Boiling and Condensation**	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
7.b.or 8.b **Heat Exchangers**	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-5:

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 infinite parallel plates- Radiation shields.

Unit	Module	Micro content
9.a. or 10.a **Thermal Radiation**	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
9.b.or 10.b **Thermal Radiation**	Thermal 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 infinite parallel plates
		Radiation shields

III-Year-II Semester	MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS	L T P C
HS3201		3 1* 0 3

PRE-REQUISITES:

1. Basic knowledge related towards an organization.

2. Basic mathematical calculations.

Course objectives:

The objective of this course is to inculcate basic knowledge to students relating to concepts of Managerial Economics and Accounting to make them effective business decision makers.

Other course educational objectives of this course:

1. To equip the students with the basic inputs of managerial economics and demand concepts.
2. To understand the concepts of production and cost for various business decision.
3. To understand the different types of market, market structures & pricing strategies and their applications in business decision making and to know the different forms of Business organization and the concept of Business Cycles.
4. To understand the fundamental of accounting and analysis of accounting statements for managerial decision making.
5. To understand the concept of Capital, Capital Budgeting and the techniques used to evaluate Capital Budgeting proposals.

Syllabus	
Unit No	**Contents**
I	**Introduction to Managerial Economics and demand Analysis:** Definition of Managerial Economics –Scope of Managerial Economics and its relationship with other subjects –Concept of Demand, Types of Demand, Determinants of Demand- Demand schedule, Demand curve, Law of Demand and its limitations- Elasticity of Demand, Types of Elasticity of Demand and Measurement- Demand forecasting and Methods of forecasting.

II	**Theory of Production and Cost Analysis:** Production Function – Isoquant and Isocost, MRTS, Least Cost Combination of Inputs - Laws of Returns to scale - Internal and External Economies of Scale, Cost Analysis: Cost concepts, Cost & output relationship in short run & long run - Break-even Analysis (BEA)-Determination of Break-Even Point - Significance and limitations.
III	**Introduction to Markets, Pricing Policies & Types of Business Organization and Business Cycles:** Market Structures: Perfect Competition, Monopoly, Monopolistic competition and Oligopoly – Features – Price and Output Determination – Methods of Pricing: Average cost pricing, Limit Pricing, Market Skimming Pricing, and Internet Pricing: Flat Rate Pricing, Usage sensitive pricing and Priority Pricing. Features and Evaluation of Sole Trader, Partnership, Joint Stock Company – Business Cycles: Phases of Business Cycles.
IV	**Introduction to Financial Accounting & Analysis:** **Financial Accounting and analysis:** Accounting –significance -- Book Keeping-Double entry system –Journal- Ledger- Trial Balance- Final Accounts with simple adjustments. **Financial Statement Analysis through ratios:** Ratio-analysis of financial statement using different ratios (Liquidity -Profitability- Solvency -Activity ratios).
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).

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	To equipped with the knowledge of estimating the Demand and demand elasticity for a product.**{Understand level, KL2}**
CO2	The knowledge of understanding of the Input-Output-Cost relationships and estimation of the least cost combination of inputs.**{Understand level, KL2}**
CO3	To understand the nature of different markets and Price Output determination under various market conditions and also to have the knowledge of different Business Units. **{Understand level, KL2}**
CO4	To prepare Financial Statements and the usage of various Accounting tools for analysis **{Apply level, KL3}**

CO5	To evaluate various investment project proposals with the help of capital budgeting techniques for decision making **{Apply level,KL3}**

Learning Resources
Text books:
1. Dr. A. R. Aryasri – Managerial Economics and Financial Analysis, TMH 2011. 2. Dr. N. Appa Rao, Dr. P. Vijay Kumar: 'Managerial Economics and Financial Analysis', Cengage Publications, New Delhi – 2011. 3. Prof. J.V. Prabhakara rao, Prof. P. Venkatarao. 'Managerial Economics and Financial Analysis', Ravindra Publication.
Reference books
1. V. Maheswari : Managerial Economics, Sultan Chand. 2. Suma Damodaran : Managerial Economics, Oxford 2011. 3. Dr. B. Kuberudu and Dr. T. V. Ramana : Managerial Economics & Financial Analysis, Himalaya Publishing House 2011. 4. Vanitha Agarwal : Managerial Economics, Pearson Publications 2011. 5. Sanjay Dhameja : Financial Accounting for Managers, Pearson. 6. Maheswari: Financial Accounting, Vikas Publications. 7. S. A. Siddiqui & A. S. Siddiqui: Managerial Economics and Financial Analysis, New Age International Publishers, 2012.

e- Resources & other digital material
1. www.managementstudyguide.com 2. www.tutorialspoint.com

Micro-Syllabus

<table>
<tr><td colspan="3">UNIT I: Introduction to Managerial Economics and demand Analysis:

Definition of Managerial Economics –Scope of Managerial Economics and its relationship with other subjects –Concept of Demand, Types of Demand, Determinants of Demand- Demand schedule, Demand curve, Law of Demand and its limitations- Elasticity of Demand, Types of Elasticity of Demand and Measurement- Demand forecasting and Methods of forecasting.</td></tr>
<tr><td>Unit</td><td>Module</td><td>Micro content</td></tr>
<tr><td rowspan="2">1.a.or 2.a
Concept Of Managerial Economics
&
Concept Of Demand</td><td>Managerial Economics</td><td>Nature and scope of managerial economics.
Relationship of managerial economics w.r.t. other subjects.</td></tr>
<tr><td>Concept of Demand</td><td>Determinants of demand
Types of demand</td></tr>
<tr><td rowspan="2">1.b.or 2.b
Concept Of Elasticity of Deman</td><td rowspan="2">Elasticity of Demand</td><td>Law of Demand and its limitations</td></tr>
<tr><td>Types of Elasticity of Demand</td></tr>
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Deman d & Concept Of Deman d forecast ing	Demand forecastin g	Methods of demand forecasting		
Unit II: Theory of Production and Cost Analysis: Production Function – Isoquant and Isocost, MRTS, Least Cost Combination of Inputs - Laws of Returns to scale - Internal and External Economies of Scale, Cost Analysis: Cost concepts, Cost & output relationship in short run & long run - Break-even Analysis (BEA)-Determination of Break-Even Point - Significance and limitations.				**Micro content**
Unit	**Module**	Classification.		
3. a or 4.a Concept of Productio n function	**Production function**	Isoquant and Isocost, MRTS, Least Cost Combination of Inputs		
3.b or 4.b Concept of BEA	**Break-even Analysis**	Break-even Analysis (BEA)-Determination of Break-Even Point		
		Significance and limitations of BEA		
		Simple problems		

<table>
<tr><td colspan="3">UNIT III:
Introduction to Markets, Pricing Policies & Types of Business Organization and Business Cycles:
Market Structures: Perfect Competition, Monopoly, Monopolistic competition and Oligopoly – Features – Price and Output Determination – Methods of Pricing: Average cost pricing, Limit Pricing, Market Skimming Pricing, and Internet Pricing: Flat Rate Pricing, Usage sensitive pricing and Priority Pricing. Features and Evaluation of Sole Trader, Partnership, Joint Stock Company – Business Cycles: Phases of Business Cycles.</td><td></td><td>Micro content</td></tr>
<tr><td>Unit</td><td>Module</td><td>Classification.</td></tr>
<tr><td>5.a or 6.a
Concept of Market structures</td><td>Price and Output Determination of Market structures</td><td>Perfect Competition, Monopoly, Monopolistic competition and Oligopoly</td></tr>
<tr><td>Concept of Methods of Pricing</td><td>Methods of Pricing</td><td>Average cost pricing, Limit Pricing, Market Skimming Pricing, and Internet Pricing: Flat Rate Pricing</td></tr>
<tr><td>5.b or 6.b
Types of partnership</td><td>Features and Evaluation of types of partnership</td><td>Sole Trader, Partnership, Joint Stock Company</td></tr>
</table>

<table>
<tr><td>Business Cycles: Phases of Business Cycles</td><td>Phases of Business Cycles</td><td>Phases of Business Cycles</td><td></td><td></td></tr>
<tr><td colspan="3">UNIT IV:
Introduction to Financial Accounting & Analysis:
Financial Accounting and analysis: Accounting –significance -- Book Keeping-Double entry system –Journal- Ledger- Trial Balance- Final Accounts with simple adjustments.
Financial Statement Analysis through ratios: Ratio-analysis of financial statement using different ratios (Liquidity -Profitability- Solvency -Activity ratios).</td><td></td><td>Micro content</td></tr>
<tr><td>Unit</td><td>Module</td><td>Parameters of performance.</td><td></td><td></td></tr>
<tr><td rowspan="5">7.a.or 8.a
Financial Accounting and analysis</td><td rowspan="5">Financial Accounting and analysis</td><td>Journal</td><td></td><td></td></tr>
<tr><td>Ledger</td><td></td><td></td></tr>
<tr><td>Trial Balance</td><td></td><td></td></tr>
<tr><td>Balance sheet</td><td></td><td></td></tr>
<tr><td>Simple problems</td><td></td><td></td></tr>
<tr><td rowspan="2">7.b.or 8.b
Ratio-analysis</td><td rowspan="2">Ratio-analysis</td><td>Liquidity -Profitability- Solvency -Activity ratios</td><td></td><td></td></tr>
<tr><td>Simple problems</td><td></td><td></td></tr>
</table>

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).		**Micro content**

Unit	**Module**	Classification.
9.a. or 10.a **Capital Budgeting**	Capital Budgeting Traditional Methods	payback period, accounting rate of return
		Simple problems
9.b. or 10.b **Capital Budgeting**	modern methods	Net Present Value method, Internal Rate of Return Method and Profitability Index
		Simple problems

III-Year-II Semester	COMPOSITE MATERIALS	L T P C
PE320X		3 1* 0 3

Course objectives	
1	To understand various matrices and reinforcements used in composites
2	To know about polymer matrix composites, metal matrix composites and ceramic matrix composites
3	To understand the manufacturing processes and applications of composites
4	To introduce post processing operations of composites

Expected outcomes

The students will be able to gain knowledge about composites, reinforcements,

Unit No.	Content
1	Composite: Introduction, definition, characteristics, functions and classification of composites based on structure and matrix. Smart composites, advantages and limitations, history,industrial scene and applications Interfaces: wettability and bonding interface in composites
2	Fibers: Introduction, types of fibers, natural fibers, glass fiber fabrication, structure, properties and applications boron fiber fabrication, structure, properties and applications carbon fiber, Ex-Pan carbon fiber Ex cellulose carbon fiber, and Ex-Pitch carbon fiber. Carbon fiber, structure, properties and applications aramid fiber fabrication, structure, properties and applications whiskers: characteristics, properties and applications

3	Polymer matrix composites (PMC): Thermoset, thermoplastic and elastomeric polymers properties, characteristics and applications as matrix materials processing of polymer matrix composites: hand methods, Lay up method, spray up method moulding methods, pressure bagging and bag moulding methods, pultrusion and filament winding process.
4	Metal matrix composites (MMC): Classification of metals, intermetallics, alloys and their potential role as matrices in composites properties, characteristics and applications of metals as matrix materials production techniques: powder metallurgy, diffusion bonding, meltstirring, squeeze casting, liquid infiltration under pressure, spray code position, in-situ process.
5	Ceramic matrix composites (CMC): Classification of ceramics and their potential role as matrices, properties, characteristics and applications of ceramics as matrix materials conventional techniques: cold pressing and sintering, hot pressing, reaction bonding hot pressing and reaction bonding new techniques: liquid infiltration, pultrusion, lanxide process, in-situ chemical technique, sol-gel technique

Text Books:

1. K. K. Chawla, Composite Materials: Science and Engineering, Springer, 3e,2013.
2. F.L.Matthews & R.D.Rawlings, Composite Materials, Engineering and Sciences, Chapman &hall, London,1994

References Books:

1. Hand Book of Composites, George Lubin. Van Nostrand, Reinhold Co.1982
2. P.K.Mallick, Fiber-reinforced composites, Monal Deklar Inc., New York,1988.
3. Mel M. Schwartz, Composite Materials: Properties, Non-destructive testing and Repair, PH, N.Jersey
4. L.J. Broutman and R.M. Krock, Modern Composite Materials, Addison-Wesley,1967.
5. David A Colling & Thomas Vasilos, Industrial Materials: Polymers, Ceramics and Composites, vol.2, Prentice Hall, N. Jersey,1995

Micro-Syllabus

Unit-1:

Composite: Introduction, definition, characteristics, functions and classification of composites based on structure and matrix. Smart composites, advantages and limitations, history, industrial scene and applications Interfaces: wettability and bonding interface in composites

Unit	Module	Micro content
		Introduction, definition

1.a.or 2.a **Composite**	Composite	characteristics
		functions and classification of composites based on structure and matrix
		Smart composites
1.b.or 2.b **Composite**	Composite	advantages and limitations
		history
		industrial scene and applications Interfaces
		wettability and bonding interface in composites
		Air refrigeration system working on Bell Coleman cycle-COP
		Open and Dense air systems, Applications

Unit-2:

Fibers: Introduction, types of fibers, natural fibers, glass fiber fabrication, structure, properties and applications boron fiber fabrication, structure, properties and applications carbon fiber, Ex-Pan carbon fiber Ex cellulose carbon fiber, and Ex-Pitch carbon fiber. Carbon fiber, structure, properties and applications aramid fiber fabrication, structure, properties and applications whiskers: characteristics, properties and applications.

Unit	**Module**	**Micro content**
3. a or 4.a **Fibers**	Fibers	Introduction, types of fibers, natural fibers
		glass fiber fabrication, structure
		properties and applications boron fiber fabrication
		structure, properties and applications carbon fiber
		Ex-Pan carbon fiber Ex cellulose carbon fiber
		Ex-Pitch carbon fiber
3.b or 4.b **Fibers**	Fibers	Carbon fiber, structure, properties and applications
		aramid fiber fabrication, structure
		properties and applications whiskers
		characteristics, properties and applications

Unit-3:

Polymer matrix composites (PMC): Thermoset, thermoplastic and elastomeric polymers properties, characteristics and applications as matrix materials processing of polymer matrix composites: hand methods, Lay up method, spray up method moulding methods, pressure bagging and bag moulding methods, pultrusion and filament winding process.

Unit	Module	Micro content
5.a or 6.a **Polymer matrix composites (PMC)**	Polymer matrix composites (PMC)	Thermoset, thermoplastic and elastomeric polymers properties
		characteristics and applications as matrix materials processing of polymer matrix composites
		hand methods
		Lay-up method
5.b or 6.b **Polymer matrix composites (PMC)**	Polymer matrix composites (PMC)	spray up method moulding methods
		pressure bagging and bag moulding methods
		pultrusion and filament winding process

Unit-4:

Metal matrix composites (MMC): Classification of metals, intermetallics, alloys and their potential role as matrices in composites properties, characteristics and applications of metals as matrix materials production techniques: powder metallurgy, diffusion bonding, melt stirring, squeeze casting, liquid infiltration under pressure, spray code position, in-situ process.

Unit	Module	Micro content
7.a.or 8.a **Metal matrix composites (MMC)**	Metal matrix composites (MMC)	Classification of metals, intermetallics
		alloys and their potential role as matrices in composites properties
		characteristics and applications of metals as matrix materials production techniques
7.b.or 8.b **Metal matrix composites (MMC)**	Metal matrix composites (MMC)	powder metallurgy, diffusion bonding
		melt stirring, squeeze casting
		liquid infiltration under pressure
		spray code position, in-situ process

Unit-5:

Ceramic matrix composites (CMC): Classification of ceramics and their potential role as matrices, properties, characteristics and applications of ceramics as matrix materials conventional techniques: cold pressing and sintering, hot pressing, reaction bonding hot pressing and reaction bonding new techniques: liquid infiltration, pultrusion, lanxide process,in-situ chemical technique, sol-gel technique

Unit	Module	Micro content
9.a. or 10.a **Ceramic matrix composites (CMC)**	Ceramic matrix composites (CMC)	Classification of ceramics and their potential role as matrices
		properties, characteristics and applications of ceramics as matrix materials conventional techniques
		cold pressing and sintering

9.b.or 10.b **Ceramic matrix composites (CMC)**	Ceramic matrix composites (CMC)	hot pressing, reaction bonding hot pressing and reaction bonding new techniques
		liquid infiltration, pultrusion, lanxide process
		in-situ chemical technique, sol-gel technique

III-Year-II Semester	REFRIGERATION AND AIR CONDITIONING	L T P C
PE320X		3 1* 0 3

PRE-REQUISITES: Engineering Thermodynamics.

Course objectives:

1. To provide a fundamental of Refrigeration and Air Conditioning.
2. To accustom with various methods of Refrigeration systems.
3. To impart knowledge about the comfort air conditioning and cooling load design and estimation.

Syllabus	
Unit No	**Contents**
I	**FUNDAMENTALS OF REFRIGERATION:** Introduction- Necessity and applications, unit of refrigeration and C.O.P-Heat Engine, Refrigerator and Heat pump-Types of Refrigeration systems, and its Applications. **(04hrs)** **REFRIGERANTS:** Classification of refrigerants- Desirable properties-Nomenclature-Commonly used refrigerants- Ozone friendly refrigerants –Green house effect, global warming potential, Ozone depletion potential. **(03hrs)** **AIR REFRIGERATION SYSTEM:** Introduction-Air refrigeration system working on Reversed Carnot cycle – Air refrigeration system working on Bell Coleman cycle- COP- Open and Dense air systems, Applications. **(03hrs)**
II	**VAPOUR COMPRESSION REFRIGERATION SYSTEM:** Working principle-Simple vapour compression refrigeration cycle – COP- Representation of cycle on T-s and P-h charts- Effect of Sub cooling and Superheating -Actual Vapour compression cycle and its applications. **(07 hrs)** **VCR SYSTEM COMPONENTS:** Compressors-Classification-Working -Condensers – Classification-Working-Evaporators –Classification-Working, Expansion devices –Types-Working **(03 hrs)**

III	**VAPOUR ABSORPTION REFRIGERATION SYSTEM:** Description and working of Aqua-Ammonia system- Calculation of maximum COP- Lithium Bromide- Water system-Electrolux Refrigerator, Applications. **(06 hrs)** **STEAM JET REFRIGERATION SYSTEM:** Principle of working –Analysis- Applications. **(01 hrs)** **NON CONVENTIONAL REFRIGERATION SYSTEMS-** Thermo electric Refrigeration, Vortex tube refrigeration, Adiabatic demagnetization Refrigeration **(03 hrs)**
IV	**PSYCHROMETRY: Introduction -** Psychrometric properties and relations- Psychrometric chart Psychrometric processes-Adiabatic mixing of two air streams, Sensible, Latent and Total heat–Sensible Heat Factor and Bypass Factor for cooling coil and heating coil.**(07 hrs)** **HUMAN COMFORT:** Thermodynamics of Human body-Factors affecting the human comfort-Effective temperature – Comfort chart-Air stratification.**(03 hrs)**
V	**AIR CONDITIONING SYSTEMS:** Introduction-Components of Air conditioning system-Classification of Air conditioning systems-Central and Unitary systems- Summer, Winter and Year round systems- Cooling load estimation. **(05 hrs)** **DESIGN OF AIR CONDITION SYSTEMS:** Summer air conditioning –ADP-System with Ventilated and re-circulated air with and without bypass factor- RSHF, GSHF and ESHF.**(05 hrs)**

Content beyond the Syllabus:*Ozone friendly refrigerants –Green house effect, global warmingpotential,ElectroluxRefrigerator.*

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Describe** the various methods of refrigeration systems, **identify** the desirable refrigerants and also compute the performance of Air refrigeration system. **{Apply level, KL3}**
CO2	**Understand** the working of VCR system componentsandalso **Evaluate** the performance of Vapour Compression Refrigeration System.**{Apply level, KL3}**
CO3	**Describe** thevapour absorption refrigeration system, steam jet refrigeration system and the non conventional refrigeration systems.**{Understand level,KL2}**
CO4	**Analyze** the Psychrometric processes used in Air Conditioning systems along with the human comfort. **{Analyze level, KL4}**
CO5	**Design** of Air Conditioning loads for industrial applications. **{Apply level,KL3}**

Learning Resources
Text books:
1. C. P. Arora. , Refrigeration and air conditioning - TMH, 2nd Edition, 2000.
2. R. Dossat, Principles of Refrigeration - - Pearson 4th Edition 2001

Reference books
1.S. C. Arora, Domkundwar, A course in refrigeration and air conditioning-DhanapatRai& sons 5th Edition 1997. 2. Manohar Prasad, Refrigeration and Air conditioning, New Age international, 2003. 3.Basic Refrigeration and Air-Conditioning- Ananthanarayanan, TMH.

e- Resources & other digital material
1.https://nptel.ac.in/courses/112/107/112107208/
2.https://nptel.ac.in/courses/112/105/112105128/
3.https://nptel.ac.in/courses/112/105/112105129/

Micro-Syllabus

Unit-1:

FUNDAMENTALS OF REFRIGERATION: Introduction- Necessity and applications, unit of refrigeration and C.O.P-Heat Engine, Refrigerator and Heat pump-Types of Refrigeration systems, and its Applications.

REFRIGERANTS: Classification of refrigerants- Desirable properties-Nomenclature-Commonly used refrigerants- Ozone friendly refrigerants –Green house effect, global warming potential, Ozone depletion potential.

AIR REFRIGERATION SYSTEM: Introduction-Air refrigeration system working on Reversed Carnot cycle – Air refrigeration system working on Bell Coleman cycle- COP- Open and Dense air systems, Applications.

(03hrs).

Unit	Module	Micro content
1.a.or 2.a **FUNDAMENTALS OF REFRIGERATION**	FUNDAMENTALS OF REFRIGERATION	Introduction- Necessity and applications
		unit of refrigeration and C.O.P
		Heat Engine, Refrigerator and Heat pump
		Types of Refrigeration systems, and its Applications.
1.b.or 2.b& **REFRIGERANTS**	REFRIGERANTS	Classification of refrigerants
		Desirable properties-Nomenclature-Commonly used refrigerants
		Ozone friendly refrigerants –Green house effect
		global warming potential, Ozone depletion potential.

AIR REFRIGERATION SYSTEM	AIR REFRIGERATION SYSTEM	Introduction-Air refrigeration system working on Reversed Carnot cycle
		Air refrigeration system working on Bell Coleman cycle-COP
		Open and Dense air systems, Applications

Unit-2:

VAPOUR COMPRESSION REFRIGERATION SYSTEM: Working principle-Simple vapour compression refrigeration cycle – COP- Representation of cycle on T-s and P-h charts- Effect of Sub cooling and Superheating --Actual Vapour compression cycle and its applications.

VCR SYSTEM COMPONENTS: Compressors-Classification-Working -Condensers – Classification-Working-Evaporators –Classification-Working, Expansion devices –Types-Working

Unit	**Module**	**Micro content**
3. a or 4.a **VAPOUR COMPRESSION REFRIGERATION**	VAPOUR COMPRESSION REFRIGERATION	Working principle
		Simple vapour compression refrigeration cycle – COP- Representation of cycle on T-s and P-h charts
		Effect of Sub cooling and Superheating
		Actual Vapour compression cycle and its applications.
3.b or 4.b **VCR SYSTEM COMPONENTS**	VCR SYSTEM COMPONENTS	Compressors-Classification-Working
		Condensers – Classification-Working
		Evaporators –Classification-Working
		Expansion devices –Types-Working

Unit-3:

VAPOUR ABSORPTION REFRIGERATION SYSTEM: Description and working of Aqua-Ammonia system- Calculation of maximum COP- Lithium Bromide- Water system-Electrolux Refrigerator, Applications.

STEAM JET REFRIGERATION SYSTEM: Principle of working –Analysis- Applications.

NON CONVENTIONAL REFRIGERATION SYSTEMS- Thermo electric Refrigeration, Vortex tube refrigeration, Adiabatic demagnetization Refrigeration

Unit	**Module**	**Micro content**
5.a or 6.a **VAPOUR ABSORPTION REFRIGERATION SYSTEM**	VAPOUR ABSORPTION REFRIGERATION SYSTEM	Description and working of Aqua-Ammonia system
		Calculation of maximum COP**(Simple Problems)**
		Lithium Bromide- Water system
		Electrolux Refrigerator, Applications

5.b or 6.b **STEAM JET REFRIGERATION SYSTEM**	STEAM JET REFRIGERATION SYSTEM	Principle of working –Analysis- Applications
NON CONVENTIONAL REFRIGERATION SYSTEMS	NON CONVENTIONAL REFRIGERATION SYSTEMS	Thermo electric Refrigeration
		Vortex tube refrigeration
		Adiabatic demagnetization Refrigeration

Unit-4:

PSYCHROMETRY: Introduction **-** Psychrometric properties and relations- Psychrometric chart Psychrometric processes-Adiabatic mixing of two air streams, Sensible, Latent and Total heat–Sensible Heat Factor and Bypass Factor for cooling coil and heating coil.

HUMAN COMFORT: Thermodynamics of Human body-Factors affecting the human comfort-Effective temperature – Comfort chart-Air stratification.

Unit	**Module**	**Micro content**
7.a.or 8.a **PSYCHROMETRY**	PSYCHROMETRY SYSTEM	Introduction **-** Psychrometric properties and relations
		Psychrometric chart Psychrometric processes-
		Adiabatic mixing of two air streams
		Sensible, Latent and Total heat
		Heat Factor and Bypass Factor for cooling coil and heating coil.
7.b.or 8.b **HUMAN COMFORT**	HUMAN COMFORT	Thermodynamics of Human body
		Factors affecting the human comfort-Effective temperature.
		Comfort chart-Air stratification

Unit-5:

AIR CONDITIONING SYSTEMS: Introduction-Components of Air conditioning system-Classification of Air conditioning systems-Central and Unitary systems- Summer, Winter and Year round systems- Cooling load estimation. **DESIGN OF AIR CONDITION SYSTEMS:** Summer air conditioning –ADP-System with Ventilated and re-circulated air with and without bypass factor- RSHF, GSHF and ESHF.

Unit	**Module**	**Micro content**
9.a. or 10.a **AIR CONDITIONING SYSTEMS**	AIR CONDITIONING SYSTEMS	Introduction-Components of Air conditioning system
		Classification of Air conditioning systems-Central and Unitary systems- Summer, Winter and Year round systems
		Cooling load estimation**(Simple Problems)**
9.b.or 10.b		Summer air conditioning

DESIGN OF AIR CONDITION SYSTEMS	DESIGN OF AIR CONDITION SYSTEMS	ADP-System with Ventilated and re-circulated air with and without bypass factor.
		RSHF, GSHF and ESHF.

III-Year-II Semester	ADVANCED MANUFACTURING PROCESSES	L T P C
PE320X		3 1* 0 3

Prerequisites: Material Science, Basic Manufacturing Processes.

Course objectives:

1. To make acquainted the various surface hardening processes.
2. To make acquainted the various surface treatment methods.
3. To make acquainted the various processing of ceramics and composites.
4. To know about the applications of advanced manufacturing processes (E Manufacturing, micro machining, nano manufacturing)

Syllabus	
Unit No	**Contents**
I	**Introduction:** Types of advanced manufacturing processes; Evolution, need, and classification of advanced machining processes, Conventional manufacturing vs Advanced manufacturing, Reasons for using Advanced Manufacturing processes. **(5 hrs)** **Surface hardening**: Mechanical hardening of the surface, carburizing, carbonitriding, cyaniding, nitriding, ion nitriding, boronizing, laser hardening, thin film coating (PVD, CVD). **(5 hrs)**
II	**Surface treatment:** Scope, Cleaners, Methods of cleaning, Surface coating types, ceramic and organic methods of coating, economics of coating, Electro forming, Ion implantation, diffusion coating. **(10 hrs)**
III	**Surface Treatment**: Thermal spraying, Chemical vapor deposition, Electroplating, Electroless plating, Anodizing, Painting, Diamond coating and cladding. **(10 hrs)**
IV	**Processing of ceramics:** Applications, characteristics, classification. Processing of particulate ceramics, Powder preparations, consolidation, Drying, sintering, Hot compaction, Area of application, finishing of ceramics. **(5 hrs)** **Processing of Composites:** Composite Layers, Particulate and fiber reinforced composites, Elastomers, Reinforced plastics, MMC, CMC, Polymer matrix composites. **(5 hrs)**
V	E-Manufacturing, Nano manufacturing techniques, micromachining, High Speed Machining and hot Machining-basic principles, working, applications and advantages. **(10 hrs)**

Course Outcomes: Upon successful completion of the course, the student will be able to	
CO1:	Understand the types of advanced manufacturing processes and various surface hardening processes**{Understand level, KL2}**
CO2:	Understand the types of surface treatment (surface coating processes, thin film coating methods) **{Understand level, KL2}**
CO3:	Understand the types of surface treatment methods like chemical vapour deposition, diamond coating, cladding etc. **{Understand level, KL2}**
CO4:	Understand various processing of ceramics and composites. **{Understand level, KL2}**

CO5:	Understand the types of advanced manufacturing processes like E Manufacturing, micromachining, high speed machining etc. **{Understand level, KL2}**

Learning Resources
Text books: 1. Manufacturing Engineering and Technology by Kalpakijian, Addison Wesley, 1995. 2. Advanced Machining Processes by V. K. Jain, Allied Publications.
Reference books: 1. Process and Materials of Manufacturing by R. A. Lindburg, 4th edition, PHI 1990. 2. Introduction to Manufacturing Processes by John A Schey, Mc Graw Hill. 3. Advanced Methods of Machining by J. A Mc Geough, Springer.

Micro-Syllabus

Unit-1:

Introduction: Types of advanced manufacturing processes; Evolution, need, and classification of advanced machining processes, Conventional manufacturing vs Advanced manufacturing, Reasons for using Advanced Manufacturing processes.

Surface hardening: Mechanical hardening of the surface, carburizing, carbonitriding, cyaniding, nitriding, ion nitriding, boronizing, laser hardening, thin film coating (PVD, CVD).

Unit	**Module**	**Micro content**
1.a.or 2.a Introduction	Introduction	Types of advanced manufacturing processes
		Evolution, need, and classification of advanced machining processes,
		Conventional manufacturing vs Advanced manufacturing,
		Reasons for using Advanced Manufacturing processes
1.b.or 2.bSurface hardening	Surface hardening	Mechanical hardening of the surface
		carburizing, carbonitriding, cyaniding
		nitriding, ion nitriding, boronizing, laser hardening
		thin film coating (PVD, CVD)

Unit-2:

Surface treatment: Scope, Cleaners, Methods of cleaning, Surface coating types, ceramic and organic methods of coating, economics of coating, Electro forming, Ion implantation, diffusion coating.

Unit	Module	Micro content
3. a or 4.a **Surface treatment**	Surface treatment	Scope, Cleaners, Methods of cleaning
		Surface coating types
		ceramic and organic methods of coating
3.b or 4.b **Surface treatment**	Surface treatment	economics of coating
		Electro forming, Ion implantation
		diffusion coating

Unit-3:

Surface Treatment: Thermal spraying, Chemical vapor deposition, Electroplating, Electroless plating, Anodizing, Painting, Diamond coating and cladding.

Unit	Module	Micro content
5.a or 6.a **Surface treatment**	Surface treatment	Thermal spraying
		Chemical vapor deposition
		Electroplating
5.b or 6.b **Surface treatment**	Surface treatment	Electroless plating
		Anodizing
		Painting
		Diamond coating and cladding

Unit-4:

Processing of ceramics: Applications, characteristics, classification. Processing of particulate ceramics, Powder preparations, consolidation, Drying, sintering, Hot compaction, Area of application, finishing of ceramics.

Processing of Composites: Composite Layers, Particulate and fiber reinforced composites, Elastomers, Reinforced plastics, MMC, CMC, Polymer matrix composites.

Unit	Module	Micro content
		Applications, characteristics, classification

7.a.or 8.a **Processing of ceramics**	Processing of ceramics	Processing of particulate ceramics, Powder preparations
		consolidation, Drying, sintering, Hot compaction
		Area of application, finishing of ceramics
7.b.or 8.b **Processing of Composites**	Processing of Composites	Composite Layers, Particulate and fiber reinforced composites
		Elastomers, Reinforced plastics
		MMC, CMC, Polymer matrix composites

Unit-5:

E-Manufacturing, Nano manufacturing techniques, micromachining, High Speed Machining and hot Machining-basic principles, working, applications and advantages.

Unit	Module	Micro content
9.a. or 10.a **Modern Manufacturing Techniques**	Modern Manufacturing Techniques	E-Manufacturing
		Nano manufacturing techniques
		micromachining
9.b.or 10.b **Modern Manufacturing Techniques**	Modern Manufacturing Techniques	High Speed Machining and hot Machining-basic principles
		working, applications and advantages

III-Year-II Semester	STATISTICAL QUALITY CONTROL	L T P C
PE320X		3 1* 0 3

PRE-REQUISITES:

1. Basic knowledge related towards the term “quality”.

2. Basic Engineering Statistics I (or equivalent)

Course objectives:

This course will present the theory and methods of quality monitoring including process capability, control charts, acceptance sampling, quality engineering, and quality design.

The objectives include

1. To understand the basic concepts of quality monitoring.
2. To understand the statistical underpinnings of quality monitoring.
3. To learn various available statistical tools of quality monitoring.
4. To learn the statistical and economical design issues associated with the monitoring tools.
5. To demonstrate the ability to design and implement these tools.

Syllabus	
Unit No	**Contents**
I	**INTRODUCTION** Quality Dimensions – Quality definitions – Inspection - Quality control – Quality Assurance – Quality planning - Quality costs – Economics of quality – Quality loss function

II	**CONTROL CHARTS** Chance and assignable causes of process variation, statistical basis of the control chart, control charts for variables- X , R and S charts, attribute control charts - p, np, c and u- Construction and application.
III	**SPECIAL CONTROL PROCEDURES** Warning and modified control limits, control chart for individual measurements, multi-vary chart, X - chart with a linear trend, chart for moving averages and ranges, cumulative-sum and exponentially weighted moving average control charts.
IV	**STATISTICAL PROCESS CONTROL** Process stability, process capability analysis using a Histogram or probability plots and control chart. Gauge capability studies, setting specification limits.
V	**ACCEPTANCE SAMPLING** The acceptance sampling fundamental, OC curve, sampling plans for attributes, simple, double, multiple and sequential, sampling plans for variables.

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Understand the application of Data Analysis and Decision making in quality monitoring. **{Understand level, KL2}**
CO2	Design empirical projects, collect and evaluate data in order to make technical decisions **{Understand level, KL2}**
CO3	Apply Problem-Solving methods that address technological problems involving quality assurance as encountered in science and technology. **{Apply level, KL3}**
CO4	Make informed decisions based on information available using various Process Control Monitoring tools and techniques.**{Apply level, KL3}**
CO5	Analyse and interpret Control Charts in order to improve the productivity and quality of products. **{Apply level,KL3}**

Learning Resources
Text books:

1. Introduction to Statistical Quality Control, 7th Edition by Douglas C. Montgomery, 2013, John Wiley & Sons, Inc., New York. 2. **A Text Book of Statistical Quality Control: Guidelines for Quality Engineers,** ASIN : 3846590908 LAP LAMBERT Academic Publishing
Reference books
1. Engineering Statistics by Douglas C. Montgomery, George C. Runger, and Norma F. Hubele, John Wiley & Sons, Inc., New York. 2. Grant E.L. and Leavensworth, Statistical Quality Control, TMH, 2000.

e- Resources & other digital material
1. https://onlinecourses.nptel.ac.in/noc20_mg18/preview

Micro-Syllabus

UNIT I:

INTRODUCTION

Quality Dimensions – Quality definitions – Inspection - Quality control – Quality Assurance – Quality planning - Quality costs – Economics of quality – Quality loss function

Unit	**Module**	**Micro content**
1.a.or 2.a Quality Dimensions – Quality definitions – Inspection - Quality control	Quality Dimensions – Quality definitions – Inspection - Quality control	Quality definitions
		Inspection
		Quality control
1b.or 2.b Quality Assurance – Quality planning - Quality costs – Economics of quality – Quality loss function	Quality Assurance – Quality planning - Quality costs – Economics of quality – Quality loss function	Quality planning
		Economics of quality
		Quality costs

UNIT II:

CONTROL CHARTS

Chance and assignable causes of process variation, statistical basis of the control chart, control charts for variables- X , R and S charts, attribute control charts - p, np, c and u- Construction and application.

Unit	Module	Micro content
3. a or 4.a Statistical basis of the control chart.	X , R and S charts	X , R and S charts
3.b or 4.b Attribute control charts	Attribute control charts - p, np, c and u	p, np, c and u charts

UNIT III:

SPECIAL CONTROL PROCEDURES

Warning and modified control limits, control chart for individual measurements, multi-vary chart,

X -chart with a linear trend, chart for moving averages and ranges, cumulative-sum and exponentially weighted moving average control charts.

<table>
<tr><th>Unit</th><th>Module</th><th>Micro content</th></tr>
<tr><td rowspan="3">5.a or 6.a
Control charts</td><td rowspan="3">Warning and modified control limits, control chart for individual measurements, multi-vary chart.</td><td>Warning and modified control limits</td></tr>
<tr><td>control chart for individual measurements</td></tr>
<tr><td>Multi-vary chart.</td></tr>
<tr><td rowspan="4">5.b or 6.b
X-charts/ procedures</td><td rowspan="4">X -chart with a linear trend, chart for moving averages and ranges, cumulative-sum and exponentially weighted moving average control charts.</td><td>X -chart with a linear trend</td></tr>
<tr><td>Chart for moving averages and ranges</td></tr>
<tr><td>Chart for cumulative-sum</td></tr>
<tr><td>Exponentially weighted moving average control charts.</td></tr>
</table>

UNIT IV:

STATISTICAL PROCESS CONTROL

Process stability, process capability analysis using a Histogram or probability plots and control chart. Gauge capability studies, setting specification limits.

Unit	Module	Micro content
7.a.or 8.a Process stability, process capability analysis using a Histogram.	Process stability, process capability analysis using a Histogram	Process stability
		process capability analysis using a Histogram
7.b.or 8.b Probability plots and control chart. Gauge capability studies, setting specification limits.	Probability plots and control chart. Gauge capability studies, setting specification limits.	Probability plots and control chart.
		Gauge capability studies, setting specification limits.

UNIT V:

ACCEPTANCE SAMPLING

The acceptance sampling fundamental, OC curve, sampling plans for attributes, simple, double, multiple and sequential, sampling plans for variables.

Unit	Module	Micro content
9.a. or 10.a The acceptance Sampling	The acceptance sampling fundamental, OC curve, sampling plans for attributes	Acceptance sampling fundamental
		OC curve
		Sampling plans for attributes

9.b. or 10.b Simple, double, multiple and sequential, sampling plans for variables.	Simple, double, multiple and sequential, sampling plans for variables .	Simple, double plans for variables
		Multiple and sequential plans for variables
		Sampling plans for variables.

III-Year-II

Semester **ADVANCED MECHANICS OF SOLIDS** **L T P C**

3 1* 0 3

PE320X

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.

Unit No	Contents
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.
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.

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.
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.
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.

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

1. Solve the stress, strain and deformations for statically in-determinate members **(Apply level, KL3)**

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

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

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

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

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.

e- Resources & other digital material:

1. https://nptel.ac.in/courses/112/101/112101095/
2. https://www.youtube.com/watch?v=_2d8YsXwm7M
3. https://nptel.ac.in/content/storage2/courses/105106049/pdfassignments/main.pdf

Micro Syllabus

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	Module	Micro content
1.a. or 2.a	Statically indeterminate bars	Analysis of bars of composite sections**(Numericals)**
		Temperature stresses in composite sections **(Numericals)**
1.b. or 2.b	Statically indeterminate beams	Analysis of beams by the differential equations of the Deflection curve **(Numericals)**
		Analysis of beams by Macaulay’s Method & moment area method **(Numericals)**

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	Module	Micro content
3. a or 4.a	Continuous Beams	Clapeyron's theorem of three moments, Beams with overhang and fixed ends **(Numericals)**
		Beams with constant and varying moments of inertia **(Numericals)**
3.b or 4.b	Energy Methods	Statically indeterminate beams & Castigliano's theorem **(Theory &numericals)**
		Applications of Castigliano's theorem **(Numericals)**

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	Module	Micro content
5.a or 6.a	Thick Cylindrical & Spherical Pressure Vessels	Stresses in a thick cylindrical shell, stresses in compound thick cylinders & stresses in thick spherical shells. **(Only theory & associated problems)**
5.b or 6.b	Centrifugal Stresses	Centrifugal stresses in rotating disc & rotating disc of uniform strength **(Only theory & associated problems)**

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	Module	Micro content
7.a. or 8.a	Curved Beams	Winkler-Bach theory **(Theory & derivation)**
		Stresses in Crane Hook with trapezoidal cross-section **(Problems)**
7.b. or 8.b	Shear center	Determination of shear centre for channel section **(Only numericals)**
		Determination of shear centre for I – section **(Only numericals)**

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.

Unit	Module	Micro content
9.a. or 10.a	Hertz contact stresses	Determination of contact stresses forspheres & cylinders **(Theory & problems)**

9.b. or 10.b	Stress concentration	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 **(Theory and associated problems)**

III-Year-II Semester		L T P C
PE320X	**POWER PLANT ENGINEERING**	3 1* 0 3

PRE-REQUISITES : Engineering Thermodynamics, Engineering Physics, Engineering Chemistry.

Course objectives:

(1)To make the student learn and understand about various sources of energy, working of thermal power plants and combustion process

(2) To familiarize the student with the functioning of Diesel and gas power

(3) To learn about the power is produced from Hydroelectric and Nuclear power plants.

(4) Able to learn about combined operations of different power plants and the power plant instrumentation and control

(5) To make students learn about power plant economics and environmental considerations.

Syllabus	
Unit No	**Contents**
I	**INTRODUCTION TO THE SOURCES OF ENERGY** – resources and development of power in India. **STEAM POWER PLANT:** Plant layout, working of different circuits, fuel and handling equipments, types of coals, coal handling, choice of handling equipment, coal storage, ash handling systems. **(05 hrs)** **COMBUSTION:** properties of coal – overfeed and underfeed fuel beds, travelling grate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components, combustion needs and draught system, cyclone furnace, design and construction, dust collectors, Dust collection and its disposal –Mechanical type –Electrostatic Precipitator, cooling towers and heat rejection, corrosion and feed water treatment, dearation. **(05 hrs)**

II	**INTERNAL COMBUSTION AND GAS TURBINE POWER PLANTS:** **DIESEL POWER PLANT:** Plant layout with auxiliaries – fuel supply system, air starting equipment, super charging. Advantages and Disadvantages of Diesel plants over Thermal plants. **(05 hrs)** **GAS TURBINE PLANT:** Introduction – classification - Principles of working of closed and open cycle gas turbines construction – layout with auxiliaries, Combined cycle power plants and comparison. **(05 hrs)**
III	**HYDRO ELECTRIC POWER PLANT:** Water power – hydrological cycle / flow measurement– drainage area characteristics – hydrographs – storage and pondage – classification of dams and spill ways. **HYDRO PROJECTS AND PLANT:** Classification – plant operation and pumped storage plants. **(5 hrs)** **NUCLEAR POWER PLANT:**Nuclear fuel – breeding and fertile materials – nuclear reactor– Components of Reactor– reactor operation, **TYPES OF REACTORS:** Pressurized water reactor, boiling water reactor, sodium-graphite reactor, fast breeder reactor, radiation hazards and shielding – radioactive waste disposal. **(5hrs)**
IV	**COMBINED OPERATIONS OF DIFFERENT POWER PLANTS:** Introduction, advantages of combined working, load division between power stations, storage type hydro-electric plant in combination with steam plant, run-of-river plant in combination with steam plant, pump storage plant in combination with steam or nuclear power plant, co-ordination of hydro-electric and gas turbine stations. **(05 hrs)** **POWER PLANT INSTRUMENTATION AND CONTROL:** Importance of measurement and instrumentation in power plant, measurement of water purity, gas analysis, O2 and CO2 measurements, measurement of smoke and dust, measurement of moisture in carbon dioxide circuit, nuclear measurements. **(05 hrs)**
V	**POWER PLANT ECONOMICS AND ENVIRONMENTAL CONSIDERATIONS:** Capital cost, investment of fixed charges, operating costs, general arrangement of power distribution, load curves, load duration curve, definitions of connected load, maximum demand, demand factor, average load, load factor, diversity factor – related exercises,Performance and Operating Characteristics of Power Plant, Effluents from power plants and Impact on environment – pollutants and pollution standards – methods of pollution control. **(10 hrs)**

Content beyond Syllabus:*Performance and Operating Characteristics of Power Plant*

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Describe** sources of energy **and Understand** the working of steam power plants. **{Understand level, KL2}**
CO2	**Understand** the working of Internal combustion and Gas Turbine power plants.**{Understand level, KL2}**
CO3	**Describe** the basic working principles of Hydel power and Nuclear power plants. **{Understand level, KL2}**
CO4	**Understand** aboutcombined operations of different power plants and the power plant instrumentation and control.**{Understand level, KL2}**

CO5	**Apply** thepower plant economics for **estimation** of unit power cost and also **Understand** the impact of effluents on environment. **{Apply level,KL3}**

Learning Resources
Text books:
1.A course in Power Plant Engineering - Arora and Domkundwar/Dhanpatrai & Co. 2.Power Plant Engineering - P.C.Sharma / S.K.Kataria Pub.
Reference books
1.Power Plant Engineering - P.K.Nag/ II Edition /TMH. 2.Power station Engineering – ElWakil / McGrawHill. 3.An Introduction to Power Plant Technology - G.D. Rai/Khanna Publishers

e- Resources & other digital material
1. https://nptel.ac.in/courses/112/107/112107291/
2. http://nptel.ac.in/courses/112106133/1
3. http://nptel.ac.in/courses/112106133/2
4. http://nptel.ac.in/courses/112106133/3
5. http://nptel.ac.in/courses/112106133/4
6.http://nptel.ac.in/courses/112106133/5

Micro-Syllabus

Unit-1:

INTRODUCTION TO THE SOURCES OF ENERGY – resources and development of power in India.

STEAM POWER PLANT: Plant layout, working of different circuits, fuel and handling equipments, types of coals, coal handling, choice of handling equipment, coal storage, ash handling systems.

COMBUSTION: properties of coal – overfeed and underfeed fuel beds, travelling grate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components, combustion needs and draught system, cyclone furnace, design and construction, dust collectors, Dust collection and its disposal – Mechanical type –Electrostatic Precipitator, cooling towers and heat rejection, corrosion and feed water treatment, dearation.

Unit	**Module**	**Micro content**
1.a.or 2.a **SOURCES OF ENERGY**	Sources of Energy	Energy Resources
		Working of different circuits

& **STEAM POWER PLANT**	Steam Power Plant	Types of coals, coal handling, choice of handling equipment, coal storage
		Ash handling systems
1.b.or 2.bCOMBUSTION	Combustion	Overfeed and underfeed fuel beds, travelling grate stokers, spreader stokers, retort stokers
		Pulverized fuel burning system and its components
		Dust collection and its disposal
		Cooling towers
		Corrosion and feed water treatment, Dearation.

Unit-2:

DIESEL POWER PLANT: Plant layout with auxiliaries – fuel supply system, air starting equipment, super charging. Advantages and Disadvantages of Diesel plants over Thermal plants.

GAS TURBINE PLANT: Introduction – classification - Principles of working of closed and open cycle gas turbines construction – layout with auxiliaries, Combined cycle power plants and comparison.

Unit	**Module**	**Micro content**
3. a or 4.a **Diesel Power Plant**	Diesel Power Plant	Fuel supply system, air starting equipment
		Super charging
		Advantages and Disadvantages of Diesel plants over Thermal plants.
3.b or 4.b **Gas Turbine Plant**	Gas Turbine Plant	Working of closed and open cycle gas turbines
		Layout with auxiliaries
		Combined cycle power plants and comparison.

Unit-3:

HYDRO ELECTRIC POWER PLANT: Water power – hydrological cycle / flow measurement– drainage area characteristics – hydrographs – storage and pondage – classification of dams and spill ways.

HYDRO PROJECTS AND PLANT: Classification – plant operation and pumped storage plants.

NUCLEAR POWER PLANT: Nuclear fuel – breeding and fertile materials – nuclear reactor– Components of Reactor– reactor operation,

TYPES OF REACTORS: Pressurized water reactor, boiling water reactor, sodium-graphite reactor, fast breeder reactor, radiation hazards and shielding – radioactive waste disposal.

Unit	**Module**	**Micro content**
5.a or 6.a **HYDRO ELECTRIC**	HYDRO ELECTRIC POWER PLANT	Hydrological cycle / flow measurement– drainage area characteristics
		Hydrographs – storage and pondage.

ELECTRIC POWER PLANT & HYDRO PROJECTS AND PLANT	HYDRO PROJECTS AND PLANT	Classification of dams
		Classification of spill ways
		Plant operation
		Pumped storage plants
5.b or 6.b **NUCLEAR POWER PLANT** **&** **TYPES OF REACTORS**	NUCLEAR POWER PLANT	Nuclear fuel – breeding and fertile materials
		Reactor– Components of Reactor.
		Reactor operation
	TYPES OF REACTORS	Pressurized water reactor, Boiling water reactor
		Sodium-graphite reactor, Fast breeder reactor.
		Radiation hazards and shielding – radioactive waste disposal

Unit-4:

COMBINED OPERATIONS OF DIFFERENT POWER PLANTS:

Introduction, advantages of combined working, load division between power stations, storage type hydro-electric plant in combination with steam plant, run-of-river plant in combination with steam plant, pump storage plant in combination with steam or nuclear power plant, co-ordination of hydro-electric and gas turbine stations.

POWER PLANT INSTRUMENTATION AND CONTROL: Importance of measurement and instrumentation in power plant, measurement of water purity, gas analysis, O_2 and CO_2 measurements, measurement of smoke and dust, measurement of moisture in carbon dioxide circuit, nuclear measurements.

Unit	Module	Micro content
7.a.or 8.a **COMBINED OPERATIONS OF DIFFERENT POWER PLANTS**	COMBINED OPERATIONS OF DIFFERENT POWER PLANTS	Advantages of combined working, load division between power stations
		Storage type hydro-electric plant in combination with steam plant, run-of-river plant in combination with steam plant,
		Pump storage plant in combination with steam or nuclear power plant,
		Co-ordination of hydro-electric and gas turbine stations
7.b.or 8.b **POWER PLANT INSTRUMENTATI ON AND CONTROL**	POWER PLANT INSTRUMENTATION AND CONTROL	Measurement of water purity, gas analysis, O_2 and CO_2 measurements, measurement of smoke and dust
		Measurement of moisture in carbon dioxide circuit, nuclear measurements.

Unit-5:

POWER PLANT ECONOMICS AND ENVIRONMENTAL CONSIDERATIONS:

Capital cost, investment of fixed charges, operating costs, general arrangement of power distribution, load curves, load duration curve, definitions of connected load, maximum demand, demand factor, average load, load factor, diversity factor – related exercises. Effluents from power plants and Impact on environment – pollutants and pollution standards – methods of pollution control.

Unit	Module	Micro content
9.a. or 10.a **POWER PLANT ECONOMICS**	POWER PLANT ECONOMICS	Capital cost, investment of fixed charges, Operating costs,
		general arrangement of power distribution
		Load curves, load duration curve,.
		Definitions of connected load, maximum demand,
		Demand factor, average load, Load factor, diversity factor – **Simple Problems**
9.b.or 10.b **ENVIRONMENTAL CONSIDERATIONS**	ENVIRONMENTAL CONSIDERATIONS	Effluents from power plants and Impact on environment
		Pollutants and pollution standards
		Methods of pollution control.

III-Year-II Semester	DESIGN FOR MANUFACTURING & ASSEMBLY	L T P C
PE320X		3 1* 0 3

PRE-REQUISITES: Basics of design procedure, Basics of manufacturing processes.

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 No	**Contents**
I	**Introduction:** Design philosophy-steps in design process-general design rules for manufacturability-basic principles of designing for economical production-creativity in design. Design for the life cycle total product life of consumer goods-design considerations. **(10 hrs)**
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. **(10 hrs)**
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. **(10 hrs)**
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. **(05 hrs)** **Forging:**Design factors for forging – closed die forging design – parting lines of dies – drop forging die design – general design recommendations. **(05 hrs)**

V	**Extrusion & Sheet metal work:** Design guide lines extruded sections-design principles for punching, blanking, bending, deep drawing- component design for blanking. **(05 hrs)** **Plastics:** Visco elastic and creep behavior in plastics-design guidelines for plastic components-design considerations for injection moulding – design guidelines for machining and joining of plastics. **(05 hrs)**

Content beyond Syllabus: Designof components using NX software.

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1:	Understand the Design guide lines for manufacturing and Product Life Cycle. **{Understand level, KL2}**
CO2:	Understand the design rules for Machining and apply the design recommendations for machined parts. **{Understand level, KL2}**
CO3:	Understand the casting design and choose the best casting process for a specific product. **{Understand level, KL2}**
CO4:	Identify the effect of thermal stresses in weld joints. **{Identify level, KL2}**
CO5:	Apply the sheet metal processes and their formation mechanisms to design components and machining and joining of plastics. **{Apply level, KL3}**

Learning Resources
Text books:
1.Design for manufacture / John cobert / Adisson Wesley. 1995 2. Design for Manufacture / Boothroyd/CRC Press 3. Design for manufacture/ James Bralla/McGrawHill Edition
Reference books
1. ASM Hand book Vol.20

Micro-Syllabus

Unit 1: Introduction: Design philosophy-steps in design process-general design rules for manufacturability-basic principles of designing for economical production-creativity in design. Design for the life cycle total product life of consumer goods-design considerations.		
Unit	**Module**	**Micro content**

1a. & 2a. Introduction	Introduction- Design for manufacturing and assembly	Objectives of design for manufacturing
		Objectives of design for assembly
		Similarities and Difference between design for manufacturing and assembly
		Reduce total number of parts
		Develop a modular design
		Sequence of analysis, Process flow diagram
		Design for machinability- Standardization, Choice of material, shape and size of the material, assembly, accuracy and surface finish

1b. & 2b. Introduction	Introduction-Design for manufacturing and assembly	Design for economy, Clampability, accessability,
		Use of standard components
		Design parts to be multifunctional and multi-use
		Design for ease of fabrication
		Avoid separate fasteners
		General design principles
		Minimize assembly directions
		design recommendations for product development.
Unit 2: 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	Module	Micro content
3a. & 4a. Machining processes	Machining processes	Design for machining
		selection of manufacturing sequences and optimal selection
		reasons for optimal selection of machining parameters.
		the various casting design, machining design, designing of formed components.
3b. & 4b. Machining processes	Machining processes	Advantages & Disadvantage of machining processes
		Typical machined parts
		Recommended materials for machinability

		Design recommendations

Unit 3: 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.	**Micro content**

Unit	Module	Micro content
5a. & 6a. Metal casting	sand casting	Sand casting
		Typical characteristics of a sand cast part
		Design considerations and recommendations
	Investment casting	Investment Casting, Pattern materials
		Typical characteristics and applications
	Investment casting	General design considerations
		Suitable material for investment casting
		Detail design recommendations

5b. & 6b. Metal casting	Die casting	Die casting,Advantages & Disadvantages of the die casting process, Applications
		Suitable material consideration
		General design consideration
		Specific design recommendation
		Dimension and tolerance

Unit 4: 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.	**Micro content**	

Unit	**Module**	Introduction to welding process
		Arc welding and similar processes

7a. & 8a. Metal joining	Welding process	Shielded-Metal Arc (SMAW) or Stick Welding
		Submerged Arc Welding (SAW)
		Flux-Cored Arc Welding (FCAW)
		Gas-Metal Arc Welding (GMAW)
		Gas-Tungsten Arc Welding (GTAW)
		Plasma Arc Welding (PAW),Other Welding Processes
		Design recommendations
	Design for welding	Minimizing Distortion
		Weld Strength
		Electron and Laser Beam Weldment
		Weldments and Heat Treatment

7b. & 8b. Metal joining		Dimensional factors and recommended tolerances
		Types of forging
	Forging	Characteristics of forging
		Applications of forging
		Forging nomenclature
		Design recommendations
		Suitable materials for forging, Tolerances

Unit 5: Extrusion & Sheet metal work: Design guide lines extruded sections-design principles for punching, blanking, bending, deep drawing-component design for blanking. **(05 hrs)**

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

Micro content

Unit	**Module**	Metal extrusion

9a. & 10a. **Extrusion & Sheet metal work**	Extrusion	Typical parts and applications
		Suitable material for extrusion
		General design recommendation
		Detail design recommendation
		Dimensional factor
		Recommended tolerances
		design principles for punching
	Sheet metal work-punching	Characteristics and application of metal stamping
		Suitable materials for stamping
		Design Recommendations
		Fine Blanked Parts
		Typical characteristics and application

	Sheet metal work-blanking	Material suitable for fine blanked parts
		Design recommendations for piece parts
		Deep drawing Parts
9b. & 10b. Sheet metal work & Plastics	Sheet metal work-deep drawing	Typical characteristics and application
		Material suitable for deep drawing parts
		Design recommendations for deep drawing parts
		Visco elastic and creep behavior in plastics
	Plastics	Design guidelines for plastic components
		Design guidelines for machining and joining of plastics.

	Injection moulding	Injection moulding, Typical characteristics of injection moulded parts, Effect of shrinkage, Suitable materials, Design recommendations, Dimensional factors and tolerance

III-Year-II Semester **MECHATRONICS** **L T P C**

3 1* 0 3

PE320X

Pre-Requisites: Material Science, Basics of Manufacturing Processes.

Course objectives:

The main objective of this course is to introduce the integrative nature of Mechatronics. To describe the different components and devices of mechatronics systems.

Unit No	Contents
I	Mechatronics systems – Elements & levels of mechatronics system, Mechatronics design process, system, measurement systems, control systems, microprocessor-based controllers, advantages and disadvantages of mechatronics systems. Sensors and transducers, types, displacement, position, proximity, velocity, motion, force, acceleration, torque, fluid pressure, liquid flow, liquid level, temperature and light sensors. **(10 hrs)**
II	Solid state electronic devices - PN junction diode, BJT, FET, DIAC, TRIAC and LEDs. Analog signal conditioning, operational amplifiers, noise reduction, filtering. **(10 hrs)**
III	Hydraulic and pneumatic actuating systems - Fluid systems, Hydraulic systems, and pneumatic systems, components, control valves, electro-pneumatic, hydro-pneumatic, electro-hydraulic servo systems. Mechanical actuating systems and electrical actuating systems – basic principles and elements. **(10 hrs)**
IV	Digital electronics and systems - digital logic control, micro processors and micro controllers, programming, process controllers, programmable logic controllers, PLCs versus computers, application of PLCs for control. **(10 hrs)**
V	System and interfacing and data acquisition – Data Acquisition Systems, Analog to Digital and Digital to Analog conversions; Digital Signal Processing – data flow in DSPs, block diagrams, typical layouts, Interfacing motor drives. Design of mechatronics systems & future trends. **(10 hrs)**

Course Outcomes: Upon successful completion of the course, the student will be able to	
CO1:	Understand Different elements of mechatronics systems and types along with different types of sensors and transducers.**{Understand level, KL2}**
CO2:	Understand Different types of solid state electronic devices like PNP, NPN junction diode, FET along with signal conditioning.**{Understand level, KL2}**

CO3:	Understand Different types of actuating systems like mechanical, electrical, hydraulic & pneumatic and their elements.**{Understand level, KL2}**
CO4:	Understand Different types of controllers/ processors used in mechatronics system like micro controllers, computers.**{Understand level, KL2}**
CO5:	Understand The significance of system interfacing, data aquisition and data flow along with future trends of mechatronics system. **{Understand level, KL2}**

Learning Resources
Text books:
1. MECHATRONICS Integrated Mechanical Electronics Systems/KP Ramachandran, GK Vijaya Raghavan & MS Balasundaram/WILEY India Edition.
Reference books
1 Mechatronics /Smaili A, Mrad F/ Oxford Higher Education, Oxford University Press 2 Mechatronics Source Book / Newton C Braga/Thomson Publications,Chennai. 3 Mechatronics – N. Shanmugam / Anuradha Agencies Publishers. 4 Mechatronics System Design / Devdas shetty/Richard/Thomson. 5 Mechatronics/M.D.Singh/J.G.Joshi/PHI. 6 Mechatronics – Electronic Control Systems in Mechanical and Electrical Engg. 4th Edition / W. Bolton/ Pearson, 2012 7 Mechatronics – Principles and Application / Godfrey C. Onwubolu/Elsevier, Indian print

Micro-Syllabus

Unit 1: Mechatronics systems – Elements & levels of mechatronics system, Mechatronics design process, system, measurement systems, control systems, microprocessor-based controllers, advantages and disadvantages of mechatronics systems. Sensors and transducers, types, displacement, position, proximity, velocity, motion, force, acceleration, torque, fluid pressure, liquid flow, liquid level, temperature and light sensors.		
Unit	Module	Micro content
1a. & 2a. Mechatronics systems	Introduction	Introduction to mechatronics and mechatronics systems
	Elements and levels of mechatronics system	different elements and classification of levels of mechatronics systems
	Design process	steps in design process of mechatronics systems
		traditional design vs mechatronics design
	Systems	measurement systems and its basic elements
		control systems and its types

1b. & 2b. Mechatronics systems	Systems	microprocessor-based controllers
		advantages and disadvantages of mechatronics systems
	Sensors and Transducers	definitions od sensor and transducer and their differences
		performance terminology
		static and dynamic characteristics
		different types of sensors and transducers and examples for each type
Unit 2: Solid state electronic devices - PN junction diode, BJT, FET, DIAC, TRIAC and LEDs. Analog signal conditioning, operational amplifiers, noise reduction, filtering.		
3a. & 4a. Solid state electronic devices	Solid state electronic devices	different types of solid state electronic devices
		principle and working of PN junction diode, BJT, FET, DIAC, TRIAC and LEDs
	Signal conditioning	Need for signal conditioning
		Process of signal conditioning
		Elements used in signal conditioning
3b. & 4b. Solid state electronic devices	Operational amplifiers	Brief introduction to amplifiers, operational amplifiers
		Different types of operational amplifiers
	Noise reduction and filtering.	Need for noise reduction and filtering
		Classification of filters
Unit 3: Hydraulic and pneumatic actuating systems - Fluid systems, Hydraulic systems, and pneumatic systems, components, control valves, electro-pneumatic, hydro-pneumatic, electro-hydraulic servo systems. Mechanical actuating systems and electrical actuating systems – basic principles and elements.		
5a. & 6a. Actuating systems	Hydraulic and pneumatic actuating systems	Introduction to actuating systems
		Different types of actuating systems
		Different components and working of hydraulic and pneumatic actuating systems
		Control valves and its types
	Hydraulic and pneumatic actuating systems	Electro-pneumatic, hydro-pneumatic, electro-hydraulic servo systems

5b. & 6b. Actuating systems	Mechanical and electrical actuating systems	Basic principles, elements and operations of Mechanical and electrical actuating systems
Unit 4: Digital electronics and systems - digital logic control, microprocessors and micro controllers, programming, process controllers, programmable logic controllers, PLCs versus computers, application of PLCs for control.		
7a. & 8a. Digital electronics and systems	Digital logic control	Introduction to digital electronics and systems
		Difference between analog and digital system
		Numbering systems and conversions
		Boolean algebra
		Different types of logic gates
	Microprocessors and Micro controllers	Difference between microprocessor and microcontroller
		Characteristics and important features of microprocessor
7b & 8b. Digital electronics and systems	Microprocessors and Micro controllers	Applications of microprocessors
		Characteristics and applications of microcontrollers
	Plc	Brief introduction to plc and its basic structure
		Components of a PLC, and programming
		PLCs versus computers
		Application of PLCs for control.
Unit 5: System and interfacing and data acquisition – Data Acquisition Systems, Analog to Digital and Digital to Analog conversions; Digital Signal Processing – data flow in DSPs, block diagrams, typical layouts, Interfacing motor drives. Design of mechatronics systems & future trends.		
9a. & 10a. System and interfacing and data acquisition	Data acquisition systems (DAQ)	Introduction to Data Acquisition Systems
		Objectives and components of DAQ
		Block diagram of DAQ
		Advantages and disadvantages of DAQ
	Signal conversions	Analog to digital conversion
		Digital to analog conversion
	Digital signal processing	Data flow in DSPs
		Block diagrams and typical layout of DSP

9b. &10b. System and interfacing and data acquisition		Interfacing motor drives
	Design of mechatronics systems & future trends.	Design considerations of mechatronics systems
		Different steps in design of mechatronics systems
		Future trends in the field of mechatronics and its applications

III-Year-II Semester		**L T P C**
PC3201L	**HEAT TRANSFER LAB**	**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 co-efficient 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** theheat 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	SIMULATION LAB	L T P C
PC3202L		0 0 3 1.5

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

Course objectives:

1) To give exposure to software tools needed to Analyze engineering problems.
2) To expose the students to different applications of simulation and analysis tools.

ANY TEN EXPERIMENTS OF THE FOLLOWING:

1. Determination ofForce and stress analysis using link elements in Trusses, cables etc.
2. Determination ofStress and deflection analysis in beams with different support conditions.
3. Determination ofStress analysis of flat plates and simple shells.
4. Determination ofStress analysis of axi-symmetric components.
5. Determination ofHarmonic, transient and spectrum analysis of simple systems.
6. Determination ofVibration analysis of spring-mass systems.
7. Determination ofModal analysis of beams.
8. Determination ofThermal stress analysis of cylindrical shells.
9. Determination ofThermal stress and heat transfer analysis of plate.
10. MAT LAB basics, dealing with matrices, Graphing-functions of one variable and two variables.
11. Use of MATLAB to solve simple problems in vibration.
12. Mechanism Simulation using multi body dynamic software.

Course Outcomes: Upon successful completion of the course, the student will be able to	
CO1:	Compute the deflection and stress in 1D and 2D problem. **(ComputeLevel, KL-3)**

CO2:	Examine the effect of various load acting on 1D beam in real time problem.**(Examine Level, KL-3)**
CO3:	Determine the effects due to harmonic loading on structures.**(Determine Level, KL-3)**
CO4:	Examine the modal analysis for beam under various boundary conditions.**(Examine Level, KL-3)**
CO5:	Examine the thermal effects on 2D structure.**(Examine Level, KL-3)**
CO6:	Apply numeric techniques and computer simulations to solve engineering-related problems.**(Apply Level, KL-3)**
Reference books: Lab Manual	