Academic Regulations

Program structure & Detailed Syllabus

2017

For

Under Graduate Programme (B.Tech)

MECHANICAL ENGINEERING

(Applicable For Batches Admitted From 2017 – 2018)

VIGNAN'S INSTITUTE OF INFORMATION TECHNOLOGY
(AUTONOMOUS)

DUVVADA - VISAKHAPATNAM – 530 049

(An Autonomous Institute, Accredited by NAAC, Affiliated to JNTUK, Kakinada, AP)

VIGNAN'S INSTITUTE OF INFORMATION TECHNOLOGY

(AUTONOMOUS)

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ACADEMIC REGULATIONS

(VR 17)

VIGNAN'S INSTITUTE OF INFORMATION TECHNOLOGY (AUTONOMOUS)
VISAKHAPATNAM

ACADEMIC REGULATIONS for B. Tech. (Regular)

(Applicable for the batches admitted 2017-18 onwards)

The Admission of students into B. Tech. course shall be as per the Govt. of Andhra Pradesh rules.

1. Award of B. Tech. Degree

A student will be declared eligible for the award of the B. Tech. degree if he/she fulfils the following academic regulations.

a. Pursue a program of study for not less than four academic years and not more than eight academic years.
b. For lateral entry scheme admission: Pursue a program of study for not less than three academic years and not more than six academic years.
c. For the award of a degree, regular candidate has to register for 189 credits and shall secure 189 credits.
d. Lateral entry candidate has to register for all the courses from second year onwards and secure all the credits registered for.

2. Courses of Study

The following courses of study are offered at present for specialization in the B. Tech. Course.

S. No.	Course Code	Programme & Abbreviation
01	01	Civil Engineering (CE)
02	02	Electrical and Electronics Engineering (EEE)
03	03	Mechanical Engineering (ME)
04	04	Electronics and Communication Engineering (ECE)
05	05	Computer Science and Engineering (CSE)
06	12	Information Technology (IT)
07	19	Electronics and Computer Engineering (E.Com E)

And any other Course as approved by the authorities of the Institute from time to time.

3. Registration: A student shall register for courses in each semester as per the courses offered by the concerned department.

4. Curricular Program

The Curriculum of the four-year B. Tech Course has been designed to achieve a healthy balance between theory & lab hours, industry experience and to develop technical skills required for a career in the industry or a career in research**.**

5. 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 courses and 100 marks for practical course. The project work shall be evaluated for 200 marks.

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

Distribution of marks for theory course, practical course and Design/Drawing is detailed below:

5.1. Internal 40 marks for theory course shall be awarded as follows:

i) 25 marks for MID exams
ii) 10 marks for continuous assessment
iii) 5 marks for Attendance

MID marks shall be calculated with 80% weightage for best of the two MIDs and 20% weightage for other MID exam.

5.2. For practical courses (Laboratory): There shall be continuous evaluation during the semester. Each Lab exam is evaluated for 100 marks. 50 marks shall be awarded for internal examination and 50 marks shall be awarded for external examinations.

5.2.1. Internal marks shall be awarded as follows

i) Day to day assessment– 20 Marks
ii) Record – 10 Marks
iii) Internal laboratory exam– 20 Marks

5.2.2.The semester end examinations shall be conducted by the teacher concerned and external examiner

5.3. For the courses having design and/or drawing, (Such as Engineering Graphics, Engineering Drawing, Machine Drawing) and estimation, the distribution shall be 40 marks for internal evaluation.

5.3.1. Internal marks shall be awarded as follows:

i) 20 marks for Day-to-day assessment
ii) 15 marks for internal exam
iii) 5 marks for Attendance

There shall be two internal examinations in a semester and the internal marks shall be calculated with 80% weightage for best of the two internals and 20% weightage for other internal exam.
5.3.2. External examination shall be conducted for 60 marks.

5.4. Industrial Visit: The industrial visit shall be carried out in their domain during the summer vacation after the second year second semester. A student has to submit a report which will be evaluated for 100 marks and will be submitted to an internal evaluation committee comprising Head of the Department or his / her nominee and two senior faculty of the department including the industrial visits coordinator/ supervisor.

5.5. Industry- Oriented Mini Project: The Industry oriented mini project is carried out during the third year second semester vacation. The students have an option to choose their own area of interest which may be related to the course work. Mini project report is evaluated for 100 marks in fourth year first semester before the first mid-term exam. Assessment is done by the supervisor /guide for 40 marks based on the work and mini project report. The remaining 60 marks are allocated for presentation by the student to a committee comprising of the project supervisor and senior faculties members nominated by Head of the Department.

5.6. MOOCs: It is an online course (Minimum of 12 weeks) to promote advanced knowledge suitable for placement and research.

To award credits, the student should get certificate after they have registered for written exam and successfully passed

(Or)

College will conduct the written examination/Viva-voce and award the credits and grades.

In case a student fails in any online course, he/she may be permitted to register for the same course or an alternate course decided by the department committee. The internal marks secured earlier will be nullified if the course is changed. The assessment procedure of MOOCs course remains same as general theory course.

Note: The registered course must not be same as any of the courses listed in the program structure of their regulation till final year including electives.

5.7. Technical Seminar: For Technical seminar, the student shall collect the information on a specialized topic and prepare a technical report, showing his/her understanding over the topic, and submit to the department, which shall be evaluated by the Departmental Committee consisting of Head of the Department, seminar supervisor and a senior faculty member. The seminar report shall be evaluated for 50 marks. There shall be no external examination for seminar.

5.8. Comprehensive Viva: The Comprehensive Viva aims to assess the students' understanding in various subjects he / she studied during the B.Tech course of study. Comprehensive Viva is conducted for a total of 50 marks. It shall be conducted in IV Year II Semester. The Comprehensive Viva–Voce will be conducted by a Committee consisting of Head of the Department, two senior faculty members of the Department and External Expert.

5.9. Internship: Internships help students to acquire in depth knowledge about a particular topic related to the program of study. Such extensive work is expected to create a platform for a job or further research in the chosen area. Interested students may opt for a full semester Internship during the fourth year second semester. Such students shall be exempted for equivalent theory course credits during that semester and the corresponding credits are awarded through the Internship. A self-study report, duly authorized by the industry supervisor / guide, shall be submitted at the end of the fourth

year second semester. Internship report is evaluated for 400 marks in total. Internal assessment is done by the academic supervisor/guide for 100 marks based on the work and presentation of the internship report. The assessment for 300 marks is evaluated and awarded by a panel of members consisting of Head of the Department, Senior Faculty and Industry Expert.

5.10. Main Project: Out of total 200 marks for the project work, 80 marks shall be for Internal Evaluation and 120 marks for the external assessment. The Internal Evaluation shall be on the basis of two mid-term project reviews conducted during the progress of the project. The End Semester Examination (Viva-Voce) shall be conducted by the committee consists of an External Examiner, Head of the Department (internal examiner) and a senior faculty of the Department. The evaluation of project work shall be conducted at the end of the IV year.

5.11. Audit courses: All audit courses will be "Pass/Fail" type with no credit points allotted. The result of the student in the audit course will be notified in the marks memo. A student must pass all the audit courses registered to be eligible for the award of B. Tech. degree.

List of audit courses will be notified from time to time. An indicative list of courses is as shown below.

a) Professional Ethics & Human Values b) Any Foreign Language c) Journalism d) Finance e) Legal Sciences f) Social Sciences g) English for Special Purposes h) Fine Arts i) Clinical Psychology j) Intellectual Property Rights & Patents etc.

6. Attendance Requirements:

6.1. It is desirable for a candidate to have 100% attendance in the class in all the courses. However, a candidate shall be permitted to appear for the end semester examination if he/she has a minimum of 75% aggregate attendance in the semester. Student will not be permitted to write Mid examination if the attendance percentage is less than 75 % during the stipulated instruction duration. However, Academic Monitoring Committee shall review the situation and take appropriate decision.
Note: Special cases for students having extraordinary performance at National and International level will be considered by the Academic monitoring committee.

6.2. Condonation of shortage of attendance may be considered on Medical grounds maximum up to 10%, if the student provides the medical certificate to the HOD immediately after he / she recovers from the illness. Medical Certificate submitted afterwards shall not be permitted. Shortage of attendance equal to or above 65% and below 75%will be condoned on payment of fee as fixed by the competent authority and the student concerned will be permitted to take the end semester examination. ***This privilege is given only three times for regular student and only two times for lateral entry student during the entire program of study***.

6.3. Shortage of attendance may be considered for the students who participate in prestigious sports, co and extra-curricular activities if their attendance is in the minimum prescribed limit.

6.4. A student will be promoted to the next semester if satisfies attendance and credits requirement.

7. Academic Requirements:

The following academic requirements have to be satisfied in addition to the attendance requirements.

For any course, student is considered to be passed upon securing minimum 35% marks in the external examination alone and minimum 50% marks from both internal and external examination put together

8. Promotion Policy:

To promote to III year, a student has to secure minimum 50% of total credits from I & II-year courses
To promote to IV year, a student has to secure minimum 50% of total credits from I, II & III-year courses
In case of Lateral entry students, to promote to IV year, a student has to secure minimum 50% of total credits from II & III-year courses

9. Supplementary examinations: Supplementary examinations for the odd Semester shall be conducted with the regular examinations of even semester and vice versa. In case a student fails in online courses/ industrial lecture(s), he/she may be permitted to register for another course/lecture(s).

10. Examinations and Evaluation

10.1. General guidelines

i. All the semester end examinations are conducted for duration of three hours
ii. External examination shall be conducted for 60 marks consist of five questions of internal choice carrying 12 marks each.
iii. For laboratory examinations, the evaluation is done by internal examiner and one external examiner.

10.2. Revaluation

There is a provision for revaluation of theory courses if student fulfils the following norms.

The request for revaluation must be made in the prescribed format duly recommended by the Chief Superintendent of Examinations through Additional Controller along with the prescribed revaluation fee.

11. Grading System:

CGPA

Marks Range (in %)	Letter Grade	Level	Grade Point
≥ 90	O	Outstanding	10
≥80 to <90	A	Excellent	9
≥70 to <80	B	Very Good	8
≥60 to <70	C	Good	7
≥50 to <60	D	Satisfactory	6
<50	F	Fail	0
		Absent	-1
		Withheld	-2
		Malpractice	-3

Computation of SGPA

The following procedure is to be adopted to compute the Semester Grade Point Average. (SGPA) and Cumulative Grade Point Average (CGPA):

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

SGPA (Si) = Σ(Ci x Gi) / ΣCi

Where Ci is the number of credits of the i^{th} course and Gi is the grade point scored by the student in the i^{th}course.

Computation of CGPA

- The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

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

Where Si is the SGPA of the i^{th} semester and Ci is the total number of credits in that semester.

- Equivalent Percentage = (CGPA – 0.75) X 10

12. Award of Class

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

Class Awarded	CGPA to be secured	
First Class with Distinction	≥ 7.75 without course failures during entire duration of study	**CGPA secured from 189 Credits.**
First Class	≥ 6.75 to <7.75	
Second Class	≥ 5.75 to < 6.75	

13. General Instructions

i. Where the words 'he', 'him', 'his', occur, they imply 'she', 'her', 'hers', also.

ii. The academic regulations should be read as a whole for the purpose of any interpretation.

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

iv. The college may change or amend the academic regulations or syllabi from time to time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the Institution.

14. Transitory Regulations

i. The student has to continue the course work along with the regular students of the respective semester in which the student gets re-admission.

ii. The student has to register for Substitute / Compulsory courses offered in place of courses studied earlier.

iii. The mode of internal evaluation and end-semester examinations shall be on par with the regular students, i.e., the student has to follow the mode of internal evaluation and the then question paper model for the end-semester examinations along with the regular students of the respective semester in which the student gets re-admission. The marks secured in the internal and end-semester examinations will be pro-rated in accordance with the regulations under which the student was first admitted.

iv. For the courses studied under earlier regulations but failed, the student has to appear, pass and acquire credits from the supplementary examinations as and when conducted. The question paper model shall remain same as the one in which the student took examination during previous regulations.

v. The promotion criteria based on attendance as well as credits shall be in accordance with the regulations under which the student was first admitted.

vi. All other academic requirements shall be in accordance with the regulations under which the student was first admitted.

vii. The decision of the Principal is final on any other clarification in this regard.

viii. Transcripts: After successful completion of the entire program of study, a transcript containing performance of all academic years will be issued as a final record. Partial transcript will also be issued up to any point of study to a student on request, after payment of requisite fee.

15. Minimum Instruction Days

The minimum instruction days for each semester shall be 16 weeks

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

16. Withholding of Results

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

Note: All other regulations including attendance requirements related to four year B. Tech Regular program will be applicable for B.Tech. Lateral Entry Scheme.

17. Malpractices Rules

DISCIPLINARY ACTION FOR MALPRACTICES / IMPROPER CONDUCT IN EXAMINATIONS

S.No	Nature of Malpractices/ Improper conduct	Punishment
1 (a)	If the candidate possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the course 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 course of the examination)	Expulsion from the examination hall and cancellation of the performance in that course only.
(b)	If the candidate 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 course 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	If the candidate has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the	Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and

	course of the examination (theory or practical) in which the candidate is appearing.	project work and shall not be permitted to appear for the remaining examinations of the courses of that Semester/year. The Hall Ticket of the candidate is to be cancelled.
3	If the candidate impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate, who has been impersonated, shall be cancelled in all the courses of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining courses of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4	If the candidate smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that course and all the other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5	If the candidate uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that course.
6	If the candidate 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	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that course and all other courses the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the courses of that semester/year. The candidates also are debarred and forfeit their seats. In case of

	to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	outsiders, they will be handed over to the police and a police case is registered against them.
7	If the candidate leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that course and all the other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8	If the candidate possesses any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred and forfeits the seat.
9	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the college, expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and. a police case will be registered against them.
10	If the candidate comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that course

		and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year.
11	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that course and all other courses the candidate has appeared including practical examinations and project work of that semester/year examinations.
12	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the Academic committee of the Institute for further action to award suitable punishment.	

18. UGC RECOMMENDED PUNISHMENT FOR RAGGING

i. Suspension from attending classes and academic privileges
ii. Withholding/withdrawing scholarships/fellowship and other benefits.
iii. Debarring from appearing in any test/examination or other evaluation process
iv. Withholding results
v. Debarring from representing the institution in any regional, national or international meet, tournament, youth festival etc.
vi. Suspension/expulsion from the hostel
vii. Cancellation of admission
viii. Rustication from the institution for period ranging from 1 to 4 semesters.
ix. Expulsion from the institution and consequent debarring from admission to any other institution for a specified period.
x. Fine may extend up to Rs. 2.5 lakh.

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DEPARTMENT OF MECHANICAL ENGINEERING
PROGRAM STRUCTURE (VR 17)

I Year- I Semester

S. No	Course Code	Course Title	L	T	P	Credits
1.	1000171101	English- I	3	1	0	3
2.	1000171102	Engineering Mathematics-I	3	1	0	3
3.	1000171104	Engineering Chemistry	3	1	0	3
4.	1000171105	Computer Programming using C	3	1	0	3
5	1000171112	Environmental Studies	3	1	0	3
6	1000171116	Engineering Mechanics	3	1	0	3
7	1000171121	English - Communication Skills Laboratory-I	0	0	3	2
8	1000171127	Engineering Chemistry Laboratory	0	0	3	2
9	1000171128	Computer Programming Laboratory	0	0	3	2
Total Credits						**24**

I Year – II Semester

S. No	Course Code	Course Title	L	T	P	Credits
1.	1003171201	English-II	3	1	0	3
2.	1003171202	Engineering Mathematics-II	3	1	0	3
3.	1003171203	Engineering Mathematics-III	3	1	0	3
4.	1003171204	Engineering Physics	3	1	0	3
5.	1003171205	Basic Electrical and Electronics Engineering	3	1	0	3
6.	1003171206	Engineering Drawing	3	1	0	3
7.	1003171221	English Communication Skills Lab-2	0	0	3	2
8.	1003171222	Engineering Physics Laboratory	0	0	3	2
9.	1003171224	Engineering Workshop	0	0	3	2
Total Credits						**24**

II B.Tech - I Semester

S.No	Course Code	Course Title	L	T	P	Credits
1	1003172101	Metallurgy & Materials Science	3	1	0	3
2	1003172102	Mechanics of Solids	3	1	0	3
3	1003172103	Thermodynamics	3	1	0	3
4	1003172104	Fluid Mechanics & Hydraulic Machines	3	1	0	3
5	1003172105	Computer Aided Machine Drawing	3	1	0	3
6	1099172106	Managerial Economics & Financial Analysis	3	1	0	3
7	1003172121	Fluid Mechanics & Hydraulic Machinery Lab	0	0	3	2
8	1003172122	Mechanics of Solids & Metallurgy Lab	0	0	3	2
Total Credits:						**22**

II B.Tech - II Semester

S.No	Course Code	Course Title	L	T	P	Credits
1	1003172201	Kinematics of Machinery	3	1	0	3
2	1003172202	Thermal Engineering - I	3	1	0	3
3	1003172203	Manufacturing Technology - I	3	1	0	3
4	1003172204	Design of Machine Members - I	3	1	0	3
5	1003172205	Instrumentation & Control Systems	3	1	0	3
6	1003172206	Industrial Engineering and Management	3	1	0	3
7	1003172221	Production Technology Lab	0	0	3	2
8	1003172222	Electrical & Electronics Engineering Lab	0	0	3	2
9	1003172231	Industrial Visit	0	0	0	2
Total Credits:						**24**

III B.Tech I Semester

S.No.	Course Code	Course Title	L	T	P	Credits
1	1003173101	Dynamics of Machinery	3	1	0	3
2	1003173102	Manufacturing technology -II	3	1	0	3
3	1003173103	Design of Machine Members – II	3	1	0	3
4	1003173104	Thermal Engineering – II	3	1	0	3
5	1003173105	Metrology	3	1	0	3
6	1003173121	Kinematics & Dynamics Lab	0	0	3	2
7	1003173122	Thermal Engineering Lab	0	0	3	2
8	1003173123	Instrumentation and Metrology Lab	0	0	3	2
9	1099173101	IPR & Patents	1	0	0	0
Total Credits:						**21**

III B.Tech - II Semester

S. No	Course Code	Course Title	L	T	P	Credits
1	1003173201	Finite Element Methods	3	1*	0	3
2	1003173202	Heat Transfer	3	1*	0	3
3	1003173203	Robotics	3	1*	0	3
4	1003173204	Operations Research	3	1*	0	3
5	**Open Elective-I**		3	1*	0	3
	1005173206	Introduction to Data Base Management Systems				
	1005173207	Introduction to Python Programming				
	1001173207	Waste Water Management				
	1099173201	Entrepreneurship Development				
6	**Open Elective-II (CBCS) (MOOCS)**		3	1*	0	3
	1003173291	• Artificial Intelligence search methods for Problem solving				
		• Electrical Measurements & Electronic Instruments				
		• Sustainable Materials and Green Building				
		• Control systems				
		*Any available online course approved by department committee at the time of				

		semester commencement.				
7	1099172103	Professional Ethics & Human Values	2	0	0	0
8	1003173221	Machine Tools and Metal Cutting Lab	0	0	3	2
9	1003173222	Heat Transfer Lab	0	0	3	2
10	1003173223	CAE Lab (FEA+CFD)	0	0	3	2
Total Credits:						**24**

S. No	Course Code	Course Title	L	T	P	Credits
1	1003173241	Industry Oriented Mini Project	0	0	0	2

IV B.Tech – I-Semester

S. No	Course Code	Course Title	L	T	P	Credits
1	1003174101	CAD/CAM	3	1	0	3
2	1003174102	Automobile Engineering	3	1	0	3
3	1003174103	Power Plant Engineering	3	1	0	3
4	**Elective-I**					
	1003174104	Fundamentals of Acoustics & Vibration	3	1	0	3
	1003174105	Optimization and Reliability				
	1003174106	Refrigeration & Air Conditioning				
	1003174107	Gas Dynamics & Jet Propulsion				
	1003174108	CNC Machine Tools				
	1003174109	Quality and Reliability Engineering				
5	**Elective-II**					
	1003174110	Composite Materials	3	0	0	3
	1003174111	Condition Monitoring				
	1003174112	Computational Fluid Dynamics				
	1003174113	Green Engineering Systems				
	1003174114	Computer Graphics				
	1003174115	Additive Manufacturing				
6	1003174121	CAD/CAM Lab	0	0	3	2
7	**Industry Oriented Laboratory**					
	1003174122	Vibration and Acoustics Lab	0	0	3	2
	1003174123	Simulation Lab(Mat-Lab Tools)				
	1003174124	Mechatronics Lab				
8	1003174131	Mechanical Synthesis Project	0	0	3	3
Total Credits:						**22**

IV B.Tech – II-Semester

S. No	Course Code	Course Title	L	T	P	Credits
1	1003174201	Production Planning and Control	3	1	0	3
2	**Elective –III**					
	1003174202	Advanced Materials	3	1	0	3
	1003174203	Nano-Technology				
	1003174204	Thermal Equipment Design				
	1003174205	Industrial fire and Safety				
	1003174206	Mechatronics				
	1003174207	Design for Manufacture				
3	1003174208	Un Conventional Machining Processes	3	1	0	3
4	1003174209	Non-Destructive Evaluation	3	1	0	3
(OR)						
	1003174281	Internship	0	0	0	12
5	1003174251	Technical Seminar	0	3	0	2
6	1003174261	Comprehensive Viva	0	0	0	2
7	1003174231	Main Project	0	0	0	10
Total Credits:						**26**

GRAND TOTAL CREDITS = 24+24+22+24+21+26+22+26 = 189

PROGRAM STRUCTURE

For

I-B.Tech

I & II SEMESTERS

DEPARTMENT OF MECHANICAL ENGINEERING
PROGRAM STRUCTURE

I Year- I Semester

S. No	Course Code	Course Title	L	T	P	Credits
1.	1000171101	English- I	3	1	0	3
2.	1000171102	Engineering Mathematics-I	3	1	0	3
3.	1000171104	Engineering Chemistry	3	1	0	3
4.	1000171105	Computer Programming using C	3	1	0	3
5	1000171112	Environmental Studies	3	1	0	3
6	1000171116	Engineering Mechanics	3	1	0	3
7	1000171121	English - Communication Skills Laboratory-I	0	0	3	2
8	1000171127	Engineering Chemistry Laboratory	0	0	3	2
9	1000171128	Computer Programming Laboratory	0	0	3	2
Total Credits						**24**

I Year – II Semester

S. No	Course Code	Course Title	L	T	P	Credits
1.	1003171201	English- II	3	1	0	3
2.	1003171202	Engineering Mathematics-II	3	1	0	3
3.	1003171203	Engineering Mathematics-III	3	1	0	3
4.	1003171204	Engineering Physics	3	1	0	3
5.	1003171205	Basic Electrical and Electronics Engineering	3	1	0	3
6.	1003171206	Engineering Drawing	3	1	0	3
7.	1003171221	English Communication Skills Lab-2	0	0	3	2
8.	1003171222	Engineering Physics Laboratory	0	0	3	2
9.	1003171224	Engineering Workshop	0	0	3	2
Total Credits						**24**

DETAILED SYLLABUS

For

I-B.Tech

I SEMESTERS

Course Code		L	T	P	Credits
1000171101	**ENGLISH – I**	3	1	0	3

Course Objectives

- To improve the language proficiency of the students in English with emphasis on LSRW skills.
- To enable the students to study and comprehend the prescribed lessons and subjects more effectively related to their theoretical and practical components.
- To develop the communication skills of the students in both formal and informal situations.
- Practice critical thinking to develop innovative and well-founded perspectives related to the students' emphases. Build and maintain healthy and effective relationships.
- To convey a credible message and create concise messages using a structured writing process.
- To develop effective interpersonal communication skills.

Course Outcomes

After completing this Course, the student should be able to:

- Use English language, both written and spoken, competently and correctly.
- Improve comprehension and fluency of speech.
- Gain confidence in using English in verbal situations.
- Display competence in oral, written, and visual communication.
- Communicate ethically.
- Demonstrate positive group communication exchanges.

	Course outcome	**Cognitive Level as per Bloom's Taxonomy**	**PO**
CO1	Enhance English Language by relating the ideas of eminent personalities.	Understanding	PO6,PO9, PO10, PO12
CO2	Articulate the technological advancements fluently.	Applying	PO10, PO12
CO3	Inculcate the art of thinking and writing clearly and logically.	Applying	PO10, PO12
CO4	Enact various themes through team work and learn the usage of vocabulary through humourous texts.	Analyzing	PO10, PO12

Detailed Text: English Essentials

1. **In London**-M. K.Gandhi
2. **The Knowledge Society** - A. P. J. Abdul Kalam
3. **Principles of Good Writing -** L. A.Hill
4. **Man's Peril –**Bertrand Russell
5. **Luck –**Mark Twain

Non-Detailed Text: Panorama

1. **War** – Luigi Pirandello
2. **The Verger** – Somerset Maugham

PRESCRIBED TEXTBOOKS:

1. **English Essentials** by Ravindra Publishing House
2. **Panorama** by Oxford University Press

SUGGESTED TEXT BOOKS:

1. **You Can Win** by Shiv Khera
2. **English for Engineers and Technologists** by Orient Black Swan
3. **Objective English** by R. S. Agarwal, S.Chand.co

REFERENCE BOOKS:

1. "Practical English Usage" by Michael Swan, 3rd Edition, OUP.
2. "Intermediate English Grammar" by Raymond Murphy, CUP.
3. "Study: Reading" by Eric H .Glendinning, 2ndEditionCUP.
4. "Business Correspondence and Report writing" by R.CSharma,TataMc Grawhill

Course Code		L	T	P	Credits
1000171102	**ENGINEERING MATHEMATICS-I**	3	1	0	3

Course Overview:

This course deals with differential equations and its application with more focus on advanced Engineering Mathematics. This course helps the students to learn relevant mathematical tools which are required in the analysis of problems in engineering and scientific professions. Topics included in this course are differential equations of first order and their applications, higher order linear differential equations and their applications, functions of single variable and their applications and multiple integrals, Laplace transforms and their applications. The mathematical skills derived from this course form a necessary base for analytical and design concepts encountered in the program.

Course Objectives:

1. To explain mathematical modeling with the knowledge of differential equations.
2. To discuss higher order differential equations and its applications to solve engineering problems.
3. To evaluate maxima and minima of function of several variables.

Course Outcomes:

1. Solve basic engineering problems described by first order differential equations.
2. Determine solutions to higher order linear homogeneous and non-homogeneous differential equations with constant coefficients.
3. Apply the techniques of multivariable differential calculus to determine extreme and series expansions etc. of functions of several variables.
4. Extend the concept of integration to two and three dimensions and support it through applications in engineering mechanics.
5. Appraise the Laplace transform technique and use it to solve various engineering problems.

	Course outcome	**Cognitive Level as per Bloom's Taxonomy**	**PO**
CO1	Solve linear differential equations of first and higher order.	Understanding	PO1,PO2, PO3, PO12
CO2	Determine extrema and series expansions of functions of several variables.	Applying	PO1, PO2,PO4, PO12
CO3	Determine double integral, triple integral to find area and volume.	Applying	PO1, PO2, PO3, PO12

CO4	Appraise Laplace transform to solve various engineering problems.	Analyzing	PO1, PO2, PO12

UNIT-I: MEAN VALUE THEOREMS:

Mean Value Theorems - Rolle's Theorem - Lagrange's mean value theorem – Cauchy's mean value theorem (without proofs)

ORDINARY DIFFERENTIAL EQUATIONS:

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

Applications: Orthogonal trajectories, Simple Electric Circuits

UNIT-II: LINEAR DIFFERENTIAL EQUATIONS OF HIGHER ORDER:

Linear differential equations of second and higher order with constant coefficient Non-homogeneous term of the type o$Q(x=eax$, sinax, cosax,xn,$eaxV(x)$,$xnV(x)$-Method variation of parameters.

Applications: LCR Circuit

UNIT-III: FUNCTIONS OF SEVERAL VARIABLES:

Functions of several variables – Partial Differentiation –Euler's Theorem-Total Derivative – Change of variables - Jacobian -Functional dependence – Taylors theorem for functions of two variables.

Applications: Maxima and Minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT-IV: MULTIPLE INTEGRALS:

Introduction: Review of Coordinate Systems (Cartesian, Polar, Parametric, Spherical, Cylindrical) -multiple integrals - double and triple integrals – change of variables – Change of order of Integration.

Applications: Areas and Volumes of Simple curves (Cartesian)

UNIT-V: LAPLACE TRANSFORMS:

Introduction - Laplace transforms of standard functions – Shifting Theorems - Transforms of derivatives and integrals - multiplication by t^n - division by t – Unit step function –Dirac delta function. Laplace transform of Periodic functions.

Introduction - Inverse Laplace transforms–Properties- Convolution theorem (without proof).

Applications: Solution of ordinary differential equation with constant coefficients (Initial Value Problems) using Laplace transforms.

TEXT BOOKS:

1. Higher Engineering Mathematics – 43rd Edition by Dr. B. S. Grewal, Khanna Publishers, New Delhi.

REFERENCE BOOKS:

1. Advanced Engineering Mathematics, Erwin Kreszig, 8thEd, Wiley Student Edition.
2. Engineering Mathematics, Greenburg, 2nd Ed, Pearson education.
3. A Text book of Engineering Mathematics, N.P.Bali, Laxmi Publications (P) Ltd.
4. Advanced Engineering Mathematics, B. V. Ramana, TataMc Graw Hill Publishing Co. Ltd.
5. Engineering Mathematics, P.Sivaramakrishna Das, C.Vijayakumari , 2017Pearson Education Services Pvt. Ltd

Course Code		L	T	P	Credits
1000171104	**ENGINEERING CHEMISTRY**	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.

Objectives:

- Plastics are nowadays used in household appliances; also they are used as composites (FRP) in aerospace and automotive industries.
- Fuels as a source of energy are a basic need of any industry, particularly industries like thermal power stations, steel industry, fertilizer industry etc., and hence they are introduced.
- To know the mechanism of Corrosion for its control and prevention.
- Water is a basic material in almost all the industries, more so where steam is generated and also where it is supplied for drinking purposes.
- With the increase in demand, a wide variety of materials are coming up; some of them have excellent engineering properties and a few of these materials are introduced.

Outcomes:

The student

- Gains basic knowledge of polymer materials and their engineering applications.
- Understands fuels which are used commonly and their advantages and limitations.
- Extends the principles involved in corrosion to predict and prevent the corrosion in real life system
- Able to analyze the water quality and understand various methods of treatment of water.
- Recalls the principles, working and design of energy storage devices and acquires knowledge of advanced materials and their applications.

	Course outcome	**Cognitive Level as per Bloom's Taxonomy**	**PO**
CO1	Categorize various types of polymeric materials, fuels, lubricants, refractories and establish their applications.	Understanding	PO1,PO2, PO6, PO8, PO12
CO2	analyze hardness of water and describe various softening methods	Applying	PO1, PO2, PO7, PO12
CO3	Illustrate the principles of green chemistry, corrosion and its prevention and demonstrate the construction and working of batteries	Applying	PO1, PO2, PO7, PO12

CO4	Emphasize on various engineering materials like nano materials, solar cells and their applications.	Analyzing	PO1, PO4

UNIT I: POLYMER TECHNOLOGY:

Polymerization: Introduction - Types of polymerization (Addition, Condensation & Co-polymerizastion) – Physical and mechanical properties – advantages and limitations – **Plastics**: Thermoplastics and Thermosetting plastics – Compounding, Mouldingtechniques(Compression,Injection&Blowfilmmoulding)-Preparation,properties and applications of polyethene, PVC, Bakelite and Teflon. **Elastomers** – Natural rubber- compounding and vulcanization – Synthetic rubbers - Buna S, Buna N and Thiokol – Applications. Composite materials & Fiber reinforced plastics (CFRP & GFRP) – Biodegradable polymers – Conducting polymers.

UNIT II: FUEL TECHNOLOGY

Introduction – Classification – Calorific value - Bomb calorimeter – Numerical problems – Coal — Proximate and ultimate analysis and its Significance – Liquid fuels – Petroleum - Refining – Cracking – knocking - Octane and Cetane numbers - Natural gas - LPG and CNG – Combustion – Flue gas analysis – Orsat apparatus – Numerical problems on combustion. Energy scenario in India – working of thermal power plant – Advantages and disadvantages – Renewable energy – Solar energy – Harnessing of solar energy – solar heaters – photo voltaic cells – Bio energy – Bio diesel.

UNIT III: ELECTROCHEMICAL CELLS & CORROSION

Galvanic cells - Reversible and irreversible cells, Electrode potential – Standard electrodes (Hydrogen and Calomel electrodes). Electro chemical series and its applications,

Batteries-: Dry Cell, lead acid battery and Ni-Cd battery - H_2-O_2 fuel cell & H_3PO_4 fuel cells.

Corrosion: Introduction – Theories of Corrosion (dry and wet) – Types of corrosion – galvanic, pitting, stress, differential aeration and waterline corrosion – Factors influencing corrosion – controlling methods – Design and material selection

– Cathodic protection - inhibitors - Protective coatings – Metallic coatings (cathodic and anodic) - Methods of application on metals (Galvanizing, Tinning & Electroplating).

UNIT IV: WATER TECHNOLOGY

Hardness of water: Reasons, units - determination of hardness by EDTA method, Problems on hardness - Boiler troubles – Scale & sludge formation, Boiler corrosion, Caustic embrittlement - Priming and Foaming – Internal treatment methods - Softening of Hard water – Lime - Soda process, Zeolite process and numerical problems based on these processes and Ion Exchange process – Municipal water treatment - Break point chlorination - desalination of brackish water Reverse osmosis and Electro dialysis methods.

UNIT V: CHEMISTRY OF ADVANCED ENGINEERING MATERIALS

Nano materials: Introduction – Preparation, Properties and engineering applications of Carbon nano tubes and fullerenes. **Green Chemistry:** Principles, any three methods of synthesis –

engineering applications. **Refractories:** Definition, classification, properties (Refractoriness, R.U.L, Porosity, Dimensional stability & Thermal spalling) failure of refractories. **Lubricants:** Introduction, functions, mechanism of lubrication and properties (cloud & pour point, volatility, carbon residue & Aniline point). **cement:** Constituents, manufacturing of Portland cement, setting and hardening, decay of cement.

Prescribed books:

1. Engineering Chemistry (16^{th}edn.) by Jain and Jain; Dhanpat Rai Publication Co.
2. A text book of Engineering Chemistry by S. S. Dara; S. Chand &CoLtd., Latest Edition

Reference Books:

1. Chemistry for Engineers by TehFu Yen, Imperial college press,London.
2. Engineering Chemistry of Wiley India Pvt. Ltd., Vairam and others, 2014, 2^{nd} edition
3. Engineering Chemistry by Shikha Agarwal; Cambridge University Press, 2015edition.
4. Applied Chemistry by H.D. Gesser, Springer Publishers
5. Text book of Nano-science and nanotechnology by B.S. Murthy, P. Shankar and others, University Press, IIM

Course Code	COMPUTER	L	T	P	Credits
1000171105	PROGRAMMING USING C	3	1	0	3

Course Objectives:

- Understanding the basics of the computers and background.
- Drawing flowcharts and Formulating algorithmic solutions to problems and implementing in C language.
- Understanding branching, iteration and data representation using arrays.
- Modular programming and recursive solution formulation.
  Understanding pointers and dynamic memory allocation.

Course Prerequisites:

Students should have knowledge of

- Basics of Computer Components.
- Distinction between software and hardware.

Course Outcomes:

Students will be able to:

- Understand the fundamentals of computers, solving the problems using flow charts, algorithms and pseudo code.
- Write, compile and execute simple programs in C language.
- Use different data types and operators in C language.
- Design programs involving decision structures, loops, functions and passing parameters to functions.
- Develop programs using arrays, structures and pointers.
- Understand the dynamic memory allocation functions using pointers.
- Understand the basics of file operations, reading, writing and updating the files.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Write compile and debug Programs in C language	Understand	PO1,PO2, PO3
CO2	Use operators, data types and write programs	Understand	PO1,PO2
CO3	Select the best loop construct for a given problem	Analyzing	PO3,PO5

CO4	Design and implement C programs	Analyzing	PO1,PO2 PO3,PO4, PO12

UNIT-I

Computer Basics – What is a computer, History of computers, Characteristics of computers, Classification of computers, Applications of computers, Components and functions of a Computer System: hardware and software concept, input/output devices, memory concept and secondary memories, Number System, Computer languages, Flow Charts, algorithms and pseudo code.

Introduction to C programming- Background and characteristics of C, Structure of a C Program, Input/ Output Statements in C, writing C programs, compiling and executing C programs.

UNIT-II

Programming Style – Tokens of C, Keywords, Variables, Constants and rules to form variables and constants, Data Types, Declaration of Variables and initialization, Operators, Expression Types, Operator Precedence and Associativity. Implicit Type Conversions, Explicit Type Conversions (Casts), Assignment Variations, Mathematical Library Functions, Interactive Input, Formatted Output, Format Modifiers.

Flow of Control:

Selection: if and if-else Statements, if-else if statement and switch case, nested if, examples.

Repetition and Unconditional Control Statements: Pretest and Posttest Loops, Counter-Controlled and Condition-Controlled Loops, while Statement, do while statement, for Statement, Nested Loops. Break, continue and go to statements.

UNIT-III

Modular Programming:

Function and Parameter Declarations: Function definition, types of functions, declaration and definition of user defined functions, its prototypes and parameters, calling a function. Function stubs and Functions with and without Parameters. Variable Scope, Variable Storage Class, Local Variable Storage Classes, Global Variable Storage Classes.

Parameter passing Techniques: Pass by Value, recursive functions.

UNIT-IV

Arrays and Strings

Arrays: One-Dimensional Arrays, Declaration, Array Initialization, Input and Output of Array Values, Arrays as Function Arguments, Two-Dimensional Arrays, linear search, and bubble

sort.

Strings: String Fundamentals, String Input and Output, String manipulation functions, String Processing, String manipulation operations without Library Functions.

UNIT-V

Pointers, Structures and Unions, Data Files

Pointers: Concept of a Pointer, Initialization of pointer variables, pointers as function arguments, Dangling memory, address arithmetic, character pointers and functions, pointers to pointers, Pointers and arrays, Pointers and strings, Array of Pointers, Dynamic memory management functions, parameter passing by address, command line arguments.

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

Data Files: Declaring, Opening, and Closing File Streams, Reading from and Writing to Text Files, Random File Access.

Text Books:

- ANSI C Programming, Gary J. Bronson, C engage Learning.
- Programming in C, Reema Thareja, Oxford.
- Programming in C, BlJuneja Anita Seth, and C engage Learning.

Reference Books:

- C Programming-A Problem Solving Approach, Forouzan, Gilberg, Cengage.
- Programming with C, Bichkar, and Universities Press.
- The C Programming Language, Dennis Richie and Brian Kernighan, Pearson Education.
- C by Example, Noel Kalicharan, Cambridge.

Course Code	ENVIRONMENTAL STUDIES	L	T	P	Credits
1000171112		3	1	0	3

Course Overview:

The course gives a broad view on the importance of environment and its conservation. It deals with distribution of biotic and a biotic components on the Earth, their over exploitation and its associated problems. It provides knowledge on different types of environmental pollutions and their control aspects. It develops practical orientation towards environmental concerns.

Course Objectives: The objectives of the course are:

- Classify, describe and explains the concept of Ecosystems and Environmental Engineering.
- Overall understanding of different types of natural resources and its conservation.
- Acquaintance on various environmental challenges induced due to unplanned anthropogenic activities.
- An understanding of the environmental impacts of developmental activities and the importance of Environmental Management
- Awareness on the social issues, environmental legislations and global treaties

Course Outcomes

- Give an outline of the natural resources and their importance for the sustenance of life and recognize the need to conserve the natural resources.
- Explain the concepts of the ecosystem and its function in the environment; explains the need for protecting the producers and consumers in various ecosystems and their role in the food web
- Elucidate the biodiversity of India and threats to biodiversity and conservation practices to protect the biodiversity
- Give a broad view on various attributes of pollution and their impacts and measures to reduce or control the pollution along with waste management practices.

	Course outcome	**Cognitive Level as per Bloom's Taxonomy**	**PO**
CO1	Elucidate the natural resource & their importance for the sustenance of life and recognises the need to conserve natural resource	Understanding	PO2,PO5, PO6, PO7, PO12
CO2	Gives the broad view on the various attributes of pollution & and their impact & measure to reduce he pollution along	Applying	PO2,PO3, PO5, PO6, PO7, PO12

	with waste management		
CO3	Debates on social issues both rural and urban environment possible means to combat the challenges and trace the legislation of India towards sustainability	Applying	PO1, PO2,PO5, PO6, PO7, PO12
CO4	Educates about Environmental Impact Assessment, Environmental Impact Statement & Environmental Audit	Analyzing	PO1, PO2, PO4, PO5, PO6, PO7, PO12

UNIT – I

Multidisciplinary nature of Environmental Studies & Natural Resource

Definition, Scope and Importance of Environmental Engineering – Sustainability: Stockholm and Rio Summit–Global

Forest resources– Use and over– exploitation, deforestation – 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, conflict over water, dams– benefits and problems

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources

Food resources: World food problems, changes caused by non-agriculture activities- effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity

Energy resources: Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources.

Land resources: Land as a resource, land degradation, Wasteland reclamation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles

UNIT - II

Environmental Pollution

Definition, Cause, effects and control measures of Air pollution,

Water pollution, Soil pollution, Noise pollution, Nuclear hazards. Role of an individual in prevention of pollution. - Pollution case studies.

Environmental Challenges: Global warming and climate change, acid rains, ozone layer depletion, population growth and explosion, effects. Role of information Technology in Environment and human health.

Solid Waste Management: Sources, classification, effects and control measures of urban and industrial solid wastes. Consumerism and waste products.

UNIT – III

Social Issues and the Environment

Urban problems related to energy -Water conservation, rain water harvesting- Resettlement and rehabilitation of people; its problems and concerns.

Environmental ethics: Issues and possible solutions. Environmental Protection Act – Air(Prevention and Control of Pollution) Act. –Water (Prevention and control of Pollution) Act -Wildlife Protection Act -Forest Conservation Act-Issues involved in enforcement of environmental legislation -Public awareness.

UNIT - IV

Ecosystems, Biodiversity & 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 Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems.

Biodiversity and its conservation

Definition: Levels of Biodiversity, Value of biodiversity: consumptive use, productive use, social- Biodiversity at national and local levels. India as a mega- diversity nation - Hot-spots of biodiversity -Threats to biodiversity: habitat loss, man-wildlife conflicts. -Endangered and endemic species of India – Conservation of biodiversity.

UNIT - V

Environmental Management and Field Studies

Impact Assessment and its significance various stages of EIA, Preparation of EMP and EIS, Environmental audit. Eco-tourism, Environmental Economics & Study of a Ecotourism spot in a local area, Visit to some Polluted site. Environmental diary.

Text Books:

1. Environmental Studies by R. Rajagopalan, 2nd Edition, 2011, Oxford University Press.

2. A Textbook of Environmental Studies by Shaashi Chawla, TMH, New Delhi

3. Environmental Studies by P.N. Palanisamy, P. Manikandan, A. Geetha, and K. Manjula Rani; Pearson Education,Chennai.

References:

1. Text Book of Environmental Studies by Deeshita Dave & P. Udaya Bhaskar, Cengage Learning.

2. Environmental Studies by K.V.S.G. Murali Krishna, VGS Publishers, Vijayawada.

3. Environmental Studies by Benny Joseph, Tata McGraw Hill Co, NewDelhi

4. Environmental Studies by PiyushMalaviya, Pratibha Singh, Anoopsingh: Acme Learning, NewDelhi.

Course Code		L	T	P	Credits
1000171116	**ENGINEERING MECHANICS**	3	1	0	3

Objectives: The students completing this course are expected to understand the concepts of forces and its resolution in different planes, resultant of force system, Forces acting on a body, their free body diagrams using graphical methods. They are required to understand the concepts of centre of gravity and moments of inertia and their application, Analysis of frames and trusses, different types of motion, friction and application of work – energy method.

- The students are to be exposed to the concepts of force and friction, direction and its application.
- The students are to be exposed to application of free body diagrams. Solution to problems using graphical methods and law of triangle of forces.
- The students are to be exposed to concepts of centre of gravity
- The students are to be exposed to concepts of moment of inertia and polar moment of inertia including transfer methods and their applications.
- The students are to be exposed to motion in straight line and in curvilinear paths, its velocity and acceleration computation and methods of representing plane motion.
- The students are to be exposed to concepts of work, energy and particle motion.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO number mapped
CO1	Analyze the force systems for equilibrium conditions and able to draw free body diagram.	Analyzing	PO1,PO2,PO3
CO2	Evaluate the frictional forces between contact surfaces.	Applying	PO1,PO2,PO3
CO3	Able to differentiate between centroid and centre of gravity and determine Centroid, centre of gravity and second moment of area for composite sections.	Applying	PO1,PO2,PO3
CO4	Analyze the motion and calculate trajectory characteristics.	Analyzing	PO1,PO2,PO3

UNIT – I: Introduction to Engineering Mechanics – Basic Concepts.
Systems of Forces: Coplanar Concurrent Forces – Components in Space –Resultant

– Moment of Force and its Application – Couples and Resultant of Force Systems. Free Body Diagrams, Equations of Equilibrium of Coplanar Systems, Spatial Systems for concurrent forces. Lamis Theorem, Graphical method for the equilibrium of coplanar forces, Converse of the law of Triangle of forces, converse of the law of polygon of forces condition of equilibrium.

UNIT –II: **Friction:** Introduction **-** limiting friction and impending motion, coulomb's laws of dry friction, coefficient of friction, cone of friction

UNIT – III: Centroid: Centroids of simple figures (from basic principles) – Centroids of Composite Figures **Centre of Gravity:** Centre of gravity of simple body (from basic principles), centre of gravity of composite bodies, pappus theorem.

UNIT IV: Area moments of Inertia: Definition – Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of Composite Figures, Products of Inertia, Transfer Formula for Product of Inertia. **Mass Moment of Inertia: Moment** of Inertia of Masses, Transfer Formula for Mass Moments of Inertia, mass moment of inertia of composite bodies.

UNIT – V: Kinematics: Rectilinear and Curve linear 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.

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

TEXT BOOKS:

1. Engineering Mechanics - S. Timoshenko & D. H. Young., 4th Ed., Mc Graw Hill publications.
2. Engineering Mechanics: Statics and Dynamics 3rd ed., Andrew Pytel and JaanKiusalaas, Cengage Learning publishers.

REFERENCES:

1. Engineering Mechanics statics and dynamics, R.C. Hibbeler, 11th Ed.Pearson
2. Engineering Mechanics, statics, J. L. Meriam, 6th Edn – Wiley India PvtLtd.
3. Engineering Mechanics, dynamics, J. L. Meriam, 6th Edn – Wiley India PvtLtd

Course Code	ENGLISH – COMMUNICATION SKILLS	L	T	P	Credits
1000171121	LABORATORY-I	0	0	3	2

Objectives: The Language Lab focuses on the production and practice of sounds of language and familiarizes the students with the use of English in everyday situations and contexts.

- To sensitize the students to the nuances of English speech sounds, word accent, intonation and rhythm.
- To bring about a consistent accent and intelligibility in their pronunciation of English by providing an opportunity for practice in speaking.
- To improve the fluency in spoken English and neutralize mother tongue influence. To train students to use language appropriately to enhance Oratory Skills.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Demonstrate the usage of phonemes while referring to the dictionary	Understanding	PO5,PO9, PO10, PO12
CO2	Articulate with others by using proper functions.	Applying	PO5,PO9, PO10, PO12
CO3	Enact the roles with proper body language.	Applying	PO5,PO9, PO10, PO12
CO4	Communicate fluently with proper pronunciation	Analyzing	PO5,PO9, PO10, PO12

Unit -1: Letters and Sounds

Unit-2: Interaction 1

Unit-3: The Sounds of English

Unit-4: Interaction 2

PRESCRIBED LAB MANUAL:

Speak Well - Orient Black Swan Publishers

SUGGESTED BOOKS/ MANUALS AND SOFTWARES:

1. Interact - Orient Black Swan
2. Strengthen your Communication Skills by Maruthi Publishers
3. Personality Development and Soft Skills (Oxford University Press, Delhi)
4. GRE-Barons-12thEdition
5. Objective English-R.S.Agarwal-S.Chand Publishers
6. The Rossetta stone
7. English in Mind

Course Code	ENGINEERING CHEMISTRY	L	T	P	Credits
1000171127	LABORATORY	0	0	3	2

List of Experiments

1. Determination of hardness of water using standard EDTA solution
2. Determination of Total alkalinity of a water sample.
3. Determination of Ferrous iron using standard $K_2Cr_2O_7$solution.
4. Determination of Copper using standard EDTA solution.
5. Determination of Iron in cement by Colorimetric method
6. Determination of Zinc by ferro cyanide method.
7. Determination of strong acid by Conductometrictitration
8. Determination of Acetic acid by Conductometrictitration
9. Determination of iron by Potentiometric method using$K_2Cr_2O_7$
10. Preparation of Phenol formaldehyde resin

11.Determinationof Vitamin –C

12. Determination of flash and fire point of a lubricant oil.
13. Determination of viscosity of a lubricant by Red-wood viscometer.
14. Advanced design experiment - Preparation of Bio diesel.
15. Additional design experiment - Construction of Galvanic cell

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Categorize various types of polymeric materials, fuels, lubricants, refractories and establish their applications.	Understanding	PO1,PO2, PO6, PO8, PO12
CO2	analyze hardness of water and describe various softening methods	Applying	PO1, PO2, PO7, PO12
CO3	Illustrate the principles of green chemistry, corrosion and its prevention and demonstrate the construction and working of batteries	Applying	PO1, PO2, PO7, PO12
CO4	Emphasize on various engineering materials like nanomaterials, solar cells and their applications.	Analyzing	PO1, PO4

***The student should carry out a minimum of 12 experiments.**

Outcome: The student is able to acquire principles of various analytical techniques and their applications.

Reference Books:

1. A Textbook of Quantitative Analysis, Arthur J.Vogel.
2. Dr. Jyotsna Cherukuri (2012) Laboratory Manual of engineering chemistry-II, VGS Techno Series
3. Chemistry Practical Manual, Lorven Publications
4. K. Mukkanti (2009) Practical Engineering Chemistry, B.S.Publication

Course Code	COMPUTER PROGRAMMING	L	T	P	Credits
1000171128	LABORATORY	0	0	3	2

Learning Objectives:

- Understand the basic concept of C Programming, and its different modules that includes conditional and looping expressions, Arrays, Strings, Functions, Pointers, Structures and File programming.
- Acquire knowledge about the basic concepts of writing a program in C language
- Demonstrate Role of constants, variables, identifiers, operators, type conversion and other building blocks of C Language.
- Demonstrate Use of conditional expressions and looping statements to solve problems associated with conditions and repetitions.
- Demonstrate Role of Functions involving the idea of modularity.

Outcomes:

- Apply and practice logical ability to solve the problems.
- Understand C programming development environment, compiling, debugging, and linking and executing a program using the development environment
- Analyzing the complexity of problems, Modularize the problems into small modules and then convert them into programs
- Understand and apply the in-built functions and customized functions for solving the problems.
- Understand and apply the pointers, memory allocation techniques and use of files for dealing with variety of problems.

Exercise - 1 Basics

a) What is an OS Command, Familiarization of Editors - vi,Emacs.
b) Using commands like mkdir, ls, cp, mv, cat, pwd, andman.
c) C Program to Perform Adding, Subtraction, Multiplication and Division of two numbers From Command line.

Exercise - 2 Basic Math

a) Write a C Program to Simulate 3 Laws at Motion
b) Write a C Program to convert Celsius to Fahrenheit and vice versa

Exercise - 3 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 Add Digits & Multiplication of a number

Exercise – 4 Control Flow - II

a) Write a C Program to Find Whether the Given Numberis

i) Prime Number

ii) Armstrong Number

b) Write a C program to print Floyd Triangle

c) Write a C Program to print Pascal Triangle

Exercise – 5 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 – 6 Control Flow - III

a) Write a C Program to make a simple Calculator to Add, Subtract, Multiply or Divide Using switch…case

b) Write a C Program to convert decimal to binary and hex (using switch call function the function)

Exercise – 7 Functions - Continued

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

Exercise – 8 Arrays Demonstration of
arrays

a) Search-Linear.

b) Sorting-Bubble, Selection.

c) Operations on Matrix.

Exercises - 9 Structures

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

b) Write a C Program to Store Information Using Structures with Dynamically Memory Allocation c) Write a C Program to Add Two Complex Numbers by Passing Structure to a Function

Exercise - 10 Arrays and Pointers

a) Write a C Program to Access Elements of an Array Using Pointer

b) Write a C Program to find the sum of numbers with arrays and pointers.

Exercise – 11 Dynamic Memory Allocations

a) Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using malloc () function.
b) Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using calloc () function. Understand the difference between the above two programs

Exercise – 12 Strings

a) Implementation of string manipulation operations **with** library function.
    i) copy
    ii) concatenate
    iii) length
    iv) compare
b) Implementation of string manipulation operations **without** library function.
    i) copy
    ii) concatenate
    iii) length
    iv) compare

Exercise -13 Files

a) Write a C programming code to open a file and to print it contents onscreen.
b) Write a C program to copy files

Exercise - 14 Files (Continued)

a) Write a C program merges two files and stores their contents in another file.
b) Write a C program to delete a file

DETAILED SYLLABUS
FOR
I B.TECH
II SEMESTER

Course Code	ENGLISH-II	L	T	P	Credits
1000171201		3	1	0	3

Course Objectives:

- To improve the language proficiency of the students in English with emphasis on LSRW skills.
- To enable the students to study and comprehend the prescribed lessons and subjects more effectively related to their theoretical and practical components.
- To develop the communication skills of the students in both formal and informal situations.
- Practice critical thinking to develop innovative and well-founded perspectives related to the students' emphases. Build and maintain healthy and effective relationships.
- How to convey a credible message and create concise messages using a structured writing process.
- Develop effective interpersonal communication skills.

Course Outcomes:

After completing this Course, the student should be able to:

- Use English language, both written and spoken, competently and correctly.
- Improve comprehension and fluency of speech.
- Gain confidence in using English in verbal situations.
- Display competence in oral, written, and visual communication.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Enhance English Language skills through the concept of Technological advancements.	Understanding	PO6,PO9, PO10, PO12
CO2	Illustrate the life of eminent personalities for developing the skills of vocabulary and grammar	Applying	PO10, PO12
CO3	Emphasize the relevance of cultures and traditions for enhancing writing skills through literature	Applying	PO10, PO12
CO4	Correlate the importance of Environment and sustainability with an emphasis on language skills	Analyzing	PO10, PO12

Detailed Text: English Encounters

1. **A Dilemma-** A Layman looks at Science
2. **Culture Shock**
3. **Lottery**
4. **Health Threats of Climate Change**
5. **A Chief Architect of Microsoft**

Non-Detailed Text: Panorama

1. **A Scarecrow** –SatyajitRay
2. **A Village Lost to the Nation -** Krishna Chandra Pujari

Prescribed Books:

1. **English Encounters** by Maruthi Publications
2. **Panorama** by Oxford University Press

Course Code	ENGINEERING MATHEMATICS-II	L	T	P	Credits
1000171202		3	1	0	3

Course Overview:

The entire course material is divided into 5 modules covering duly recognized areas of theory and study. This course includes the topics of advanced Engineering Mathematics with more focus on the mathematical tools required to analyze the problems of Engineering & Scientific Professions. Some important topics of this course are Solutions of Algebraic and Transcendental Equations, Interpolation, Numerical integration and Numerical solution of ordinary differential equations, Fourier series and Fourier transforms. The main aim of this course is to provide a platform to the students to think, design, formulate and derive any problem encountered in real life situation.

Course Objective:

1. To formulate and apply numerical techniques for root finding, interpolation.
2. To estimate definite integrals using Newton-Cotes quadrature formula.
3. To compute numerical solution of ordinary differential equations.
4. To determine the Fourier coefficients of a given function.
5. To analyze the characteristics and properties of Fourier transforms.

Course Outcomes:

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

1. Determine numerical solution of non Linear equation
2. Compute Interpolating polynomial for the given data
3. Explain Numerical Solution of ODE and Numerical Integration.
4. Construct Fourier series expansion of periodic functions
5. Determine Fourier transform, Fourier sine and cosine transform of function.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Determine numerical solution of non Linear equation	Understanding	PO1,PO2, PO12
CO2	Compute Interpolating polynomial for the given data	Applying	PO1, PO2,PO12
CO3	Explain Numerical Solution of ODE and Numerical Integration.	Applying	PO1, PO2, PO4, PO12
CO4	Construct Fourier series and Fourier transforms for functions	Analyzing	PO1, PO2, PO3, PO5, PO6, PO12

UNIT-I: SOLUTIONS OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS & INTRODUCTION TO FINITEDIFFERENCES:

Bisection method - Regula-falsi method - Iteration method - Newton-Raphson method. Finite differences: Forward, Backward and Central differences - Other difference operators and relations between them - Differences of a polynomial – To find missing terms.

UNIT-II: INTERPOLATION

Newton's forward interpolation, Newton's backward interpolation, Gauss Forward and Backward interpolation, Interpolation with unequal intervals – Newton's divided difference - Lagrange's interpolation.

UNIT-III: **NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS AND NUMERICALINTEGRATION**:

Single step methods: Taylor's series method –Picard's Method - Euler's and modified Euler's Methods - Fourth order Runge-Kutta method for solving first order equations. Numerical Integration: Trapezoidal Rule, Simpson's $1/3^{rd}$Rule, Simpson's $3/8^{th}$Rule

UNIT-IV: FOURIER SERIES:

Introduction- Determination of Fourier coefficients – Even and Odd functions – Change of interval– Half-range sine and cosine series-Practical Harmonic Analysis.

UNIT-V: FOURIER TRANSFORMS:

Fourier integral theorem (only statement) – Fourier sine and cosine integrals – Fourier transforms-Fourier Sine and Cosine transforms – Properties – Inverse transforms – Finite Fourier transforms.

TEXT BOOKS:

1. Higher Engineering Mathematics – 43rd Edition by Dr. B. S. Grewal, Khanna Publishers, New Delhi

REFERENCE BOOKS:

1. Advanced Engineering Mathematics, Erwin Kreszig, 8thEd, Wiley Student Edition.
2. Engineering Mathematics, B.V.Ramana, Tata McGraw Hill.
3. Mathematical Methods – Dr. Ravindranath & Dr. P. Vijaya Lakshmi, Himalaya Pub.
4. Engineering Mathematics, P.Sivaramakrishna Das, C.Vijayakumari , 2017Pearson Education Services Pvt. Ltd

Course Code	ENGINEERING MATHEMATICS-III	L	T	P	Credits
1000171203		3	1	0	3

Course Overview:

This course focuses on basic theoretical concepts and advanced Engineering Mathematics. This course helps the students to understand mathematical tools required in the analysis of problems in Engineering and Scientific Professions. The topics included are Solution for linear systems, Eigen values & Eigen vectors, linear transformations, partial differential equations, Vector integral theorems(Green's, Stoke's and Gauss's divergence theorems). Thus mathematical skills derived from this course enables the students to design and solve the problems.

Course Objectives:

1. To explain the concepts of matrix algebra and methods of solving system of linear equations.
2. To compute Eigen values and Eigen vectors of real and complex matrices.
3. To apply properties of partial differential equations to obtain solution for science and engineering problems.
4. Classify and Solve partial differential equations
5. Generalize calculus to vector functions and to compute line, surface and volume integrals.

Course Outcomes:

Up on successful completion of this course, student will be able to:

1. Apply elementary transformations to reduce matrices to echelon form, normal form and hence find their rank.
2. Solve the system of linear equations and compute Eigen values and Eigen vectors of a square matrix.
3. Compute directional derivative and the gradient of functions of several variables.
4. Infer vector integral theorems to evaluate line, surface and volume integrals.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Solve simultaneous linear equations numerically using rank of a matrix and compute Eigen values and Eigen vectors of a square matrix.	Understanding	PO1,PO2, PO3, PO12
CO2	Identify/classify and solve partial differential equations.	Applying	PO1, PO2, PO3, PO6, PO8
CO3	Calculate gradient of a scalar function, divergence and curl of a vector function.	Applying	PO1, PO2, PO3, PO12
CO4	Determine line, surface and volume integrals using appropriate integral theorems.	Analyzing	PO1, PO2, PO6, PO12

UNIT-I: LINEAR SYSTEMS OF EQUATIONS:

Introduction-Rank-Echelon form-Normal form-Solution of Linear systems - Gauss elimination- Gauss Seidel methods-Applications of matrix methods to finding current in the circuits.

UNIT-II: EIGEN VALUES-EIGEN VECTORS AND QUADRATIC FORMS:

Introduction-Eigen values-Eigen vectors-Properties(without proofs)-Cayley Hamilton theorem (without proof) - Inverse and power of a matrix by using Cayley Hamilton theorem, Diagonalisation of matrix-Quadratic forms-Reduction of Quadratic form to Canonical form-Rank-Index-Signature-Nature-Applications of Eigen value and Eigen vectors to Free Vibrations of two mass system.

UNIT-III: PARTIAL DIFFERENTIAL EQUATIONS:

Formation of partial differential equation by elimination of arbitrary constants and arbitrary functions- Solutions of first order linear (Lagrange's) equation and nonlinear (standard type) equations- Equations reducible to standard forms.

UNIT-IV: VECTOR DIFFERENTIATION:

Differentiation of vectors-Scalar and Vector point functions- Gradient of a scalar field and directional derivatives- Divergence and Curl of a vector field and its physical interpretation-Solenoidal and Irrotational of a vector-Vector identities.

UNIT-V: VECTOR INTEGRATION:

Line integral- Circulation, Work done, Surface and Volume integrals-Vector integral theorems: Green's, Stoke's and Gauss's Divergence theorems (without proofs) and related problems.

TEXT BOOKS:

1. Higher Engineering Mathematics – 43rd Edition by Dr. B. S. Grewal, Khanna Publishers, NewDelhi.

REFERENCE BOOKS:

1. Advanced Engineering Mathematics, Erwin Kreszig, 8thEd, Wiley StudentEdition.
2. Advanced Engineering Mathematics, Greenburg, 2ndEd, Pearsoneducation.
3. Engineering Mathematics, N.P.Bali, Laxmi Publications (P) Ltd.
4. Engineering Mathematics, B. V. Ramana, TataMcGrawHill Publishing Co.Ltd.
5. Engineering Mathematics, P.Sivaramakrishna Das, C.Vijayakumari , 2017 Pearson India Education Services Pvt.Ltd
6. Advanced Engineering Mathematics, Cengage India, by Peter V O'Neil

Course Code	ENGINEERING PHYSICS	L	T	P	Credits
1000171204		3	1	0	3

Course Objective:

To introduce physics of all the core subjects of engineering for better understanding.

Learning Objectives:

- Impart concepts of Optical Interference, Diffraction and Polarization required to design instruments with higher resolution - Concepts of coherent sources, its realization and utility optical instrumentation.
- Study the Structure-property relationship exhibited by solid crystal materials for their utility.
- Tap the Simple harmonic motion and its adaptability for improved acoustic quality of concert halls.
- To explore the Nuclear Power as a reliable source required to run industries
- To impart the knowledge of materials with characteristic utility in appliances.

Outcome:

Construction and working details of instruments, ie., Interferometer, Diffractometer and Polarimeter are learnt. Study Acoustics, crystallography magnetic and dielectric materials enhances the utility aspects of materials.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Describe the wave phenomena and working principle of optical instruments.	Understanding	PO1,PO2, PO3, PO9, PO12
CO2	Apply the knowledge of acoustics and ultrasonics for characterization of acoustics design and non-destructive testing.	Applying	PO1, PO2, PO9, PO12
CO3	Understand the concepts of nuclear reactions for construction and working of nuclear reactors.	Applying	PO1, PO2, PO9, PO12
CO4	Discuss the structural, magnetic and electrical properties of materials.	Analyzing	PO1, PO2, PO9

UNIT-I. INTERFERENCE:

Principle of Superposition – Coherent Sources – Interference in thin films (reflection geometry) – Newton's rings – construction and basic principle of Interferometers.

UNIT-II. **DIFFRACTION:**

Fraunhofer diffraction at single slit cases - Circular Aperture (Qualitative treatment only) - Grating equation - Resolving power of a grating, Telescope and Microscopes. **POLARIZATION:** Types of Polarization – Double refraction - Quarter wave plate and Half Wave plate – Working principle of Polarimeter (Sacharimeter)

UNIT-III. **ACOUSTICS:** Reverberation time - Sabine's formula – Acoustics of concert-hall

ULTRASONICS: Production - Ultrasonic transducers- Non-Destructive Testing Applications.

UNIT-IV CRYSTALLOGRAPHY & X-RAY DIFFRACTION:

Basis and lattice – Bravais systems- Symmetry elements- Unit cell- packing fraction – coordination number- Miller indices – Separation between successive (h k l) planes – Bragg'slaw.

NUCLEAR ENERGY – SOURCE OF POWER:

Mass defect & Binding Energy – Fusion and Fission as sources – Fast breeder Reactors.

UNIT-V MAGNETISM: Classification based on Field, Temperature and order/disorder – atomic origin – Ferromagnetism- Hysteresis- applications of magnetic materials (Para and Ferro)

DIELECTRICS: Electric Polarization – Dielectrics in DC and AC fields – Internal field – Clausius Mossoti Equation - Loss, Breakdown and strength of dielectric materials – Ferroelectric Hysteresis and applications.

Text Books:

1. A Text book of Engineering Physics – by Dr. M.N.Avadhanulu and Dr.P.G.Kshirasagar, S.Chand& Company Ltd.,(2014)
2. VK Mehta, Principles of electronics,s.chand.

Reference Books:

1. Searls and Zemansky. University Physics,2009.
2. Mani P. Engineering Physics I. Dhanam Publications,2011.
3. MarikaniA. Engineering Physics. PHI Learning Pvt., India,2009.
4. Palanisamy P.K. Engineering Physics. SCITECH Publications,2011.
5. Rajagopal K. Engineering Physics. PHI, New Delhi,2011.
6. Senthilkumar G. Engineering Physics I. VRB Publishers,2011.
7. Robert L.Boylestad. Electronic Devices And Circuit Theory prentice hall,7thEd.
8. Mani Naidu S. Engineering Physics, Second Edition, PEARSON Publishing,2011.

Course Code	BASIC ELECTRICAL AND	L	T	P	Credits
1000171205	ELECTRONICS ENGINEERING	3	1	0	3

Preamble: This course covers the topics related to analysis of various electrical circuits, operation of various electrical machines, various electronic components to perform well in their respective fields.

Learning Objectives:

- To learn the basic principles of electrical law's and analysis of networks.
- To understand the principle of operation and construction details of DC machines.
- To understand the principle of operation and construction details of transformer.
- To understand the principle of operation and construction details of alternator and 3-Phase induction motor.
- To study the operation of PN junction diode, half wave, full wave rectifiers and OPAMPs.
- To learn the operation of PNP and NPN transistors and various amplifiers.

Outcomes:

- Able to analyse the various electrical networks.
- Able to understand the operation of DC generators,3-point starter and conduct the Swinburne's Test.
- Able to analyse the performance of transformer.
- Able to explain the operation of 3-phase alternator and 3-phase induction motors.
- Able to analyse the operation of half wave, full wave rectifiers and OP-AMPs.
- Able to explain the single stage CE amplifier and concept of feedback amplifier.

UNIT–I ELECTRICALCIRCUITS:

Basic definitions, Types of network elements, Ohm's Law, Kirchhoff's Laws, Inductive networks, Capacitive networks, series, parallel circuits and star-delta and delta-star transformations.

UNIT–II DCMACHINES:

Construction and Principle of operation of DC generator – EMF equation - types of DC machines –torque equation – applications – three point starter, Swinburne's Test, speed control of DC motor.(Simple Numerical Problems only)

UNIT – III AC MACHINES:

Construction and Principle of operation of single phase transformers – e.m.f equation – losses- OC and SC Test –efficiency and regulation. Construction and Principle of operation of alternators – Construction and principle of operation of 3- Phase synchronous motor- Construction and principle of operation of 3-Phase induction motor – slip-torque characteristics - efficiency – applications (Simple numerical problems only).

UNIT – IV ELECTRICAL AND ELECTRONIC MEASURING INSTRUMENTS:

Classification of measuring instruments- Operating principle of moving coil and moving iron instruments (Ammeter, Voltmeter, Wattmeter, Energy meter) - Electronic Voltmeters (AC &DC), Multimeters. (Only Basic Theoretical Concepts)

UNIT - V SEMICONDUCTOR DEVICES ANDAPPLICATIONS:

PN junction diode, VI Characteristics, Diode applications (Half wave & bridge rectifiers), Bipolar Junction transistor - NPN and PNP- construction, operation, characteristics (CB and CE configurations) - transistor as an amplifier-concept offeedback- Introduction to SCR, UJT, IGBT and MO SFET. (Basic symbols and V-I characteristics)

TEXT BOOKS:

1. Electronic Devices and Circuits, R. L. Boylestad and Louis Nashelsky, 9th edition, PEI/PHI2006.
2. Electrical Technology by Surinder Pal Bali, Pearson Publications.
3. Electrical Circuit Theory and Technology by John Bird, Routledge Taylor & Francis Group

REFERENCES:

1. Basic Electrical Engineering, M. S. Naidu and S. Kamakshiah, TMH Publications
2. Fundamentals of Electrical Engineering, Rajendra Prasad, PHI Publications, 2nd edition
3. Basic Electrical Engineering, Nagsarkar, Sukhija, Oxford Publications, 2nd edition
4. Industrial Electronics, G. K. Mittal, PHI

Course Code		L	T	P	Credits
1000171206	**ENGINEERING DRAWING**	3	1	0	3

Objective: Engineering drawing being the principle method of communication for engineers, the objective to introduce the students, the techniques of constructing the various types of polygons, curves and scales. The objective is also to visualize and represent the 3D objects in 2D planes with proper dimensioning, scaling etc.

- To introduce the use and the application of drawing instruments and to make the students construct the polygons, curves and various types of scales. The student will be able to understand the need to enlarge or reduce the size of objects in representing them.
- To introduce orthographic projections and to project the points and lines parallel to one plane and inclined to other.
- To make the students draw the projections of the lines inclined to both the planes.
- To make the students draw the projections of the plane inclined to both the planes.
- To make the students draw the projections of the various types of solids in different Positions inclined to one of theplanes.
- To represent the object in 3D view through isometric views. The student will be able to represent and convert the isometric view to orthographic view and viceversa.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO number mapped
CO1	Understand the use of drawing instruments to construct the polygons and curves	Understanding	PO1,PO2,PO3
CO2	Learn the principle of orthographic projections. Draw Orthographic projections of points, lines.	Analyzing	PO1,PO2,PO3,PO12
CO3	Draw the various types of planes and solids its views in different Positions	Analyzing	PO1,PO2,PO3,PO12
CO4	Draw isometric views of simple objects	Analyzing	PO1,PO2,PO3,PO12

UNIT I: Polygons, Construction of regular polygons using given length of a side; Ellipse, arcs of circles and Oblong methods; Scales – Vernier and Diagonal scales.

UNIT II: Introduction to orthographic projections; projections of points; projections of straight lines parallel to both the planes; projections of straight lines – parallel to one plane and inclined to the other plane.

UNIT III: Projections of straight lines inclined to both the planes, determination of true lengths, angle of inclinations and traces.

UNIT IV: Projections of planes: regular planes perpendicular/parallel to one plane and inclined to the other reference plane; inclined to both the reference planes.

UNIT V: Projections of Solids – Prisms, Pyramids, Cones and Cylinders with the axis inclined to one of the planes. Conversion of isometric views to orthographic views; Conversion of orthographic views to isometric views.

Text Books:

1. Engineering Drawing, N. D. Bhatt, Chariot Publications
2. Engineering Drawing, K. L. Narayana & P. Kannaiah, Scitech Publishers.
3. Engineering Graphics, P.I. Varghese, McGraw Hill Publishers

Reference Books:

1. Engineering Graphics for Degree, K. C. John, PHI Publishers
2. Engineering Drawing, Agarwal & Agarwal, Tata McGraw Hill Publishers
3. Engineering Drawing + AutoCad – K Venugopal, V. Prabhu Raja, New Age

Course Code	ENGLISH COMMUNICATION	L	T	P	Credits
1000171221	SKILLS LAB-2	0	0	3	2

Objectives:

This Lab focuses on using computer-aided multimedia instruction for language development to meet the following targets:

To improve the students' fluency in English, through a well-developed vocabulary and enable them to listen to English spoken at normal conversational speed by educated English speakers and respond appropriately in different socio-cultural and professional contexts. Further, they would be required to communicate their ideas relevantly and coherently in writing.

Course outcomes: The proposed course to enable students to use 'good' English and perform the following: Gather ideas and information, to organize ideas relevantly and coherently. Engage in debates. Participate in group discussions. Face interviews. Write project/research reports/technical reports. Make oral presentations.

Writing formal letters and to take part in social and professional communication.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Demonstrate the usage of phonemes while referring to the dictionary	Understanding	PO5,PO9, PO10, PO12
CO2	Articulate with others by using proper functions.	Applying	PO5,PO9, PO10, PO12
CO3	Enact the roles with proper body language.	Applying	PO5,PO9, PO10, PO12
CO4	Communicate fluently with proper pronunciation	Analyzing	PO5,PO9, PO10, PO12

Unit-1: Pronouncing Words

Unit-2: Interaction 3

Unit-3: Stress & Intonation

Unit-4: Interaction 4

PRESCRIBED LAB MANUAL:

Speak Well - Orient Black Swan Publishers

SUGGESTED BOOKS/ MANUALS AND SOFTWARES:

1. Interact - Orient Black Swan
2. The Rosetta Stone English Library
3. Language in Use
4. English in Mind

Course Code	ENGINEERING PHYSICS LABORATORY	L	T	P	Credits
1000171222		0	0	3	2

Course Objectives:

(Any 8 of the following listed experiments)

- The Objective of this course is to make the students gain practical knowledge to co-relate with the theoretical studies. To achieve perfectness in experimental skills and the study of practical applications will bring more confidence and ability to develop and fabricate engineering and technical equipments.
- Design of circuits using new technology and latest components and to develop practical applications of engineering materials and use of principle in the right way to implement the modern technology.

Outcome: Hands on experience for all the instruments and better understanding of theory.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Experimentation of laws of vibrations in strenteched string	Understanding	PO1,PO2, PO9, PO12
CO2	Determination of velocity of sound, rigidity modulus of a wire, acceleration due to gravity, radius of gyration and Planck's constant.	Applying	PO1, PO2, PO9, PO12
CO3	Analyze the voltage vs. current characteristics of Zener diode and temperature vs. resistance characteristics of a thermistor	Applying	PO1, PO2, PO9
CO4	Demonstration of formation Newton's rings, diffraction pattern using grating and induced magnetic field in a cirucuclar coil.	Analyzing	PO1, PO2, PO9

List of Experiments

1. Determination of wavelength of a source-Diffraction Grating-Normal incidence
2. Newton's rings –Radius of Curvature of Plano_ConvexLens.
3. Determination of Rigidity modulus of a material- Torsional Pendulum.
4. Determination of Acceleration due to Gravity and Radius of Gyration-Compound Pendulum.
5. Melde's experiment – Transverse and Longitude in almodes.
6. Verification of laws of stretched string –Sonometer.
7. Determination of velocity of sound – Volumeresonator.
8. L C R Senes Resonance Circuit
9. Study of I/V Characteristics of Semi conductordiode
10. I/V characteristics of Zenerdiode
11. Thermistor characteristics – Temperature Coefficient
12. Magnetic field along the axis of a current carrying coil – Stewart and Gee's apparatus.
13. Determination of wavelength of laser source using dirreraction grating
14. Determination of Planck's constant using photo cell

Course Code	ENGINEERING WORKSHOP	L	T	P	Credits
1000171224		0	0	3	2

Course Objective:

To impart hands-on practice on basic engineering trades and skills.

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

Trade:

Carpentry	1. T-Lap Joint 2. Cross Lap Joint 3. Dovetail Joint 4. Mortise and Tenon Joint
Fitting	1. VeeFit 2. SquareFit 3. Half RoundFit 4. DovetailFit
BlackSmithy	1. Round rod to Square 2. S-Hook 3. Round Rod to Flat Ring 4. Round Rod to Square headed bolt
HouseWiring	1. Parallel / Series Connection of three bulbs 2. Stair Case wiring 3. Florescent Lamp Fitting 4. Measurement of Earth Resistance
TinSmithy	1. Taper Tray 2. Square Box without lid 3. Open Scoop 4. Funnel

PROGRAM STRUCTURE

FOR

II-B.Tech

I & II SEMESTERS

DEPARTMENT OF MECHANICAL ENGINEERING

PROGRAM STRUCTURE

II B.Tech - I Semester

S.No	Course Code	Course Title	L	T	P	Credits
1	1003172101	Metallurgy & Materials Science	3	1	0	3
2	1003172102	Mechanics of Solids	3	1	0	3
3	1003172103	Thermodynamics	3	1	0	3
4	1003172104	Fluid Mechanics & Hydraulic Machines	3	1	0	3
5	1003172105	Computer Aided Machine Drawing	3	1	0	3
6	1099172106	Managerial Economics & Financial Analysis	3	1	0	3
7	1003172121	Fluid Mechanics & Hydraulic Machinery Lab	0	0	3	2
8	1003172122	Mechanics of Solids & Metallurgy Lab	0	0	3	2
Total Credits:						**22**

II B.Tech - II Semester

S.No	Course Code	Course Title	L	T	P	Credits
1	1003172201	Kinematics of Machinery	3	1	0	3
2	1003172202	Thermal Engineering – I	3	1	0	3
3	1003172203	Manufacturing Technology -I	3	1	0	3
4	1003172204	Design of Machine Members -I	3	1	0	3
5	1003172205	Instrumentation & Control Systems	3	1	0	3
6	1003172206	Industrial Engineering and Management	3	1	0	3
7	1003172221	Production Technology Lab	0	0	3	2
8	1003172222	Electrical & Electronics Engineering Lab	0	0	3	2
9	1003172231	Industrial Visit	0	0	0	2
Total Credits:						**24**

DETAILED SYLLABUS

FOR

II B.TECH

I SEMESTER

Course Code		L	T	P	Credits
1003172101	METALLURGY & MATERIALS SCIENCE	3	1	0	3

Course Overview:

The course covers the structure – property correlation, limitations and applications of ancient metals and alloys to the modern high performance alloys and composite materials. It also covers a few metallurgical strengthening concepts like heat treatment and mechanical behavior.

Course Objectives:

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

Course Outcomes:

	Course Outcomes	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Recognize the various phases in metals and alloys and how metallographic structure influences the mechanical properties	Understanding	PO1
CO2	Select different class of materials based on the applications.	Applying	PO1
CO3	Quantify mechanical integrity and failure in materials.	Analyzing	PO1, PO2, PO3
CO4	Explore the new combinations of alloys, composites and nano-materials suitable for specific purposes.	Evaluating and creating	PO1, PO2, PO3, PO4

Unit-I:

Structure of Metals and Constitution of alloys:

Crystal structure, Crystal imperfections, Polymorphism and allotropy – Solidification – Nucleation and Growth mechanism, Cooling curve of pure metal and alloy, grain and grain boundaries, effect of grain boundaries on the properties of metal / alloys, grain size measurements, Necessity of alloying, types of solid solutions, Hume Rothery's rules, intermediate alloy phases, and electron compounds.

Outcome: Student will be able to understand the various phases and how alloying elements influences the structure of metals

Activity: Create models for crystal structure of various metals/alloys using some spherical objects. Grain size measurement for steels.

Unit-II:

Equilibrium Diagrams:

Experimental methods of construction of equilibrium diagrams, Isomorphous alloy systems, equilibrium cooling and heating of alloys, Lever rule, coring, miscibility gaps, eutectic systems, congruent melting, intermediate phases. Transformations in the solid state – invariant reactions, phase rule, relationship between equilibrium diagrams and properties of alloys. Study of important binary phase diagrams of Cu-Ni, Al-Cu, Bi-Cd, and Fe-Fe3C. Effect of alloying elements on Fe-Fe3C system.

Outcome: Student will be able to understand the concepts of phase diagrams and able to calculate the compositions and relative amounts of phases in binary alloys.

Activity: Compute the compositions and relative amounts of phases in two phase region of binary alloys on graph sheets.

Unit-III:

Heat treatment of steels:

Stress relieving, annealing, normalizing, hardening, TTT diagrams, CCT diagram, tempering, harden ability, surface hardening methods, Jomny end quench test. Age hardening treatment, Cryogenic treatment of alloys.

Mechanical Properties of Material:

Basic concepts Critical resolved shear stress, fatigue, fracture toughness and creep.

Outcome: Student will be able to apply their knowledge to improve mechanical properties by heat treatment and understand the concepts of failure in materials

Activity: Perform any one type of heat treatment in and measure the hardness. Collect small fractured pieces of different metals/alloys and describe the fracture.

Unit-IV:

Ferrous alloys:

Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, Spheroidal graphite cast iron, Alloy cast irons. Classification of steels, structure and properties of plain carbon steels, Low alloy steels, Stainless Steels, Hadfield manganese steels, tool and die steels.

Non-ferrous alloys:

Structure and properties of Copper and its alloys, Aluminum and its alloys, Titanium and its alloys.

Outcome: Student will be able to gain knowledge about the various ferrous and non-ferrous alloys their properties, limitations and applications.

Activity: Choose the appropriate ferrous and non-ferrous material for a given structure and describe the reason for it.

Unit-V:

Introduction to composite materials:

Natural and synthetic composites- Classification of composites, Applications, Objectives and challenges in composites, manufacture of composites, PMC, CMC, MMC, CCC, Characterization of composites.

Outcome: Student will be able to describe the properties, limitations and applications of composite materials.

Activity: Fabricate a composite using foils, fibers and adhesives of different materials by stacking it with the change in orientation of foils and fibers at each layer.

Text Books:

1. Introduction to Physical Metallurgy by Sidney H. Avner, Tata McGraw Hill, 2014
2. Callister's Materials Science and Engineering by R. Bala subrahmanyam, Wiley India Pvt Ltd; 1st edition(2010)

Reference Books:

1. Essential of Materials Science and Engineering - Donald R. Askeland – Cengage publications.
2. Material Science for Engineering students – Fischer – Elsevier Publishers
3. Material science and Engineering - V. Raghavan, PHI
4. Introduction to Material Science and Engineering – Yip-Wah Chung CRC Press
5. Material Science and Metallurgy – U. C. Jindal – Pearson Publications
6. Engineering Mechanics of Composite Materials – Issac M.Daniel

Course Code		L	T	P	Credits
1003172102	**MECHANICS OF SOLIDS**	3	1	0	3

Course Overview:

Strength is a very important property to be calculated for every engineering application. The course enumerates about the analysis of various strength parameters of various engineering applications.

Course Objectives:

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

Course Outcomes:

	Course Outcomes	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Establish the concept of stresses in members.	Analyzing	PO1,PO2,PO3, PO12
CO2	Identify the deflection of beams.	Evaluating	PO2,PO3,PO4
CO3	Analyze the application of vessels.	Analyzing	PO2,PO3,PO4
CO4	Analyze the torsion in shafts.	Analyzing	PO2,PO3,PO4

Unit-I:

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 – Bars of varying section – composite bars – Temperature Stresses - Complex Stresses - Stresses on an inclined plane under different uni-axial and biaxial stress conditions
Principal planes and principal stresses - Mohr's circle - Relation between elastic constants, Strain energy –Resilience – Gradual, sudden, impact and shock loadings.

Outcome:

- Determine stresses in bars of varying cross sections, composite bars, thermal stress in members, stresses on inclined planes with analytical approach and graphical approach.
- Compare Strain energy under different loadings and also problem-solving techniques.

Activity: 1. Axial deformation activity
2.Simple or direct shear stress activity
3.Simple or direct shear stress activity

Unit-II:

Shear Force and Bending Moment:

Definition of beam –Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever,simplysupportedandoverhangingbeamssubjectedtopointloads, U.D.L,uniformlyvaryingloadsandcombinationoftheseloads–Pointofcontraflexure and inflection– Relation between S.F, B.M and rate of loading at a section of a beam.

Deflection of Beams:

Determination of slope and deflection for cantilever and simply supported beams under point load, U.D.L and uniformly varying load- double integration method, Macaulay's method and Moment area method

Outcome:

- Construct the shear force diagrams and bending moment diagrams to the different loads for the different support arrangements and also problem- solving techniques.
- Finding slope and deflection for different support arrangements

Activity: 1**.** Sample beam deflection activity

Unit-III:

Flexural Stresses: Theory of simple bending – Assumptions – Derivation of bending equation: Neutral axis –Determination of bending stresses – section modulus of rectangular, circular cross sections (Solid and Hollow), I, T, Angle and Channel sections.

Shear Stresses: Derivation and distribution of shear stress in rectangular, circular, triangular, I and T sections.

Outcome:

- Derive bending and shear stress induced in the beams which are made with different cross sections like rectangular, circular, triangular, I, T angle sections.
-

Activity: Sample beam deflection activity

Unit-IV:

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– Thin spherical shells.

Thick Cylinders: Lame's equation – cylinders subjected to inside &outside pressures – compound cylinders

Outcome:

- Analyse the different ways of cylinder failure
- Determine the stresses induced in cylinders subjected to internal, external pressures and also problem-solving techniques.

Activity: A cylindrical or spherical vessel is filled with air to various pressures and change in volume, volumetric strains are calculated.

Unit-V:

Torsion: Introduction-Derivation-Torsion of Circular shafts- Pure Shear Transmission of power by circular shafts.

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

Outcome:

- Determine shear stresses induced in circular shafts.
- Discussing columns in stability point of view and with different end conditions.

Activity: Torsional shear stress and design activity

Reference Books:

1. Analysis of structures by Vazirani and Ratwani.
2. Strength of Materials byS.Timoshenko.
3. Strength of material by B CPunmia.
4. Mechanics of materials by Beer and Johnston.
5. Engineering Mechanics of solids by Popov.

Course Code	THERMO DYNAMICS	L	T	P	Credits
1003172103		3	1	0	3

Course Overview:

This course will focus on the fundamentals of thermodynamics including thermodynamic properties, ideal gases, equation of state, and Zeroth, First and Second laws of thermodynamics. This course also takes a brief look into power cycles so that we can understand how these basic concepts apply to real world situations (e.x., steam power plants or refrigerator).

Course Objectives:

To impart the knowledge of the thermodynamic laws and principles so as to enable the student to prepare an energy audit of any mechanical system that exchange heat and work with the surroundings

Course Outcomes*:*

	Course Outcomes	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Identify and use units and notations in thermodynamics	Understanding	PO1
CO2	State and illustrate the first and second laws of thermodynamics	Understanding	PO1,PO2,PO12
CO3	Identify and explain the concepts of entropy, enthalpy, specific energy, reversibility, and irreversibility.	Applying	PO1,PO2,PO3,PO4,PO12
CO4	Apply the first and second laws of thermodynamics to formulate and solve engineering problems for (i) closed systems, (ii) open systems under steady-state and transient conditions, and (iii) power cycles.	Applying	PO1,PO2,PO3,PO4,PO12
CO5	Use thermodynamic tables, charts, and equation of state (e.g. the ideal gas law) to obtain appropriate property data to solve thermodynamics problems	Applying	PO1,PO2,PO3,PO4,PO12

Unit-I:

Introduction: Basic Concepts:
System, control volume, surrounding, boundaries, universe, types of systems, macroscopic and microscopic viewpoints, concept of continuum, thermodynamic equilibrium, state, property, types of thermodynamic processes, causes of irreversibility-cycle – reversibility – quasi – static process, – energy in state and in transition, different forms of work and heat - zeroth Law of thermodynamics.

First law of Thermodynamics:
Joule's experiments – corollaries – PMM I - first law applied to a process – and SFEE applied to a various flow system.

Outcome:

1. Bring out the knowledge related to invention of temperature measurement systems through Zeroth Law of thermodynamics.
2. Apply the first law of thermodynamics to study steady-state, steady-flow (SSSF) processes

Activity: To Study Basic Laws of Thermodynamics using beaker sand thermometer setup.

Unit-II:

Second Law of Thermodynamics:

Limitations of the first law, thermal reservoir, heat engine, heat pump, kelvin-planck and clausius Statements and their equivalence-corollaries, PMM-II, carnot's principle, carnot cycle and its specialties.

Entropy:

Clausius inequality, principle of entropy increases – energy equation, availability and irreversibility – maxwell relations – introduction to third law of thermodynamics

Outcome:

1. Illustrate the second law of thermodynamics
2. Determination of Entropy Changes in Various Fluids

Activity: Prove the Entropy change with respect to temperature by using Beaker- ink solution setup.

Unit-III:

Perfect Gas Laws:

Equation of state, specific and universal gas constants – various non-flow processes, properties, end states, heat and work transfer, changes in internal energy – throttling and free expansion processes – flow processes- deviations from perfect gas model – vaderwaals equation of state – compressibility charts – variable specific heats.

Mixtures of perfect Gases:
Mole fraction, mass friction, gravimetric and volumetric analysis – Dalton's law of partial pressure, Avogadro's laws of additive volumes, equivalent gas constant,

molecular internal energy, enthalpy, sp. heats and entropy of mixture of perfect gases, vapour, and atmospheric air.

Outcome: Estimation of properties of various gas mixtures.

Activity: To Experimentally analyze Mixture of gases using gravimetric analysis concept

Unit-IV:

Pure Substances: P-V-T- surfaces, t-s and h-s diagrams, mollier charts, phase transformations – triple point at critical state properties during change of phase, dryness fraction – clausius –clapeyron equation- property tables. mollier charts – various thermodynamic processes and energy transfer – steam calorimetry.

Psychrometry: Psychrometric properties – dry bulb temperature, wet bulb temperature, dew point temperature, thermodynamic wet bulb temperature, specifichumidity,relativehumidity,saturatedair,vapourpressure,degreeofsaturation – adiabatic saturation, carrier's equation – psychrometric chart.

Outcome: Estimation of properties of Pure Substances using P-V, T-S and h-s diagrams.

Activity: Development of h-s plot for a given sample at various temperatures and pressures.

Unit-V:

Power Cycles:
Otto, Diesel, Dual Combustion cycles, Sterling Cycle, Atkinson Cycle, Ericsson Cycle, Lenoir Cycle – Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles.

Refrigeration Cycles:
Brayton and Rankine cycles – Performance Evaluation, Bell-Coleman cycle, Vapour compression cycle-performance Evaluation.

Outcome: Estimation of Process parameters on Otto, Diesel, Dual and Brayton cycles.
Activity: To Perform experimental analysis on engines.

Text Books:

1. Engineering Thermodynamics, PK Nag 4th EdnTMH
2. Thermodynamics & Heat Engines by. R. Yadav Vol-1, CPH,Allahabad

Reference Books:

1. Engineering Thermodynamics – Jones & DuganPHI.
2. Thermodynamics – J.P.Holman,McGrawHill.
3. Basic Engineering Thermodynamics – A.Venkatesh – Universitiespress.
4. An Introduction to Thermodynamics - Y.V.C.Rao – Universitiespress.
5. Thermodynamics – W.Z.Black&J.G.Hartley, 3rd Edn PearsonPubl.
6. Engineering Thermodynamics – D.P.Misra, CengagePubl.
   Engineering Thermodynamics – P.Chattopadhyay – Oxford Higher EdnPubl.

Course Code		L	T	P	Credits
1003172104	FLUID MECHANICS & HYDRAULIC MACHINES	3	1	0	3

Course Overview:

The subject Fluid Mechanics and hydraulic machines has a wide scope and is of prime importance in several fields of engineering and science. Present course emphasizes the fundamental underlying fluid mechanical principles and application of those principles to solve real life problems. Special attention is given towards deriving all the governing equations starting from the fundamental principle. There is a well-balanced coverage of physical concepts, mathematical operations along with examples and exercise problems of practical importance. After completion of the course, the students will have a strong fundamental understanding of the basic principles of Fluid Mechanics and will be able to apply the basic principles to analyze fluid mechanical systems.

Course Objectives:

To impart basic knowledge and understanding about the properties of fluids, its kinematic and dynamic behavior through various laws of fluids like continuity, Euler's, Bernoulli's equations, energy and momentum equations. Further, the student shall be able to understand the theory of boundary layer, working and performance characteristics of various hydraulic machines like pumps and turbines.

Course Outcomes:

	Course Outcomes	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Explain the kinematic and dynamic behavior of fluid through various laws of fluids.	Understanding	PO1,PO2,PO12
CO2	Apply the concept of boundary layer in resolving continuity, momentum and energy equations.	Applying	PO2,PO3
CO3	Evaluate the performance characteristics of Hydraulic Turbines.	Evaluating	PO2,PO3,PO4
CO4	Evaluate the performance characteristics of Hydraulic Pumps and to understand working principles of various hydraulic systems.	Evaluating	PO2,PO3,PO4

Unit-I:

Fluid statics:

Physical properties of fluids- specific gravity, viscosity and its significance, surface tension, capillarity, vapour pressure. Atmospheric, gauge and vacuum pressure – measurement of pressure. Manometers- Piezometer, U-tube, inverted and differential manometers. Pascal's law, hydrostatic law, Classification of fluids.

Buoyancy and floatation:

Metacentre, stability of floating and submerged bodies. Calculation of metacentric height - stability analysis and applications.

Outcome: Student should know the concept of fluid and its properties, manometry, hydrostatic forces acting on different surfaces and also problem- solving techniques.

Activity/Event: Prepare a prototype to enumerate the concept of buoyancy and calculate metacentric height for prototype.

Unit-II:

Fluid kinematics:

Introduction, flow types. Equation of continuity for one dimensional flow, circulation and vorticity, Stream line, path line and streak lines and stream tube. Stream function and velocity potential function, differences and relation between them. Conditions for irrotational flow.

Fluid dynamics:

surface and body forces –Euler's and Bernoulli's equations for flow along a stream line, momentum equation and its applications, force on pipe bend.

Closed conduit flow:

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

Outcome: Student should know the basic laws of fluids, flow patterns, viscous flow through ducts and their corresponding problems.

Activity: conduct a set of experiments on Reynolds's experiment set up in laboratory and submit a report on Reynolds's number for different flow conditions for different fluids.

Unit-III:

Boundary Layer Theory:
Introduction, momentum integral equation, displacement, momentum and energy thickness, separation of boundary layer, control of flow separation.

Dimensional analysis and model similitude:

Methods of dimensional analysis- Rayleigh's method, Buckingham's π theorem, model similitude – Dimensionless numbers- Reynolds number, Froude number, Euler's number, Weber number, Machnumber.

Outcome:

student will be aware of the concepts related to boundary layer theory, flow separation, dimensionless numbers and dimensional analysis.

Activity:

Prepare a set of Non dimensional numbers those are most widely used in Fluid Mechanics and apply the concept of Dimensional analysis theorems and compare the results.

Unit-IV:

Impact of jets:

Hydrodynamic force of jets on stationary, moving flat, inclined, and curved vanes. Jet striking centrally and at tip - velocity diagrams - work done and efficiency. Flow over radial vanes.

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, Characteristic curves, governing of turbines, unit and specific quantities.

Outcome:

Student will know the hydrodynamic forces acting on vanes and their performance. Evaluate the performance characteristics of hydraulic turbines.

Activity:

Conduct experiments on different turbines and prepare a performance report on turbines.

Unit-V:

Centrifugal pumps:

Classification, working principle, work done – manometric head - losses and efficiencies- specific speed- pumps in series and parallel- performance characteristic curves, cavitation & NPSH.

Reciprocating pumps: Working principle, Discharge, slip, indicator diagrams.

Hydraulic Systems: Hydraulic ram, hydraulic lift, hydraulic coupling.

Outcome:

Student will be aware of the importance, function and performance of pumps with knowledge on hydraulic systems and fluidics is imparted to the student.

Activity: conduct experiments on different pumps and prepare a performance report on pumps.

Text Books:

1. Fluid Mechanics and Hydraulic Machines/ RK Bansal/Laxmi Publications (P)Ltd
2. Fluid mechanics and Hydraulic machinery MODI andSETH.

Reference Books:

1. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria & Sons.
2. Fluid Mechanics and Machinery by D. Rama Durgaiah, New Age International.
3. Hydraulic Machines by Banga& Sharma, Khanna Publishers.
4. Instrumentation for Engineering Measurements by James W. Dally, William E. Riley, John Wiley & Sons Inc.2004 (Chapter 12 – Fluid Flow Measurements)
5. Fluid Mechanics and Hydraulic Machines byDomkundwar & Domkundwar, Dhanpatrai&Co.

Course Code	COMPUTER AIDED MACHINE DRAWING	L	T	P	Credits
1003172105		3	1	0	3

Course Overview:

Machine Drawing gives representation of a machine components or machine by lines according to certain set rules. Machine drawing generally gives all the external and internal details of the machine components from which it can be manufactured. Computer Aided drawings gives an idea to draw any component by using mechanical software packages.

Course Objectives:

1. Understand drawing and develop capacity to represent any object with the help of sketch.
2. To develop primary knowledge of working drawing.
3. To provide knowledge on views of different machine parts.
4. To develop skill to produce assembly drawings from part drawings (computer aided drawings).

Course Outcomes:

	Course Outcomes	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Reproduce and use the techniques of conventions of machine parts and their necessity.	Understanding	PO1,PO2,PO3
CO2	Apply their knowledge and skills of drawing to draw simple machine elements including screw threads, bolts, nuts, keys.	Applying	PO3
CO3	Draw machine elements including cotter joints, riveted joints and bearings.	Applying	PO4,PO5
Co4	Construct and draw assembly drawings as well as to analyze and interpret assemblies of various engine parts, machine parts from part drawings.	Applying	PO4,PO5

Part-A:

Introduction to sectional views:

Hatching of Sections, Cutting Planes, Revolved or Removed Section, Local Section, Arrangement of Successive Sections, Full Section, Half Section, Auxiliary Sections.

Machine Drawing Conventions:

Need for drawing conventions - introduction to IS conventions. Conventional representation of materials, common machine elements and parts such as screws, nuts, bolts, keys, gears, webs, ribs (**Not applicable for end semester examination**).

Screwed Fasteners:

Forms of Screw threads, hexagonal and square nut, hexagonal and square headed bolt, Hexagonal headed bolt and nut with washer (assembly), Square headed bolt with square neck, T-headed bolt with square neck, Eye-bolt, simple assembly using stud bolts with nut, other forms of nuts, lock nut, locking by split pin, locking by spring washer and locking by set screw arrangements.

Riveted Joints:

Types of rivet heads, Single riveted lap joint, double riveted chain lap joint, double riveted zig-zag lap joint, single riveted single strap butt joint,singleriveteddoublestrapbuttjoint,doubleriveteddoublestrapchainbutt joint, double riveted double strap zig-zag butt joint.

Keyed Joints:

Flat saddle Key, hallow saddle key, taper sunk key, gib head key, parallel sunk keys, splines, woodruff key, round key joint arrangements.

Cotter Joints:

Cotter joint with sleeve, Cotter joint with socket and spigot ends & Cotter joint with a gib.

Outcome:

1. Identify the materials and machine components by their conventional representations.
2. Understand the different sectional views of the machine components.
3. Distinguish the different types of bolt, nut and key elements.

Activity:

Obtain any one of the physical component/part from the above said topics, mention the specific application and has to draw the views of that component/part by measuring the dimensions with the help of available resources.

Part-B:

Assembly Drawings:

Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportions (Part drawings shall be given). Petrol engine connecting- rod, Piston, Screw jack, Single Tool Post, Plummer block, protected flanged coupling, Foot step Bearing.

Outcome:

1. Identify each and every individual component of an assembly by its name and material.
2. Explain the functions of each and every part, sub parts and assembly.
3. Understand the different sectional views of individual and Assembly drawing.

Activity:

Obtain any one of the physical component/part from the above said topics, mention the specific application and has to draw the views of that component/part by measuring the dimensions with the help of available resources.

Both internal and external examination should be conducted using appropriate drafting software.

Guidelines1:

Scheme of Examination for End Exam (Part-A, &B): 60 Marks

End Semester examination shall be conducted for **Three** hours with the following pattern.

Student has to draw using mechanical software.

Part A – Four questions to be set from part A. Student has to answer any two questions from part A for 20 Marks. Each question carries 10 marks (2*10= 20 M)

Part B – Two questions to be set from part B. Student has to answer one question from part B which carries 40 Marks.

Guidelines2:

Scheme of Evaluation for Internal Assessment (Part-A and B): 40 Marks

(a) 15 Marks for day to day assessment (Computer Aided Machine drawing printouts).
(b) 15 Marks for internal examination. (Best of 2 mid exams).

i) First mid covers Part A syllabus. The student has to answer any two questions out of four questions given.
ii) Second mid covers Part B syllabus. The student has to answer one question out of two questions given.

(c) 5 Marks for faculty assessment based on the participation of the student in the respective course related activities.
(d) 5 Marks for attendance

Text Books:

1. Machine Drawing, K.L. Narayana P.Kannalah& K. Venkata Reddy NewAge/ Publishers.
2. Machine Drawing Dhawan, S.Chand Publications.

Reference Books:

1. Machine Drawing, P.S.Gill,
2. Machine Drawing, N.D. Junnarkar, Pearson
3. A Text Book of Computer Aided Machine Drawing, S. Trymbakaa Murthy, CBS Publishers.
4. Tutorial Guide to AutoCAD, SDC Publications.
5. Catia V5R17: For Engineers & Designers, Sham Tickoo, Dream tech Press.

Course Code	MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS	L	T	P	Credits
1099172106		3	1	0	3

Course Overview:

The present course is designed in such a way that it gives an overview of concepts of Economics. Managerial Economics enables students to understand micro environment in which markets operate how price determination is done under different kinds of competitions. Financial Analysis gives clear idea about concepts, conventions and accounting procedures along with introducing students to fundamentals of ratio analysis and interpretation of financial statements. Break Even Analysis is very helpful to the Business Concern for Decision Making, controlling and forward Strategic Planning. Ratio analysis gives an idea about financial forecasting, financial planning, controlling the business and decision making.

Course Objectives:

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

1. Understand the concepts of managerial economics and the market dynamics namely Demand, Elasticity of demand and pricing in different market structures.
2. Acquire the knowledge about production theories and cost analysis besides dealing with the production and factors of production.
3. Analyze the different market structures and understand various pricing methods which are adopted in attracting the customers under different markets.
4. To understand various forms of business organization and business cycles
5. To provide the basic knowledge on financial accounting, Capital and capital budgeting decisions.

Course Outcomes:

	Course Outcomes	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Describe the economic activities performed by the businessmen in the business for profit earning. Understand the significance of demand, its analysis, measurement of demand and its Forecasting	understanding	PO1,PO2,PO8, PO10,PO11,PO 12
CO2	Evaluate the production theories and pricing policies of various enterprises.	Evaluating	PO1,PO2,PO8, PO10,PO11,PO 12
CO3	Design and implement different structures of market covering how price is determined under different market structures. Also can able to take decisions using business cycles, Analyze different forms of business organizations existing in the modern business and able to choose suitable form of business	Applying	PO1,PO2,PO8, PO10,PO11,PO 12

CO4	Able to prepare financial statements and understand and implement the capital budgeting tools and techniques.	Applying	PO1,PO2,PO8, PO10,PO11,PO 12

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

Outcome:

1. Describe the economic activities performed by the businessmen in the business for profit earning. Understand the significance of demand, its analysis, measurement of demand and its Forecasting

Activity: Presentations and object oriented tests

Unit-II:

Production and Cost Analyses: Concept of Production function- Cobb-Douglas Production function- Leontief production function - Law of Variable proportions- Isoquants and Isocosts and choice of least cost factor combination-Concepts of Returns to scale and Economies of scale-Different cost concepts: opportunity costs, explicit and implicit costs- Fixed costs, Variable Costs and Total costs –Cost–Volume-Profit analysis-Determination of Breakeven point(simple problems)- Managerial significance and limitations of breakeven point.

Outcome: Evaluate the production theories and pricing policies of various enterprise

Activity: Presentations and object oriented tests

Unit-III:

Part I: Introduction to Markets, Theories of the Firm & Pricing Policies: Managerial Theories of firm: Marris and Williamson's models – Significance of Pricing and various methods of pricing with contemporary examples. Market Structures: Perfect Competition, Monopoly, Monopolistic competition and Oligopoly – Features– Price and Output Determination.

Part: II: Types of Business Organization and Business Cycles: Features and Evaluation of Sole Trader, Partnership, Joint Stock Company – State/Public Enterprises and their forms – Business Cycles : Meaning and Features – Phases of Business Cycle.

Outcome: Design and implement different structures of market covering how price is determined under different market structures. Also can able to take decisions using business cycles

Activity: Presentations and object oriented tests

Unit-IV:

Introduction to Accounting and Capital Budgeting Decisions: Part I:Introduction to Accounting, Double Entry Systems Journal, Ledger, Trail Balance, preparation of Financial Statements (Problems)

Outcome: Analyze different forms of business organizations existing in the modern business and able to choose suitable form of business

Activity: Presentations and object oriented tests

Unit-V:

Capital Budgeting Decisions: Classification of Capital- Methods of appraising Project profitability: Traditional Methods (Payback period, Accounting rate of return) and Time value of money- Modern methods (Net Present Value method, Internal Rate of Return Method and Profitability Index Method) - Problems

Outcome: Able to prepare financial statements and understand and implement the capital budgeting tools and techniques.

Activity: Presentations and object oriented tests

Text Books:

1. M.Kasi Reddy & Saraswathi, "Managerial Economics and Financial Analysis", PHI Publications, New Delhi, 10th Revised Edition,2012.
2. Varshney & Maheswari, "Managerial Economics", Sulthan Chand Publishers, 1st Revised Edition, 2009.
3. S.N. Maheshwari & S.K.Maheshwari, "Financial Accounting", Vikas Publication House Pvt.Ltd, 4th Edition,2012.

Reference Books:

1. D.N. Dwivedi, "Managerial Economics", Vikas Publication House Pvt.Ltd, 2nd Edition,2012.
2. R.Narayana Swamy, "Financial Accounting- A managerial Perspective", Pearson publications, 1st Indian Reprint Edition,2012.
3. J.V.PrabhakarRao&P.V.Rao,"ManagerialEconomics&FinancialAnalysis",Maruthi Publishers, 1st Revised Edition, 2011

Course Code	FLUID MECHANICS AND HYDRAULIC MACHINERY LAB	L	T	P	Credits
1003172121		0	0	3	2

Course Objectives:

To impart practical exposure on the performance evaluation methods of various flow measuring equipment and hydraulic turbines and pumps.

1. Calibration of Venturimeter.
2. Calibration of Orifice meter
3. Calibration of turbine flow meter.
4. Determination of friction factor for a given pipeline.
5. Determination of minor losses in apipeline.
6. Impact of jets on Vanes.
7. Performance Test on Pelton Wheel.
8. Performance Test on Francis Turbine.
9. Performance Test on Kaplan Turbine.
10. Performance Test on Single Stage Centrifugal Pump.
11. Performance Test on Multi Stage Centrifugal Pump.
12. Performance Test on Reciprocating Pump.

Course Code	MECHANICS OF SOLIDS AND METALLURGY LAB	L	T	P	Credits
1003172122		0	0	3	2

Course Objectives:

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.

NOTE: Any 6 experiments from each section A and B.

(A) Mechanics of Solids Lab:

1. Direct tension test
2. Bending teston
   a) Simple supported
   b) Cantilever beam
3. Torsiontest
4. Hardness test
   a) Brinell hardness test
   b) Rockwell hardness test
5. Test onsprings
6. Compression test on cube
7. Impact tests (Izod / Charpytests)
8. Punch shear test

(B) Metallurgy Lab:

1. Study of Metallurgical Microscope and sample preparations
2. Study of the Micro Structure of pure metals like Iron, Cu and Al.
3. Preparation and study of the Microstructure of Mild steels, low carbon steels, high –C steels.
4. Study of the Micro Structures of Cast Irons.
5. Study of the Micro Structures of Non-Ferrous alloys.
6. Study of the Micro structures of Heat treated steels.
7. Harden ability of steels by Jominy End Quench Test.
8. To find out the hardness of various treated and untreated steels

DETAILED SYLLABUS

FOR

II B.TECH

II SEMESTER

Course Code		L	T	P	Credits
1003172201	**KINEMATICS OF MACHINERY**	3	1	0	3

Course Overview:

It concerns with analysis and applications of different mechanisms

Course Objectives:

The students completing this course are expected to understand the nature and role of the kinematics of machinery, the mechanisms and machines. The course includes velocity and acceleration diagrams, analysis of mechanisms joints, Cams and their applications. Itexposes the students to various kinds of power transmission devices like belt, rope, chain and gear drives and their working principles and their merits and demerits.

Course Outcomes:

	Course Outcomes	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Explain the importance of joint in the behavior of mechanism	Understanding	PO1,PO2,PO3,PO5,PO12
CO2	Describe different types of mechanisms based on type of pairs	Understanding	PO1,PO2,PO3,PO5,PO12
CO3	Analyze the different mechanism and its motion transmission	Analyzing	PO1,PO2,PO3,PO5,PO12
CO4	Apply different mechanisms in real time applications	Applying	PO1,PO2,PO3,PO5,PO12

Unit-I:

Mechanisms and Inversions: Rigid body, Mechanism and Machine, Kinematic Link – Classification of Kinematic Pairs.

Degrees of freedom: Mobility, Grublers criterion, Grashof's law, Kutzbach criterion for planar mechanisms

Kinematic chain-Inversions of Quadric cycle chain, Single and Double slider crank chain.

Outcome: Understand the purpose of kinematics, Kinematic joint, mechanism and relative motion of parts in a machine without taking into consideration the forces involved.

Activity: Making simple model of any mechanism

Unit-II:

Straight Line Mechanisms:

Exact and approximate copiers and generatedtypes -Peaucellier, Hart and Scott Russel - Grasshopper - Watt T. Chebichef and Robert Mechanismsandstraightlinemotion,Pantograph.Conditionsforcorrectsteering -Davis Steering gear, Ackerman's steering gear – velocityratio.

Hooke's Joint: Single and double - Universal coupling-application-problems.

Outcome: Explain various mechanisms for straight line motion and their applications including steering mechanism.

Activity: 1.Making simple model of any mechanism

Unit-III:

Kinematics:

Plane motion of body: Instantaneous centre of rotation, centrode and axode - relative motion between two bodies – Kennedy's three centres in line theorem – Graphical determination of instantaneous centre for simple four bar and single slider crank chain mechanisms and determination of angular velocity of points andlinks. Motion of a link in machine - Determination of Displacement, velocity and acceleration for a Simple Four Bar Mechanism, Single slider crank chain mechanism, Double slider crank chain mechanism Corioli's component of acceleration, Klein's construction.

Outcome: Analyse the velocity and acceleration concepts and the methodology using graphical methods and principles and application of four bar chain. To understand the application of slider crank mechanism etc. and study of plane motion of the body

Activity: Assignment of simple acceleration problem for student to explain

Unit-IV:

Cams:

Definition and classification of cams and followers - Terminology - Types of follower motion: Uniform velocity, Simple harmonic motion and uniform acceleration and retardation, for Knife edge, Flat face, Roller follower and offset followers –Introduction to Specialcams

Outcome: Describe the applications of cams and their working principles.

Activity: Making of cam and follower mechanism model

Unit-V:

Elements of Power Transmission: Introduction to Belts and Rope drives - applications.

Gears:

Classification- Terminology- Forms of teeth- Law of Gearing- path of contact-arc of contact. Interference - methods of avoiding interference.

Gear trains: Simple gear train, compound gear train, reverted gear train and epicyclical gear train.

Outcome:

Various power transmission mechanisms, methodologies and working principles including gear profiles and its efficiency. Students are exposed to merits and demerits of each drive.

Activity: Making of cam and follower mechanism model

Text Books:

1. Theory of Machines S. S Rattan-TMH
2. Theory of Machines by Thomas Bevan-Pearson publishers

Reference Books:

1. Theory of Machines by RS Kurmi and J K Gupta – S Chand Publishers
2. Kinematics of Machinery through Hyper Works J.S. Rao Springer Publ.
3. Theory of Mechanisms and machines A.Ghosh & A.K.Malik East West Press Pvt. Ltd.
4. Theory of Machines by Jagadishlal-Metropolitan BookCo.,

Course Code		L	T	P	Credits
1003172202	THERMAL ENGINEERING - I	3	1	0	3

Course Overview:

This course is focused on working of various types of Internal Combustion Engines, Engine system components, performance of engine and Air compressors.

Course Objectives:

This course is designed to teach Mechanical Engineering students the application of thermodynamic principles to the design and optimization of engineering systems, like Internal Combustion engines and Air compressors

Course Outcomes:

	Course Outcomes	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Demonstrate the functional requirements of internal combustion engines and their systems	Understanding	PO1, PO2,PO3,PO4,PO 12
CO2	Explain the normal combustion phenomenon and knocking in S.I. and C.I. Engines with respect to the several engine operating parameters that affect the engine performance.	Understanding	PO1, PO2,PO3,PO4,PO 12
CO3	Describe and assess benefits and improvements to thermodynamic systems and related engine parameters that affect the performance of internal combustion engines.	Applying	PO1, PO2,PO3,PO4,PO 12
CO4	Elucidate the performance and evaluation of reciprocating and rotary compressors.	Evaluating	PO1, PO2,PO3,PO4,PO 5,PO12

Unit-I:

I. C. Engines: Classification - working principles, valve and port timing diagrams, engine systems – carburetor, fuel injection system, ignition, cooling and lubrication, principles of supercharging and turbo charging.

Outcome: The student will be familiarized with the various engine systems along with their function and necessity.

Activity: Perform an experiment in Thermal Engineering Laboratory on 4-Stroke Single Cylinder Diesel Engine at different loads and speeds.

Unit-II:

Combustion in S.I. Engines:

Normal combustion and abnormal combustion – importance of flame speed and effect of engine variables – types of abnormal combustion, pre-ignition and knocking – fuel requirements and fuel rating, anti- knock additives – combustion chamber – requirements, types.

Combustion in C.I. Engines:

Four stages of combustion – delay period and its importance – effect of engine variables – diesel knock– need for air movement, suction, compression and combustion induced turbulence –open and divided combustion chambers and nozzles used – fuel requirements and fuel rating.

Outcome: Student will be able to learn about normal combustion phenomenon and knocking in S.I and C.I engines.
Activity: Develop p-θ diagram on card board by shading combustion regions with different colors for combustion phenomenon occurred in various S.I and C.I engines.

Unit-III:

Actual Cycles and their Analysis:

Introduction, comparison of air standard and actual cycles, time loss factor, heat loss factor, exhaust blow down-loss due to gas exchange process, volumetric efficiency. Loss due to rubbing friction, actual and fuel-air cycles of C. I engines

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 Pi chart.
Outcome: Student will be able to learn and understand the reasons and affects of various losses that occurs in the actual engine operation. Students will be able to perform testing on S.I and C.I engines for calculations of performance and emission parameters.

Activity: Perform an experiment in Thermal Engineering Laboratory on multi cylinder petrol engine and single cylinder diesel engine to determine frictional power.

Unit-IV:

Compressors: Classification- positive displacement and Roto-dynamic machinery.

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

Outcome: Students will be able to learn about different types of compressors and to calculate work done and efficiency of reciprocating compressors.

Activity: Perform an experiment on Air-compressor test rig and estimate various efficiencies associated with compressor performance.

Unit-V:

Rotary (Positive Displacement Type): Roots blower, vane sealed compressor, lysholm compressor –mechanical details and principle of working – efficiency considerations.

Dynamic Compressors: Centrifugal compressors: mechanical details and principle of operation, study of velocity and pressure variations.

Axial Flow Compressors: Mechanical details and principle of operation – velocitytriangles-lossesinaxialflowcompressors-surging–stalling–choking–characteristic curves.

Outcome: Students will be able to learn mechanical details of various compressors and calculate power and efficiency of rotary compressors.

Activity: Prepare proto type models of compressor vanes/blades with card board.

Text Books:

1. I.C. Engines / V. Ganesan -TMH
2. Heat engines, Vasandani & Kumar, Metro politin Book company pvt.ltd New delhi

Reference Books:

1. Thermal Engineering / RK Rajput/ Lakshmi Publications
2. I.C. Engines – M. L. Mathur& R. P. Sharma – Dhanpath Rai &Sons.
3. I.C. Engines –Applied Thermo sciences–C.R.Ferguson& A.T.Kirkpatrick-2nd Edition-Wiley Publ.
4. I.C. Engines - J.B. Heywood /Mc Graw HIll.
5. Thermal Engineering – R. S. Khurmi & J.S.Gupta- S.chand Publ.
6. Thermal Engineering / PL Ballaney, Khanna Publishers

Course Code		L	T	P	Credits
1003172203	MANUFACTURING TECHNOLOGY - I	3	1	0	3

Course Overview:

The course covers the basic techniques of manufacturing processes like casting, welding, bulk forming, sheet metal forming, powder metallurgy and plastics used to produce parts and products in industry.

Course Objectives:

To impart basic knowledge and understanding about the primary manufacturing processes and their fundamental analysis for casting, joining, bulk forming, sheet metal forming and to introduce powder metallurgy and processing methods of plastics to meet the current manufacturing industry needs.

Course Outcomes:

	Course Outcomes	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Design patterns, gating, runner and riser systems. Select a suitable casting process based on the component material, geometry and application.	Applying	PO1, PO2, PO3
CO2	Select various fusion and solid state welding Processes based on the application.	Understanding	PO1, PO2, PO3
CO3	Estimate the force requirements for various bulk and sheet metal forming operations.	Applying	PO1, PO2, PO3
CO4	Describe powder metallurgy process and processing of plastics	Understanding	PO1, PO3

Unit-I:

Casting – Pattern and Mould making:

Steps involved in making a casting – Advantages of casting and its applications – Patterns and Patternmaking – Types of patterns – Materials used for patterns, pattern allowances and their construction. Moulding and core making – materials and machines.

Outcome: Student will be able to compute the pattern size for given casting size and material, design parting plane and prepare the mould.

Activity: Compute the pattern dimensions for the given casting.

Unit-II:

Gating, Rise ring and Special Casting Processes:

Principles of Gating, Gating ratio and design of Gating systems. Methods of melting and types of furnaces. Definition of centre line feeding resistance. Risers – Types, function and design, casting design considerations, Basic principles and applications of Centrifugal casting, Die casting and Investment casting.

Outcome: Student will be able to design the gating system for producing a casting and explain the special casting processes.

Activity: Design the gating system for a given casting.

Unit-III:

Gas and Arc Welding:

Classification of welding processes, types of welded joints and their characteristics, Gas welding, Different types of flames and uses, Oxy – Acetylene Gas cutting. Basic principles of Arc welding, Manual metal arc welding, Submerged arc welding, Inert Gas welding - TIG & MIG welding. Problems related to V-I characteristics of welding machines.

Other Welding Processes:

Resistance welding, Solid state welding processes - Friction welding, Friction stir welding, Forge welding, Explosive welding; Therm it welding, Plasma welding, Electron beam welding, Soldering, Brazing and adhesive bonding. Design of welded joints.

Outcome: Gain knowledge to select appropriate welding process based on materials

Activity: Student will be demonstrated with various types flames used in gas welding.

Unit-IV:

Bulk Metal forming processes:

Plastic deformation in metals and alloys, Hot working and Cold working, Strain hardening. Bulk forming processes: Forging, Types Forging, Smith forging, Drop Forging, roll forging, Forging hammers, Rotary forging, forging defects; Rolling – fundamentals, types of rolling mills and products, Extrusion and its characteristics. Types of extrusion, Impact extrusion, Hydrostatic extrusion; Wire drawing and Tube drawing. Analysis of bulk metal forming - Yield criteria, load estimation for bulk (forging, rolling, extrusion, drawing).

Powder metallurgy: Steps in powder metallurgy process, Advantages, limitations and applications.

Outcome: Student will be able to compute forces and power requirements in few typical bulk forming processes and explain powder metallurgy process.

Activity: Students will be demonstrated powder metallurgy process practically.

Unit-V:

Sheet metal forming: Blanking and piercing, Forces and power requirement in these operations, deep drawing, stretch forming, bending, spring back and its remedies, coining, spinning. Types of presses and press tools. Load estimation for sheet forming (shearing, deep drawing, bending).

Processing of Plastics: Types of Plastics, Properties, Applications and their processing methods - Blow and Injection moulding.

Outcome: Student will be able to compute forces and power requirements in few typical sheet metal processes and explain the processing of plastics.

Activity: Students will be asked to estimate spring back practically

Text Books:

1. Manufacturing Processes for Engineering Materials – Kalpak Jian S and Steven R Schmid- Pearson Publications, 5thEdition,2005.
2. Manufacturing Science – A. Ghosh & A. K. Mallik – East West Press Pvt. Ltd., 1985.

Reference Books:

1. Manufacturing Technology -Vol I- P.N. Rao- TMH
2. Process and materials of manufacture- Lindberg-PHI
3. Production Technology- R.K. Jain-Khanna
4. Production Technology-P C Sharma-S.Chand
5. Manufacturing Processes- H.S. Shaun-Pearson
6. Workshop Technology - WAJ Chapman/CBS Publishers & Distributors Pvt. Ltd.

Course Code		L	T	P	Credits
1003172204	**DESIGN OF MACHINE MEMBERS – I**	3	1	0	3

Course Overview:

It deals with the study of fundamentals of machine design and design of various machine elements.

Course Objectives:

1. The student shall gain appreciation and understanding of the design function in mechanical engineering, the steps involved in designing and the relation of design activity with manufacturing activity.
2. Selection of proper materials to different machine elements based on their mechanical properties.
3. Learn and understanding of different types of failure modes and criteria.
4. Design procedure for different machine elements such as fasteners, shafts, couplings, keys, axially loaded joints, springs etc.

Course Outcomes:

	Course Outcomes	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Explain the different types of simple and variable stresses.	Understanding	PO1,PO2,PO3,PO6,PO12
CO2	Apply the knowledge of simple and variable stresses in the design of fasteners like riveted, welded and bolted joints.	Applying	PO1,PO2,PO3,PO6,PO12
CO3	Design the various cotter joints, knuckle joint and shaft couplings.	Applying	PO1,PO2,PO3,PO6,PO12
CO4	Estimate the force requirements for various bulk and sheet metal forming operations.	Evaluating	PO1,PO2,PO3, PO6,PO12
CO5	Select suitable springs against static and dynamic loading.	Remembering	PO1,PO2,PO3, PO6,PO12

Unit-I:

Introduction:

Classification of Machine design - General considerations in Machine design – General procedure in Machine design - Engineering Materials - Mechanical properties –selection of materials – factor of safety - BIS codes of steels.

Stresses in Machine Members:

Simple stresses – combined stresses – torsional and bending stresses – various theories of failure.

Outcome: The student should be able to determine the various stresses in mechanical engineering design process with general considerations.

Activity: The students should make the models of various machine elements subjected to combined stresses.

Unit-II:

Stress Concentration and Fatigue:

Stress concentration – theoretical stress concentration factor – fatigue stress concentration factor, notch sensitivity – Design for fluctuating stresses – endurance limit – estimation of endurance strength – Gerber's curve - Goodman's line – Soderberg's line.

Outcome: The student can able to distinguish the concept of stress concentration and apply in the design the component under fatigue loading

Activity: The students should make various models of machine components to mitigate the stress concentration.

Unit-III:

Riveted Joints:

Introduction – Modes of failure of riveted joints – Efficiency of riveted joints – Design of longitudinal and circumferential joints of a boiler – Eccentric loading of riveted joints.

Welded joints:

Types – Advantages and Disadvantages – Strength of transverse and parallel fillet welds.

Bolted joints

Design of bolts with pre-stresses – Bolts of uniform strength.

Outcome: The student can able to Apply the knowledge of suitable fasteners in the design of machine elements.

Activity: The students should make various riveted, welded & bolted joints.

Unit-IV:

Cotter and Knuckle Joints:

Design of Cotter joints - spigot and socket, sleeve and cotter, Design of knuckle joint.

Mechanical Springs:

Stresses and deflections of helical springs – compression springs – Surge in springs - energy storage capacity - springs for fatigue loading - Design of leaf spring

Outcome:

After Completion of this unit the student can able to Explain the functions and design of various temporary joining elements and springs.

Activity: The students should make the models of cotter, knuckle joints & springs.

Unit-V:

Keys: Types and Design of keys

Shafts:

Design of solid and hollow shafts for strength and rigidity – Design of shafts for pure torsional load – pure bending load – combined torsional and bending loads – axial load in addition to combined torsional and bending loads.

Shaft Couplings:

Rigid couplings – muff, split muff and flange couplings, Flexible couplings - bushed pin flexible coupling.

Outcome: The student can able to Design suitable keys, shafts and couplings for any machinery.

Activity: The students should make various types of keys, couplings & shaft assembly.

Text Books:

1. Machine Design/V.B.Bhandari/ TMHPublishers
2. Machine Design/ Shigley, J.E/McGrawHill.

Reference Books:

1. Machine Design / Schaum Series/McGraw-HillProfessional
2. Machine Design / NC Pandya & CS Shah/Charotar Publishing HousePvt. Limited
3. Machine Design/Norton/ Pearsonpublishers.

Course Code		L	T	P	Credits
1003172205	INSTRUMENTATION AND CONTROL SYSTEMS	3	1	0	3

Course Overview:

Measurements are a very important property during the calibration by the instrument, and control systems adopted in machining operations for every engineering application. The course enumerates about the measurements and control system of various parameters of various engineering applications.

Course Objectives:

The course focuses on imparting the principles of measurement which includes the working mechanism of various sensors and devices that are in use to measure the important physical variables of various mechatronic systems.

Course Outcomes:

After undergoing the course, the student can select appropriate device for the measurement of parameters like temperature, pressure, speed, stress, humidity, flow velocity etc., and justify its use through characteristics and performance.

	Course Outcomes	Cognitive Level as per Bloom's Taxonomy	PO
CO1	The student will be able to apply the basic measurements using different instruments.	Applying	PO1, PO2, PO3, PO6, PO12
CO2	The student will be able to analyze the usage of various measuring instruments to measure pressure, level, flow and speed	Analyzing	PO1, PO2, PO3, PO5, PO12
CO3	The student would be able to analyze the importance of measurement of stress, strain, force, torque and power and humidity	Analyzing	PO1, PO2, PO3, PO5, PO12
CO4	The student will be able to learn about various types of control systems and servomechanisms to measure temperature, speed and position.	Understanding	PO1, PO2, PO3, PO4, PO12

Unit-I:

Definition – Basic principles of measurement – measurement systems, generalized configuration and functional descriptions of measuring instruments – examples. Dynamic performance characteristics – sources of error, classification and elimination of error.

Measurement of Displacement: Theory and construction of various transducers to measure displacement – piezo electric, inductive, capacitance, resistance, ionization and photo electric transducers, calibration procedures.

Measurement of Temperature: Classification – ranges – various principles of measurement –expansion, electrical resistance – thermistor – thermocouple – pyrometers – temperature indicators.

Outcome: The student will be able to apply the basic measurements using different instruments.
Activity: The students are directed to perform a group activity by assigning different measuring instruments to each group for calibration and record the values practically

Unit-II:

Measurement of Pressure: Units – classification – different principles used. Manometers, piston, bourdon pressure gauges, bellows – diaphragm gauges. low pressure measurement – thermal conductivity gauges– ionization pressure gauges, McLeod pressuregauge.
Measurement of Level: Direct method – indirect methods –capacitative, ultrasonic, magnetic, cryogenic fuel level indicators – bubbler level indicators.

Flow Measurement: Rota meter, magnetic, ultrasonic, turbine flow meter, hot – wire anemometer, laser Doppler anemometer (LDA).
Measurement of Speed: Mechanical tachometers – electrical tachometers – stroboscope, noncontact type of tachometer

Outcome: The student will be able to analyze the usage of various measuring instruments to measure pressure, level, flow and speed
Activity: The activity performed in this unit II is to prepare a prototype to enumerate the concept of measurement of flow, pressure, level and speed.

Unit-III:

Measurement of Acceleration and Vibration: Different simple instruments – principles of seismic instruments – Vibrometer and accelerometer using this principle.
Stress Strain Measurements: Various types of stress and strain measurements – electrical strain gauge – gauge factor – method of usage of resistance strain gauge for bending compressive and tensile strains – usage for measuring torque, strain gauge rosettes.

Measurement of Force, Torque and Power- Elastic force meters, load cells, torsion meters, dynamometers.

Measurement of Humidity – Moisture content of gases, sling psychrometer, absorption psychrometer, dew point meter

Outcome: The student would be able to analyze the importance of measurement of stress, strain, force, torque and power and humidity.
Activity: In this unit, the student has to perform the activity to measure the stress strain for bending and tensile loads with the help of electrical resistance like wheat stone bridge to measure practically

Unit-IV:

Elements of Control Systems: Introduction, importance – classification – open and closed systems, servomechanisms–examples with block diagrams– temperature, speed & position control systems.

Outcome: The student will be able to learn about various types of control systems and servomechanisms to measure temperature, speed and position.

Activity: Student will be assigned with a group and are allowed to measure the temperature, speed and position by using servomechanism and servo motors.

Unit-V:

Stability Analysis in S-Domain

The concept of stability – Routh's stability criterion – qualitative stability and conditional stability limitations of Routh's stability.
The root locus concept – construction of root loci-effects of adding poles and zeros to G(s)H(s) on the root loci.

Outcome: The student will be able to analyze the concept of stability of control systems

Activity: Students are given mathematical problems to solve related to concept of stability and stability criterion.

Text Books:

1. Measurement Systems: Applications & design by D.S Kumar.
2. Mechanical Measurements / BeckWith, Marangoni, Linehard, PHI /PE
3. Automatic Control Systems 8th edition– by B. C. Kuo 2003– John wiley and son's.,
4. Control Systems Engineering – by I. J. Nagrath and M. Gopal, New Age International (P) Limited, Publishers, 2ndedition.

Reference Books:

1. Measurement systems: Application and design, Doeblin Earnest.O. Adaptation by Manik and Dhanesh/TMH.
2. Experimental Methods for Engineers /Holman
3. Mechanical and Industrial Measurements / R.K. Jain/ Khanna Publishers.
4. Instrumentation, measurement & analysis by B.C.Nakra & K.K.Choudhary, TMH.
5. Control Systems by N.K.Sinha, New Age International (P) Limited Publishers, 3rd Edition,1998.
6. Control Systems Engg. by NISE 3rd Edition – JohnWiley.

Course Code		L	T	P	Credits
1003172206	INDUSTRIAL ENGINEERING AND MANAGEMENT	3	1	0	3

Course Overview:

This course deals with the concepts of industrial engineering and management in order to enhance the utilization of resources and increase the productivity.

Course Objectives:

To impart fundamental knowledge and skill sets required in the industrial Management and Engineering profession, which include the ability to apply basic knowledge of mathematics, probability and statistics, and the domain knowledge of Industrial Management and Engineering.

Course Outcomes:

	Course Outcomes	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Apply the concepts of management and industrial engineering.	Applying	PO1, PO4,PO11
CO2	Design a plant layout for specific industry	Applying	PO4,PO5
CO3	Identify the governing factors for selection of plant location for setting a specific industry	Applying	PO2,PO9
CO4	To choose the appropriate quality control technique in a manufacturing industry.	Remembering	PO6,PO3
CO5	Compute the project completion time for a specific project	Applying	PO8,PO11

Unit-I:

Introduction: Concepts of management –role of an industrial engineer – functions of management - Fayol's principles of management - Taylor's scientific management-production management, productivity. Quantitative tools of I.E - Mc Gregor theory X and theory Y - applications of I.E.

Outcome: Apply the concepts of industrial engineering and management. Also to understand the modern management theory, Taylor's scientific management, and behavior of employees in an organization

Activity: Presentations and object-oriented tests.

Unit-II:

Plant Layout: Governing factors for selection of plant location, types of plant layouts, advantages and disadvantages of different plant layouts- applications, optimal design of plant layouts. Plant maintenance, preventive and breakdown maintenance- Case studies

Outcome: Knowledge for selection of plant location to establish industries, various types of plant layouts, and plant maintenance

Activity: Make physical models of various plant layouts

Unit-III:

Operations Management: Types of production and their applications. Work study-method study and time study, PMTS, MTM, work factor system, micro- motion study and its principles, process charts- operation process chart, flow process chart, flow diagram string diagrams and therbligs. Principles of ergonomics.

Material Handling: Introduction to material handling and different types of equipment's.

Outcome: To understand the different types of production and their applications. To gain the knowledge on work study and various operation process charts.

Activity: Work study based activities – Monitor/record the time taken to assemble the bolt, washer and nut.

Unit-IV:

Statistical Quality Control: Quality control and its importance, 100 % inspection and sampling inspection, SQC. Control charts for variables and attributes- X bar and R charts, P and C charts and their applications, numerical examples.

Total Quality Management: Concepts of zero defect, Six sigma, Lean manufacturing, cause and effect diagram. Supply chain management and inventory control. ISO quality systems.

Outcome: Knowledge on quality control, SQC, sampling inspection, and various control charts. To understand the concepts of TQM, six-sigma, and ISO quality systems.

Activity: Measure the dimensions of a given specimen and draw the control charts

Unit-V:

Resource Management: Concept of human resource management (HRM), functions of HRM/ personnel management, Job evaluation, its importance and types, merit rating, quantitative methods, wage incentive plans, types.

Project Management: PERT, CPM–differences &applications. Determination of critical path and its importance, numerical examples.

Value Analysis: Value engineering, implementation procedure, enterprise resource planning.

Outcome: To understand the concepts of HRM, Job evaluation, and wage incentive plans in an organization. To gain the knowledge on project management using PERT and CPM techniques.

Activity: Determine the project completion time. Ex. House construction

Text Books:

1. Industrial Engineering and Management Science/ T. R. Banga, S. C.Sharma, N. K. Agarwal / Khanna Publishers
2. Industrial Engineering and Production management/ Martand Telsang/S.Chand& Company Ltd. NewDelhi

Reference Books:

1. Industrial Engineering and management/O.P Khanna / Khanna Publishers.
2. Industrial Management / Bhattacharya DK/Vikas publishers
3. Essentials of Management by Koontz & O' Donald- Mc Graw Hill
4. Operations Management / J.G Monks/Mc Graw Hill Publishers.
5. Statistical Quality Control /Gupta/Khanna Publishers
6. Industrial Engineering and Management/NVS Raju/Cengage Publishers

Course Code		L	T	P	Credits
1003172221	PRODUCTION TECHNOLOGY LAB	0	0	3	2

Course Objectives:

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

Note: Minimum of 12 Exercises need to be performed Metal

Casting:

1. Pattern Design and making –for one casting drawing.
2. Sand properties testing -for strength and permeability
3. Mould preparation, Melting and Casting–Visual Study of the Casting defects and reporting the probable causes.

Welding:

1. Gas welding
2. Gas cutting
3. Manual metal arc welding – Lap & Butt Joints
4. TIG/MIG Welding
5. Resistance Spot Welding
6. Brazing and soldering

Metal Forming and Powder Metallurgy:

1. Blanking &Piercing operations and study of simple, compound and progressive dies.
2. Deep drawing and extrusion operations.
3. Bending and other operations
4. Basic powder compaction and sintering

Processing of Plastics

1. Injection Moulding
2. Blow Moulding

Course Code		L	T	P	Credits
1003172222	ELECTRICAL & ELECTRONICS ENGINEERING LAB	0	0	3	2

Course Objectives:

To impart hands-on practical exposure on electrical and electronics engineering equipment's.

Section A: Electrical Engineering

The following experiments are required to be conducted as compulsory experiments:

1. Swinburne's test on D.C. Shunt machine (Predetermination of efficiency of a given D.C. Shunt machine working as motor and generator).
2. OC and SC tests on single phase transformer (Predetermination of efficiency and regulation at given power factors).
3. Brake test on 3-phase Induction motor (Determination of performance characteristics).
4. Regulation of alternator by Synchronous impedance method.
5. Speed control of D.C. Shunt motor by a) Armature Voltage control b) Field flux control method
6. Brake test on D.C. Shunt Motor.

Section B: Electronics Engineering

1. PN junction Diode characteristics A. Forward bias, B. Reverse bias. (Cut in voltage & Resistance calculations)
2. Transistor CE Characteristics (Input and Output).
3. Full wave Rectifier with and without filters.
4. CE Amplifiers.
5. RC Phase Shift Oscillator.
6. Class A Power Amplifier.

Course Code	INDUSTRIAL VISIT	L	T	P	Credits
1003172231		0	0	0	2

Industrial Visit: The industrial visit shall be carried out in their domain during the summer vacation after the second year second semester. A student has to submit a report which will be evaluated for 100 marks and will be submitted to an internal evaluation committee comprising Head of the Department or his / her nominee and two senior faculty of the department including the industrial visits coordinator/ supervisor. The industrial visit report shall be evaluated at the beginning of third year first semester before the first mid-term exams**.** Industry oriented MOOCs course (including NPTEL/ Coursera) for not less than EIGHT weeks can be considered as equivalent. The list of courses in such case shall be approved by Head of the department concerned. The registered course must not be same as any of the courses listed in the program structure of their regulation till final year. Marks/grades are awarded based on the performance in viva voce or written examination conducted for Coursera courses and online courses other than SWAYAM/NPTEL where there is no end examination.

PROGRAM STRUCTURE

FOR

III-B.Tech

I & II SEMESTER

DEPARTMENT OF MECHANICAL ENGINEERING

PROGRAM STRUCTURE

III B.Tech I Semester

S.No.	Course Code	Course Title	L	T	P	Credits
1	1003173101	Dynamics of Machinery	3	1	0	3
2	1003173102	Manufacturing technology -II	3	1	0	3
3	1003173103	Design of Machine Members – II	3	1	0	3
4	1003173104	Thermal Engineering – II	3	1	0	3
5	1003173105	Metrology	3	1	0	3
6	1003173121	Kinematics & Dynamics Lab	0	0	3	2
7	1003173122	Thermal Engineering Lab	0	0	3	2
8	1003173123	Instrumentation and Metrology Lab	0	0	3	2
9	1099173101	IPR & Patents	1	0	0	0
Total Credits:						**21**

III B.Tech - II Semester

S. No	Course Code	Course Title	L	T	P	Credits
1	1003173201	Finite Element Methods	3	1*	0	3
2	1003173202	Heat Transfer	3	1*	0	3
3	1003173203	Robotics	3	1*	0	3
4	1003173204	Operations Research	3	1*	0	3
5	**Open Elective-I**		3	1*	0	3
	1005173206	Introduction to Data Base Management Systems				
	1005173207	Introduction to Python Programming				
	1001173207	Waste Water Management				
	1099173201	Entrepreneurship Development				
6	**Open Elective-II (CBCS) (MOOCS)**		3	1*	0	3
	1003173291	Artificial Intelligence search methods for Problem solving				
		• Electrical Measurements & • Electronic Instruments				
		Sustainable Materials and Green Building				
		• Control systems				
		*Any available online course approved by department committee at the time of semester commencement.				

7	1099172103	Professional Ethics & Human Values	2		0	0
8	1003173221	Machine Tools and Metal Cutting Lab	0		3	2
9	1003173222	Heat Transfer Lab	0		3	2
10	1003173223	CAE Lab (FEA+CFD)	0		3	2
Total Credits:						**24**

S. No	Course Code	Course Title	L	T	P	Credits
1	1003173241	Industry Oriented Mini Project	0		0	2

DETAILED SYLLABUS

FOR

III B.Tech

I SEMESTER

Course Code		L	T	P	Credits
1003173101	DYNAMICS OF MACHINERY	3	1	0	3

Course Overview:

The course deals with the stabilization of sea vehicles, aircrafts and automobile vehicles, dynamic forces acting on the flywheels and governors, calculating balancing of rotary and reciprocating masses and understand how to determine the natural frequencies of vibrating systems.

Course Objectives: This course gives the

1. To equip the student with fundamental knowledge of dynamics of machines so that student can appreciate problems of dynamic force balance, transmissibility of forces, isolation of systems, vibrations.
2. To develop knowledge of analytical and graphical methods for calculating balancing of rotary and reciprocating masses.
3. To develop understanding of vibrations and its significance on engineering design.
4. To develop understanding of dynamic balancing, flywheel analysis, gyroscopic forces and moments.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Analyze stabilization of sea vehicles, aircrafts and automobile vehicles.	Applying	PO:1, PO: 2
CO2	Compute frictional losses and torque transmission of mechanical systems.	Applying	PO:1, PO:2
CO3	Understand the dynamic forces acting on the flywheels and governors.	Evaluating	PO:1, PO:2, PO:3
CO4	Apply analytical and graphical methods of calculating balancing of rotary and reciprocating masses.	Applying	PO:2
CO5	Determine the natural frequencies of vibrating system.	Applying	PO :2

Unit-I:

Precession:

Gyroscopes, effect of precession motion on the stability of moving vehicles such as motor car, motor cycle, aero planes and ships (Demonstration of models in video show).

Outcome: Analyze stabilization of sea vehicles, aircrafts and automobile vehicles.

Activity: Calculation of gyroscopic effect by using lab experimental setup.
Unit-II:

Clutches:

Friction clutches- uniform pressure, uniform wear, single disc or plate clutch, multiple disc clutch, cone clutch, centrifugal clutch.

Brakes and Dynamometers:

Simple block brakes, internal expanding brake, band brake of vehicle. General description and operation of dynamometers: Prony, Rope brake, Epicyclic, Bevis Gibson and belt transmission

Outcome: Compute frictional losses, torque transmission of mechanical systems.

Activity: Assembly/Disassembly of Clutches (or) Presentation of different types of brakes/clutches used in present applications.

Unit-III:

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.

Governors:

Watt, porter and proell governors, spring loaded governors– Hartnell and Hartung with auxiliary springs. Sensitiveness, isochronisms and hunting.

Outcome: Student will be able to understand the dynamic forces acting on the flywheels and governors.

Activity/Event: Prepare a physical model of flywheel and governor.
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 asses. Analytical and graphical methods, unbalanced forces and couples locomotive balancing, hammer blow, swaying couple, variation of tractive effort.

Outcome: Understand balancing of reciprocating and rotary masses.

Activity/Event: Prepare a model to represent reciprocating/rotary masses.

Unit-V:

Vibrations:

Free and forced vibration of single degree of freedom systems, effect of damping; vibration isolation and transmissibility; resonance; critical speeds of shafts.

Outcome: Understand how to determine the natural frequencies of vibrating systems.

Activity/Event:

Calculating the intensity of vibration and frequencies using experimental setup.

Text Books:

1. Theory of Machines – S. S. Rattan – TMH
2. Theory of Machines – R.S. Khurmi – S.Chand
3. Theory of Mechanisms and Machines – Amithaba Ghosh and A. K. Mallik – East-West Press

Reference Books:

1. Theory of Machines – Sadhu Singh, Pearsons Edn.
2. Mechanical Vibrations – G KGrover
3. Mechanism and Machine Theory - J.S.Rao, RV Dukkipati, NewAge.
4. Mechanism and Machine Theory – Ashok G Ambedkar, PHI Publication.

Course Code		L	T	P	Credits
1003173102	MANUFACTURING TECHNOLOGY- II	3	1	0	3

Course Overview:

This course deals finishing processes of engineering components with included advanced and modern manufacturing process of additive manufacturing. The course is intended to focus upon on basic theory of metal cutting, the various machine tools, their constructional features, mechanisms, operations used for the finishing of products. The economic use of these processes is included to find how best a particular machine tool can be operated. At the end important emerging topics like computer numerical control of machine tools and additive manufacturing are introduced.

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 knowledge of CNC machines and additive manufacturing process.
6. To develop fundamental knowledge on tool materials, cutting fluids and tool wear mechanisms.

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

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Apply cutting mechanics to metal machining based on cutting force and power consumption	Applying	PO:1, PO:2, PO:3
CO2	Operate lathe, milling machines, drill press, grinding machine, etc.	Understanding	PO:1, PO:3, PO:5, PO:7
CO3	Select cutting tools and tool geometries for different metals and operations economically.	Analyzing	PO:1, PO:2, PO:3, PO:4, PO:7
CO4	Understand the principles of CNC Machines and Processes of Additive Manufacturing.	Understanding	PO:1, PO:3, PO:5

Unit-I:

Fundamental of Machining:

Introduction to metal cutting theory – geometry of single point cutting tool, tool angles, systems for description of tool geometry, chip formation and types of chips – chip breakers, mechanics of orthogonal and oblique cutting – Merchant's force diagram, cutting forces, velocity relationships, cutting speeds, feed, depth of cut, tool life, tool wear, coated cutting tools, mach inability, economics of machining, coolants, tool materials and properties

Outcome:

At the end of the unit, the student should be able to compute cutting forces, power consumption in orthogonal metal cutting operations and tool life.

Activity:

The student has to identify the various angles of HSS and Carbide single point cutting tools. Also has to collect different types of chips in the laboratory.

Unit-II:

Lathe Machines:

Engine lathe – principle of working, specification of lathe – types of lathes – work holders tool holders – lathe attachments - taper turning, thread turning –Turret and capstan lathes – Principal features of automatic lathes– classification – single spindle and multi-spindle automatic lathes – tool layout. Machining time and power calculations.

Shaping, Slotting and Planning Machines: Principles of working – principal parts – specifications, operations performed, machining time calculations.

Outcome: At the end of the unit, the student should be able to understand the working of various mechanisms in the machine tools like lathe, shaping, slotting, and planning machines.
Activity: The student has to go to machine tools laboratory and check the specifications of lathe and shaper

Unit-III:

Drilling & Boring Machines:

Principles of working, specifications, types, operations performed – tool holding devices – deep hole drilling, Nomenclature of twist drill – Machining time calculations. Boring and other hole related 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. Machining time calculations. Broaching operation.

Outcome:

At the end of the unit, the student should be able to understand the working of various mechanisms in the machine tools hole making machines and milling machines.

Activity: The student has to go to machine tools laboratory and do the indexing using dividing head.

Unit-IV:

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. Machining time calculations in grinding. Lapping, Honing, Chemical mechanical polishing, Magneto-rheological finishing processes.

Outcome: At the end of the unit, the student should be able to understand the theory of grinding and compute machining time in grinding process.

Activity: The student has to go to machine tools laboratory and feel difference in surface finish produced by different machine tools.

Unit-V:

Jigs & Fixtures:

Principles of design of jigs and fixtures and uses, classification of jigs & fixtures, principles of location and clamping, types of clamping & work holding devices.

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.

Additive Manufacturing:
Introduction to additive manufacturing, classification of additive manufacturing technologies, FDM, SLS, SLM, Advantages, Applications of additive manufacturing.

Outcome: At the end of the unit, the student should be able to analyze the various jigs and fixture designs, understand the principles of CNC machines and additive manufacturing.

Activity: The student has to go to machine tools laboratory, study and validate the design of any one of the jigs and fixtures available.

Text Books:

1. Machining and Machine Tools/ A.B. Chattopadhyay /Wiley publishers- 2nd Edition
2. Manufacturing Technology Vol-II/P.N Rao/Tata McGraw Hill
3. Manufacturing Processes /JP Kaushish/ PHI Publishers-2ndEdition

Reference Books:

1. Metal cutting and machine tools /Geoffrey Boothroyd, Winston A. Knight/ Taylor &Francis
2. Manufacturing Processes for Engineering Materials-Kalpakjian S & Steven RSchmid/Pearson Publisher- 5thEdition
3. Production Technology / H.M.T. Hand Book (Hindustan Machine Tools).
4. Production Engineering/K.C Jain & A.K Chitaley/PHI Publishers

Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping and Direct Digital Manufacturing/Ian Gibson, David Rosen and Brent Stucker/Springer-2nd Edition.

Course Code	Design of Machine Members– II	L	T	P	Credits
1003173103		3	1	0	3

Course Overview:

The course covers the design of various mechanical machine elements like bearings, IC Engine parts, gears and power transmission systems. It also develops the design aspects of curved beams and mechanics of machine tool elements

Course Objectives:

1. The course gives the insight of sliding and rolling contact bearings with its life prediction.
2. To learn and design various I.C engine parts like Piston, Connecting rod, Crank shaft and Cylinder.
3. To develop knowledge towards crane hooks, power press as curved beam application and design of power screws
4. To design the mechanical power transmission elements such as belts, ropes, chain drives and machine Tool elements likelevers.
5. To impart broad knowledge and applications of spur & helical geardrives.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Design bearings and various I.C engine parts like Piston, Connecting rod, Crank shaft and Cylinder.	Evaluating	PO:1, PO:2, PO:3, PO:12
CO2	Apply the concept of curved beam and design power screws like screw Jack, Differential and compounds crews.	Evaluating	PO:1, PO:2, PO:3, PO:12
CO3	Design various power transmission elements such as belts, ropes, chains, pulleys and machine tool elements of levers.	Evaluating	PO:1, PO:2, PO:3, PO:12
CO4	Analyze the design of spur & helical gear drives along with their applications.	Evaluating	PO:1, PO:2, PO:3, PO:12

Unit-I:

Bearings:

Sliding Contact Bearings:
Classification of bearings, applications, Types of Sliding Contact Bearings, Hydrodynamic Lubricated Bearings, Wedge Film Journal Bearings, Squeeze Film Journal Bearings, bearing materials, Terms used in Hydro-Dynamic journal bearings, Materials used for Sliding Contact Bearings, lubrication – Bearing Characteristic Number and bearing modulus , Coefficient of Friction for Journal Bearing, Critical Pressure of the Journal Bearing, Somerfield Number – heat generated in a journal bearings,– Design Procedure for Journal Bearings – problems.

Rolling Contact Bearings-

Advantages and Disadvantages Over Sliding contact Bearings, Types, standard Dimensions, Designation, Thrust Ball Bearings, Types of Roller Bearings , Basic Static Load Rating of Rolling Contact Bearings, Static Equivalent Load for Rolling Contact Bearings, Life of a Bearing, Basic Dynamic Load Rating of Rolling Contact Bearings, Dynamic Equivalent Load for Rolling Contact Bearings, Dynamic Load Rating for Rolling Contact Bearings under Variable Loads, Reliability of a Bearing, Selection, Materials and Manufacture of Ball and Roller Bearings**.**

Outcome:

Understanding the design of sliding and rolling contact bearing along with life prediction.

Activity:

Service and Maintenance of journal bearing and collection & demonstration of various ball and roller bearings.

Unit-II:

Spur & Helical Gear Drives:

Spur Gear Drive-

Advantages and Disadvantages of Gear Drives, Classification of Gears, Terms used in Gears, Gear Materials, Gear Failures: Contact stresses analysis, Beam Strength of Gear Tooth: Lewis Equation, Permissible Working Stress for Gear Teeth in the Lewis Equation, Dynamic Tooth Load, Static Tooth Load, Wear Tooth Load, Design Procedure for Spur Gears-Problems

Helical Gear Drive-

Terms used in Helical Gears, Face Width of Helical Gears, Formative or Equivalent Number of Teeth for Helical Gears, Proportions for Helical Gears- Strength of Helical Gears-Problems

Outcome:

Determination the strengths of various gear drives.

Activity:

Presentation of various Gear teeth with real time models and explanation of the working of gear drives.

Unit-III:

Design of curved beams:

Introduction, stresses in curved beams, problems with various sections of curved beams

Machine Tool elements:

Design of Levers–hand levers-foot lever – cranked lever.

Wire Ropes- Advantages, Construction, Classification, Designation, properties, Diameter, area, factor of safety, Wire Rope Sheaves and Drums, Fasteners, Stresses in wire ropes, procedure for designing a wire rope

Outcome: Demonstration of various applications of Curved beams, levers and wire ropes.

Activity: Collection of various curved beam components, levers and small pieces of wire ropes.

Unit-IV:

Power transmissions systems:

Flat belt drives-

Types of Belts, Types of Flat Belt Drives, Velocity Ratio of a Belt Drive, Slip of the Belt, Creep of Belt, Length of an Open Belt Drive, Length of a Cross Belt Drive, Power transmitted by a Belt, Ratio of Driving Tensions for Flat Belt Drive, Centrifugal Tension, Maximum Tension in the Belt, Condition for Transmission of Maximum Power, Initial Tension in the Belt

Flat Belt Pulleys-

Types of Pulleys for Flat Belts, Cast Iron Pulleys, Design of Cast Iron Pulleys- Problems

V-Belt and Rope Drives-

Advantages and Disadvantages of V-belt Drive over Flat Belt Drive, Ratio of Driving Tensions for V-belt. Rope Drives, Fibre Ropes, Advantages of Fibre Rope Drives, Sheave for Fibre Ropes, Ratio of Driving Tensions for Fibre Rope.

Chain Drives-

Advantages and Disadvantages of Chain Drive over Belt or Rope Drive, Design Procedure for Chain Drive-Problems

Design of power screws- Design of screw Jack, Differential and compound screws

Outcome: Enhancing of knowledge in differential mechanical power transmissions systems

Activity:

Calculate power transmitted in a system for real time examples like screw jack, floor milling machines etc.

Unit-V:

Internal combustion engine parts:

Connecting Rod- Forces Acting on the Connecting Rod, Design of Connecting Rod,-Problems.

Crankshaft- Types, materials, manufacture of crank shafts, Bearing Pressures and Stresses in Crankshaft, Design of Centre Crankshaft, Side or Overhung Crankshaft–problems.

Piston-Material, Design of Piston: Design of Piston Head, Piston Rings, Barrel, Skirt, Pin-Problems.

Cylinder: Design of a Cylinder-Problems

Outcome: Explore the various IC engine parts in Thermal engineering.

Activity:

Assembly/Disassembly of IC engine parts with real time applications like scooter or car engine.

Text Books:

1. Machine Design/V. Bandari/ TMH Publishers
2. Machine Design/ NC Pandya & CS Shaw/ Charotar publishers
3. Design Data Hand for Mechanical Engineers in SI & Metric Units by K.Mahadevan, K.Balaveera Reddy,CBSPublishers/(ii)DesignDatabookforengineersPSGcollegeofTechnology,Kalaikathir Achchagam, Coimbatore

Reference Books:

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/PearsonPublications
5. A Text Book of Machine Design by R. S. khurmi& J. K. Gupta, S. Chand Publications

Course code	Thermal Engineering – II	L	T	P	Credits
1003173104		3	1	0	3

Course Overview:

The course is intended to provide an insight of steam power cycles and their application in boilers along with knowledge of working principles behind the functioning of steam nozzles, steam condensers and steam turbines. It also covers the theory of jet propulsion and their applications in rockets and gas turbines.

Course Objectives:

1. To make the student learn and understand the working principles of steam engines and methods of improving the cycle performance.
2. To familiarize the student with the various steam engines, boilers along with their function and necessity.
3. To make the student learn about functions, types and applications of steam nozzles.
4. To make the student solve problems on steam nozzles and turbines taking various parameters into consideration.
5. To make students understand the working mechanisms of different types of steam turbines used in industries and various engineering fields.
6. To make students learn mechanical details of gas turbine power plants and their importance in aeronautical field and various industries.
7. To make the student aware of various jet propulsion systems used in research areas.

	Course outcome	**Cognitive Level as per Bloom's Taxonomy**	**PO**
CO1	Explain the working principle of Rankin cycle, actual and ideal, its application in boilers and methods of improving the efficiency by introducing the concept of mean temperature of heat addition.	Applying	PO:1, PO:2, PO:6, PO:7, PO:8, PO:9, PO:10, PO:12
CO2	List out the advantages, applications and types of steam nozzles and condensers.	Applying	PO:1, PO:2, PO:3, PO:4, PO:6, PO:7, PO:8, PO :10, PO:12
CO3	Evaluate the performance of impulse and reaction turbines and to learn about the methods of governing.	Analyzing	PO:1, PO:2, PO:3, PO:4, PO:6, PO:7, PO:8, PO:9, PO:10, PO:12
CO4	Apply the principle of Newton laws to Jet Propulsion and Gas turbine systems.	Analyzing	PO:1, PO:2, PO:3, PO:4, PO:6, PO:7, PO:8, PO:9, PO:10, PO:12

Note: Steam Table book is permitted for examination

Unit-I:

Basic Concepts of Rankine cycle:

Schematic layout, thermodynamic analysis, concept of mean temperature of heat addition, methods to improve cycle performance – regeneration & reheating.

Boilers:

Classification – working principles of L.P & H.P boilers with sketches – mountings and accessories, draught, classification – height of chimney for given draught and discharge, condition for maximum discharge, efficiency of chimney – artificial draught, induced and forced, Introduction to supercritical boilers.

Outcome:

The student is able to understand the basic concepts of Rankine cycle which helps in solving problems related to steam power plants along with different classifications of boilers and their usage according to application.

Activity: Demonstration of various boilers in the thermal lab.

Unit-II:

Steam Nozzles:

Function of a nozzle – applications – types, flow through nozzles, thermodynamic analysis – assumptions -velocity of fluid at nozzle exit-Ideal and actualexpansioninanozzle,velocitycoefficient,conditionformaximumdischarge,critical pressure ratio, criteria to decide nozzle shape: Super saturated flow, its effects, degree ofsuper saturation and degree of under cooling – Wilson line.

Steam Turbines:

Classification – impulse turbine; mechanical details – velocity diagram – effect of friction – power developed, axial thrust, blade or diagram efficiency – condition for maximum efficiency. De-laval turbine – methods to reduce rotor speed-velocity compounding, pressure compounding and pressure & velocity compounding, condition for maximum efficiency.

Outcome:

The student is able to derive and solve equations and problems related to Steam Nozzles and Turbines where the concepts of Degree of reaction, Compounding, Velocity triangles and nozzle shape criteria's are discussed.

Activity:

Steam power plant visit (or) demonstration of impulse turbine in hydraulic machines laboratory.

Unit-III:

Reaction Turbine:

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

Steam Condensers:

Requirements of steam condensing plant – classification of condensers – working principle of different types – vacuum efficiency and condenser efficiency – air leakage, sources and its affects, air pump- cooling water requirement.

Outcome:

The student is able to classify different types of steam condensers and reaction turbines alongside calculations involved in determining the overall performance of the units.

Activity:

Demonstration of reaction turbine in hydraulic machines laboratory (or) Preparation of a cooling tower model.

Unit-IV:

Gas Turbines:

Simple gas turbine plant – ideal cycle, essential components – parameters of performance – actual cycle – regeneration, inter cooling and reheating –closed and semi-closed cycles – merits and demerits, types of combustion chambers.

Outcome:

The student is able to evaluate the performance parameters of a gas turbine plant based on the type of power plant along with merits and demerits.

Activity: Demonstration of a Gas turbine model.

Unit-V:

Jet Propulsion:

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

Rockets:

Application – working principle – classification – propellant type – thrust, propulsive efficiency – specific impulse – solid and liquid propellant rocket engines, Basics of Cryogenic propellants.

Outcome:

The student is able to classify various jet propulsive engines and their applications. A little theory of jet propulsion and rocket physics with equations are discussed.

Activity:

Prepare a small artificial rocket model using gun powder and relevant burning chemicals.

Text Books:

1. Thermodynamics and Heat Engines, Volume 2 - R. Yadav- Central bookdepot.
2. Heat Engineering – V.P Vasandani and D.S Kumar- Metropolitan Book Company, New Delhi
3. Thermal Engineering-R.SKhurmi/JS Gupta/S.Chand.

Reference Books:

1. Thermal Engineering – By R.K Rajput / Laxmi Publications.
2. Gas Turbines and Propulsive Systems – P. Khajuria& S. P. Dubey -/Dhanpatrai
3. Gas Turbines / Cohen, Rogers and SaravanaMuttoo / Addison Wesley–Longman
4. Gas Turbines – V. Ganesan/TMH

Course Code		L	T	P	Credits
1003173105	**METROLOGY**	3	1	0	3

Course Overview:

Inspection of engineering parts with various precision instruments and evaluate machine tool quality

Course Objectives:

1. Inspection of engineering parts with various precision instruments.
2. Design of part, tolerances and fits.
3. Principles of measuring instruments and gauges and their uses.
4. Evaluation and inspection of surface roughness
5. Inspection of spur gear and thread elements
6. Machine tool testing to evaluate machine tool quality.

Course Outcome:

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Explain the tolerances and fits for selected product quality, Linear and angular measurements	Analyzing	PO:1, PO:2, PO:11, PO:12
CO2	Apply appropriate method and instruments for inspection of various gear elements and thread elements.	Analyzing	PO:1, PO:2, PO:11, PO:12
CO3	Examine surface finish and measure the parts with various comparators.	Understanding	PO:1, PO:2, PO:11, PO:12
CO4	Evaluate the machine tool quality with prescribed alignment tests.	Analyzing	PO:1, PO:2, PO:11, PO:12

Unit-I:

Systems of Limits and Fits:

Introduction to mass production and cost tolerance relation – Definitions- nominal size, tolerance, limits, deviations, fits -Unilateral and bilateral tolerance system, hole and shaft basis systems- interchangeability, & selective assembly. Problems on limits of tolerance and allowance, International standard system of limits and fits, selection of limits and tolerances.

Introduction to geometrical Tolerances- Classification (Circularity, Cylindricity, Concentricity, Parallelism)

Outcome: 1.Design of part, tolerances and fits.
2. Identify various in fits in various assemblies

Activity:

Demo of Alignment tests on Lathe, Milling and Drilling machines in machine tool lab

Unit-II:

Linear Measurement:

Length standards, end standards, slip gauges- dial indicators-plunger type& lever, micrometers-outside, inside, depth,differential & vernier micrometers

Measurement of Angles and Tapers:

Different methods – bevel protractor, angle slip gauges- angle dekkor- spirit levels- sine bar- sine table, rollers and spheres used to measure angles and tapers.

Limit Gauges:

Description of go and no go gauges; plug, ring, snap, gap, taper, profile and position gauges. Design of GO and NOT-GO plug and ring gauges, Taylor's principle

Outcome:

Student will be able to Select suitable instrument for particular measuring parameter.

Activity:

Demo on principle of operation and working of linear, angular measuring instruments and gauges in Metrology Lab.

Unit-III:

Optical Measuring Instruments:

Tool maker's microscope and uses - Autocollimators, Optical projector & optical flat.

Interferometry:

Principle of Interference of light, Michelson's interferometer, NPL flatness interferometer, and NPL gauge interferometer.

Flatness Measurement:

Straight edges- Surface plates – Auto collimator.

Outcome:
Student will be able to **e**xplain difference between mechanical and optical measurements and mechanisms.

Activity: Demo on optical measuring instruments in Metrology Lab.

Unit-IV:

Surface Roughness Measurement:

Introduction-surface texture-I,II,III & IV order, Terminology as per Indian standards, Differences between surface roughness and surface waviness – Numerical assessment of surface finish-CLA,R.M.S. Rz, Ten points method Method of measurement of surface finish – Profilograph, Talysurf, ISI symbols for indication of surfacefinish.

Comparators:

Classification-description of different types - mechanical, optical,
Electrical and electronic, pneumatic comparators.

Outcome:

Student will be able to link up with different production processes and their machined surfaces.

Activity:

Sample collection of different machining components from various machining processes for surface observation.

Unit-V:

Gear Measurement:

Nomenclature of gear tooth, tooth thickness measurement with gear tooth vernier caliper, pitch measurement, total composite error and tooth to tooth composite errors, rolling gear tester.

Screw Thread Measurement:

Elements of Screw – Errors in screw threads- concept of virtual effective diameter, measurement of effective diameter, angle of thread and thread pitch.

Machine Tool Alignment Tests:

Machine tool alignment testing on lathe, drilling and milling machines.

Outcome:

Student will be able to
1. Explain profiles with nomenclature with the help of sample wooden piece.
2. Conduct alignment tests for lathe, Milling and Drillingmachine.

Activity: 1.Students are assigned to make wooden/ aluminium models.
2. Demo on alignment tests in machine tool lab.

Text Books:

1. Engineering Metrology / R.K.Jain / Khanna Publishers
2. 2.Engineering Metrology / I.C.Gupta / Dhanpat Rai Publishers

Reference Books:

1. Dimensional Metrology/Connie Dotson/Cengage Learning
2. Engineering Metrology / Mahajan / Dhanpat Rai Publishers
3. Engineering Metrology / KL Narayana/Scitech publishers
4. Precision Engineering in Manufacturing / R.L.Murthy / New Age
5. Engineering Metrology and Measurements / NV Raghavendra, L Krishna murthy/ Oxford publishers

Course code		L	T	P	Credits
1003173121	KINEMATICS AND DYNAMICS LAB	0	0	3	2

Course Objectives:

The objective of the lab is to understand the kinematics and dynamics of mechanical elements such as linkages, gears, cams and learn to design such elements to accomplish desired motions or tasks.

Course Outcomes:

Upon successful completion of this lab, students should be able to:

- Understand types of motion
- Analyse forces and torques of components in linkages
- Understand static and dynamic balance
- Understand forward and inverse kinematics of open-loop mechanisms

List of Experiments:

1. Mechanism based experiment: To develop a four bar mechanism with given components and study about Grashoff and Non-grash off linkages
2. A pantograph to be prepared and analysed to produce straight line mechanism
3. To plot slider displacement, velocity and acceleration against crank rotation for single slider crank mechanism/Four bar mechanism
4. To plot follower displacement vs cam rotation for various Cam Follower systems.
5. To find coefficient of friction between belt and pulley.
6. To study various types of gears- Spur, Helical, Worm and Bevel Gears
7. To determine the moment of inertia of irregular object using Trifilar Pendulum
8. To determine whirling speed of shaft theoretically and experimentally.
9. 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.
10. To analyse the motion of a motorized gyroscope when the couple is applied along its spin axis
11. To study the static and dynamic balancing using rigid blocks.
12. To study simple and compound screw jack and determine the mechanical advantage, velocity ratio and efficiency
13. 13.To determine the frequency of undamped free vibration of an equivalent spring mass system and to determine the frequency of damped force vibration of a spring mass system

Note: Perform any ten out of thirteen experiments from the above.

Course code		L	T	P	Credits
1003173122	**THERMAL ENGINEERING LAB**	0	0	3	2

Course Objectives:

To impart practical exposure to the student on the performance evaluation methods of various types of internal combustion engines and compressors.

Course Outcomes:

The student will be able to calculate the various efficiencies, various horse powers and energy balance for several types of Internal Combustions Engines and compressors.

List of Experiments

1. Dis-assembly / assembly of I.C Engines.
2. I.C. Engines valve / port timing diagrams.
3. Performance test on 4 -stroke diesel engine.
   (OR)
   Performance test on 4 -stroke petrol engine.
4. 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 FHP by retardation test on IC engine.
   (OR)
   Determination of FHP by motoring test on IC engine.
7. I.C. Engine heat balance sheet – SI engine. (OR)
   I.C. Engine heat balance sheet – CI engine.
8. Emission test on 4 -stroke diesel engine.
   (OR)
   Emission test on 4 -stroke petrol engine.
9. Economical speed test of an IC engine.
10. Performance test on variable compression ratio engine.
11. Volumetric efficiency of reciprocating air compressor unit.
12. Study of boilers

Note: Perform any ten out of twelve experiments from the above.

Course code		L	T	P	Credits
1003173123	INSTRUMENTATION AND METROLOGY LAB	0	0	3	2

Course Objectives:

The Metrology and instrumentation Laboratory course is designed for measuring and gauging instruments for inspection of precision linear and angular measurements. The student can learn the measurements with and calibration of instruments. They also understand the machine tool alignment test. Instrumentation lab introduces the students with the theory and methods for conducting experimental work in the laboratory and calibration of various instruments for measuring pressure, temperature, displacement, speed, strain, angle, flow, vibration etc.

Metrology Lab

1. Measurement of lengths, heights, depths, diameters by steel rule, Vernier callipers, Vernier height gauge and outside micrometers
2. Measurement of bores by internal micrometers and dial bore indicator
3. Use of gear tooth Vernier calliper for checking the chordal thickness of spur geartooth
4. Machine tool alignment test on the lathe
5. Machine tool alignment test on drillingmachine
6. Machine tool alignment test on milling machine
7. Angle and taper measurements with bevel protractor and Sinebar
8. Thread angle measurement by Two-ballmethod

Instrumentation Lab

1. Calibration of Bourdon's tube **pressure** gauge in pressure measurement
2. Calibration of RTD transducer for **temperature** measurement
3. Study and calibration of LVDT transducer for **displacement** measurement
4. Measurement of strain using strain gauge on a bar with weights
5. Calibration of **strain** gauge with known weights
6. Calibration of thermocouple in Temperature measurement
7. Calibration of capacitive transducer in **angular displacement** measurement
8. Study and calibration of photo and magnetic speed pickups in **speed** measurement
9. Study and calibration of a rotameter in flow measurement
10. Study and use of a seismic pickup for the measurement of vibration amplitude of a lathe machine at various speeds.

Note: The students have to conduct at least 6 experiments from each lab

Course Code		L	T	P	Credits
1099173101	IPR& PATENTS	1	0	0	0

Course Objectives:

To know the importance of Intellectual property rights, which plays a vital role in advanced Technical and Scientific disciplines.

Imparting IPR protections and regulations for further advancement, so that the students can familiarize with the latest developments.

Course Outcomes:

IPR Laws and patents pave the way for innovative ideas which are instrumental for inventions to seek Patents.

Student gets an insight on Copyrights, Patents and Software patents which are instrumental for further advancements.

Unit-I:

Introduction to Intellectual Property Rights (IPR)

Concept of Property - Introduction to IPR – International Instruments and IPR - WIPO - TRIPS – WTO -Laws Relating to IPR - IPR Tool Kit - Protection and Regulation - Copyrights and Neighboring Rights – Industrial Property – Patents - Agencies for IPR Registration – Traditional Knowledge –Emerging Areas of IPR - Layout Designs and Integrated Circuits – Use and Misuse of Intellectual Property Rights.

Unit-II: Copyrights and Neighboring Rights

Introduction to Copyrights – Principles of Copyright Protection – Law Relating to Copyrights - Subject Matters of Copyright – Copyright Ownership – Transfer and Duration – Right to Prepare Derivative Works –Rights of Distribution – Rights of Performers **–** Copyright Registration – Limitations – Infringement of Copyright – Relief and Remedy – Case Law - Semiconductor Chip Protection Act

Unit-III: Patents

Introduction to Patents - Laws Relating to Patents in India – Patent Requirements – Product Patent and Process Patent - Patent Search - Patent Registration and Granting of Patent - Exclusive Rights – Limitations - Ownership and Transfer — Revocation of Patent – Patent Appellate Board - Infringement of Patent – Compulsory Licensing — Patent Cooperation Treaty – New developments in Patents – Software Protection and Computer related Innovations.

Trademarks

Introduction to Trademarks – Laws Relating to Trademarks – Functions of Trademark – Distinction between Trademark and Property Mark – Marks Covered under Trademark Law - Trade Mark Registration – Trade Mark Maintenance – Transfer of rights - Deceptive Similarities

- Likelihood of Confusion - Dilution of Ownership – Trademarks Claims and Infringement – Remedies – Passing Off Action.

Unit-IV: Trade Secrets

Introduction to Trade Secrets – General Principles - Laws Relating to Trade Secrets - Maintaining Trade Secret – Physical Security – Employee Access Limitation – Employee

Confidentiality Agreements – Breach of Contract –Law of Unfair Competition – Trade Secret Litigation – Applying State Law.

Unit-V:Cyber Law and Cyber Crime

Introduction to Cyber Law – Information Technology Act 2000 - Protection of Online and Computer Transactions - E-commerce - Data Security – Authentication and Confidentiality - Privacy - Digital Signatures – Certifying Authorities - Cyber Crimes - Prevention and Punishment – Liability of Network Providers.

Relevant Cases Shall be dealt where ever necessary.

Reference Books:

- Intellectual Property Rights (Patents & Cyber Law), Dr. A. Srinivas. Oxford University Press, New Delhi.
- Deborah E. Bouchoux: Intellectual Property, C engage Learning, New Delhi.
- Prabhuddha Ganguli: Intellectual Property Rights, Tata Mc-Graw –Hill, New Delhi
- Richard Stim: Intellectual Property, Cengage Learning, New Delhi.
- Kompal Bansal &Parishit Bansal Fundamentals of IPR for Engineers, B. S. Publications (Press).
- Cyber Law - Texts & Cases, South-Western's Special Topics Collections
- R.Radha Krishnan, S. Balasubramanian: Intellectual Property Rights, Excel Books. New Delhi.
- M.Ashok Kumar and MohdIqbal Ali: Intellectual Property Rights, Serials Pub.

DETAILED SYLLABUS

FOR

III B.Tech

II SEMESTER

Course Code		L	T	P	Credits
1003173201	**FINITE ELEMENT METHODS**	3	1	0	3

Course Overview:

This course is an introduction to the finite element method as applicable to a range of problems in physics and engineering sciences. The treatment is mathematical, but only for the purpose of clarifying the formulation. This *course* introduces *finite element methods* for the analysis of solid, structural, fluid, field, and heat transfer problem

Course Objectives:

1. Understand the basic principles of finite element analysis procedure
2. Know the Theory and characteristics of finite elements that represent engineering structures.
3. Understand 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.

Learn to model complex geometry problems and solution techniques.

	Course outcome	**Cognitive Level as per Bloom's Taxonomy**	**PO**
CO1	Understand the concepts behind variational methods and weighted residual methods in FEM.	Understanding	PO:1 , PO:2, PO:3
CO2	Identify the application and characteristics of FEA elements such as bars, beams, plane and isoparametric elements.	Analyzing	PO:1, PO:2, PO:3, PO:4, PO:5
CO3	Apply suitable boundary conditions to a global structural equation, and reduce it to a solvable form.	Evaluating	PO:1, PO:2, PO:3, PO:4, PO:5
CO4	Able to identify how the finite element method expands beyond the structural domain, for problems involving dynamics, heat transfer, and fluid flow.	Applying	PO:1, PO:2, PO:3, PO:4, PO:5, PO:6, PO:12

Unit-I:

Introduction to finite element method, Weak form; Formulation of Finite Element Equations for 1D elements: 1D beam (weak formulation of governing differential equations); Discretization of weak form and boundary conditions, concept of potential energy (PE), one dimensional problems

Outcome:

Understand the concepts behind variation methods. Implement numerical methods to solve mechanics of solids problems.

Activity: Modeling of the stepped bar with reference of machine tools experiment.

Unit-II:

Discretization of domain, element shapes, Discretization procedures, assembly of stiffness matrix, band width, node numbering, mesh generation, interpolation functions, local and global coordinates, convergence requirements, treatment of boundary conditions: elimination approach and penalty approach, Analysis of one dimensional bar problems.

Outcome:

Identify the application and characteristics of FEA elements such as bars, beams, Develop element characteristic equation procedure and generation of global stiffness equation will be applied.

Activity: 1. Prepare finite element models for different types of 1-Dbar.
2. Prepare simple truss model using truss elements.

Unit-III:

Analysis of Trusses: Finite element modeling coordinates and shapes 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 Hermit beam element, derivation of load vector for concentrated and UDL, simple problems on beams.

Outcome: Able to give the differences between 1-D, and 2-D finite element analysis procedure.

Activity:

Sample beam deflection activity, Draw bending moment and shear force diagrams of Beams and Frames using FEM approach.

Unit-IV:

Finite element modeling one and two dimensional heat transfer**:** 2D conduction. Formulation of axis-symmetric problems. Two dimensional four nodded isoperimetric elements and numerical integration.

Outcome:

Implement the formulation techniques to solve two-dimensional problems using triangle and quadrilateral elements.

Activity: Prepare finite element model of 2-D plate with triangular elements.

Unit-V:

Dynamic Analysis: Formulation of finite element model, element consistent and lumped mass matrices, evaluation of eigen values and eigen vectors, free vibration analysis of 1-D bar elements. Steady state heat transfer analysis: one dimensional analysis of a fin and two dimensional analysis of thin plate.

Outcome:

Able to identify how the finite element method expands beyond the structural domain, for problems involving dynamics, heat transfer, and fluid flow.

Activity: Prepare the rectangular fin.

Text Books:

1. Introduction to Finite Elements in Engineering / Chandraputla, Ashokand Belegundu / Prentice – Hall

Reference Books:

1. S.S. Rao, The Finite Element Method in Engineering, Pergamon(2004)
2. K. J. Bathe, Finite Element Procedures, Prentice Hall(1996)
3. J. N. Reddy, An Introduction to Finite Element Method, McGraw Hill Publication(2003)

Course Code		L	T	P	Credits
1003173202	**HEAT TRANSFER**	3	1	0	3

Course Overview:

This course is intended to impart knowledge of principles of heat transfer and analyze the heat exchange process in various modes for the evaluation of rate of heat transfer and the temperature distribution in different configurations.

Course Objectives:

1. To formulate suitable mathematical equation in Cartesian, cylindrical and spherical coordinate system subjected to various boundary conditions.
2. To study the mechanism of convection heat transfer by 3 modes namely Conduction, Convection, Radiation and their governing equations.
3. To enumerate the phenomena of radiation heat transfer subjected to various laws of radiation.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Apply the basic laws of heat transfer to account for the consequence of heat transfer in thermal analyses of engineering systems to analyze problems involving steady and transient state heat conduction in simple geometries and to design an extended surface for heat transfer enhancement.	Applying	PO:1, PO:2, PO:3, PO:4, PO:6, PO:7, PO:8, PO:10, PO:12
CO2	Evaluate heat transfer coefficients for natural convection, forced convection and for a phase change process.	Analyzing	PO:1, PO:2, PO:3, PO:4, PO:5, PO:6, PO:7, PO:8, PO:10, PO:12
CO3	Design and develop a heat exchanging system for the basic engineering applications by analyzing its performance	Analyzing	PO:1, PO:2, PO:3, PO:4, PO:6, PO:7, PO:8, PO:9, PO:10, PO:12
CO4	Construct electrical analogy networks through basic principles of radiation to estimate the radiative heat exchange between the bodies.	Analyzing	PO:1, PO:2, PO:3, PO:4, PO:6, PO:7, PO:8, PO:9, PO:10, PO:12

Note: Heat and Mass Transfer Data book is permitted for examination.

Unit-I:

Introduction:
Modes and mechanisms of heat transfer, basic laws of heat transfer, General discussion about applications of heat transfer.

Conduction Heat Transfer:

General heat conduction equation in Cartesian, cylindrical and Spherical coordinates. Steady, unsteady and periodic heat transfer. One dimensional heat transfer through homogeneous slabs, hollow cylinders and spheres – overall heat transfer coefficient – electrical analogy – critical radius of insulation- Variable thermal conductivity – systems with internal heat generation.

Outcome: The student will be able to

1. Study the mechanism of conduction heat transfer in various geometries like slab, cylinder and sphere.
2. Predict the temperature distribution by considering thermal resistance offered by various systems.

Activity:
1. 1. Conduct an experimental investigation through composite wall apparatus by altering wall material in heat transfer laboratory.
2. 2. Perform a test on lagged pipe apparatus to determine optimum radius of insulation.

Unit-II:

Extended Surface (Fins) Heat Transfer:

Classification - long fin, fin with insulated tip and short fin – Efficiency and Effectiveness.

Unsteady State Conduction Heat Transfer:

Unsteady steady state heat conduction- Transient heat conduction- Lumped system analysis, and use of Heisler charts.

Outcome: The student will be able to
1. Estimate efficiency and effectiveness of various types of fins.
2. Study the behavior of lumped heat capacity system using non dimensional numbers like Biot and Fourier numbers etc.

Activity:

1. Perform an experimental study along the length of a fin using free and forced convention approach at various heat loads.
2. Estimate the time lag by quenching a hot billet in water/oil.

Unit-III:

Convection: Continuity, momentum and energy equations- concept of hydro dynamic and thermal boundary layer- application of Dimensional analysis to Free and Forced convection- significance of non-dimensional numbers.

Forced and Free Convection: Introduction to forced convection heat transfer: External flows over flat plates, cylinder, sphere and packed beds with laminar and turbulent flows - Internal Flow through pipes. Introduction to free convection: Flow over vertical surfaces, horizontal plates and cylinders.

Outcome: The student will be able to

1. Understand the variation of boundary layer thickness, on various surface geometries subjected to a temperature gradient.
2. 2. Study the impact of various non dimensional numbers like Reynold, Prandtl, Nusseltetc in convection heat transfer

Activity:

1. Conduct an experimental investigation on a circular rod by natural convection phenomenon.
2. Estimate heat transfer coefficient in a pipe flow using various inserts by forced convection phenomenon.

Unit-IV:

Heat Exchangers: Types of heat exchangers- Parallel flow- Counter flow- Cross flow heat exchangers- Overall heat transfer coefficient- LMTD and NTU methods- Fouling in heat exchangers.

Boiling and Condensation: Different regimes of boiling- condensation- Types of condensation Nusselt's theory of Condensation on vertical flat plate and horizontal tubes- Dropwise condensation.

Outcome: The student will be able to

1. Study the temperature distribution in parallel flow and counter flow heat exchanger.
2. Evaluate effectiveness of heat exchanger.
3. Observe the formulation of thin film subjected to various phases.
4. Differentiate drop wise and film wise condensation.

Activity:

1. Perform an experimental investigation on a parallel flow and counter flow heat exchanger for the same inputs and compare the LMTD.
2. Determine critical heat flux to make use of critical heat flux apparatus

Unit-V:

Radiation:

Black body radiation- radiation field, Kirchoff's laws- shape factor- Stefan Boltzman equation- Heat radiation through absorbing media- Radiant heat exchange, parallel and perpendicular surfaces- Radiation shields.

Outcome: The student will be able to

1. Study the importance of laws used in Radiation heat transfer.
2. Understand the impact of provision of Radiation Shields.

Activity: Prove the Stefen Boltzman Constant value through experimental investigation.

Text Books:

1. Fundamentals of Engg. Heat and Mass Transfer / R. C. Sachdeva / New Age International

Reference Books:

1. Text Book of Heat Transfer by S.P Sukhatme / Universities Press.
2. Heat Transfer /JP HOLMAN/TMH
3. Heat and Mass Transfer /Cengel/McGraw Hill.
4. Heat and Mass Transfer /Arora and Domkundwar/Dhanpatrai& Sons.
5. 5. Introduction to Heat Transfer by S.K. Som / PHI

Course Code		L	T	P	Credits
1003173203	**ROBOTICS**	3	1	0	3

Course Overview:

The course is focused on robots in industrial automation with kinematic and dynamic analysis of manipulators. It also explains the need for automation in industry by discussing the concepts of robot actuators and feedback mechanisms with applications.

Course Objectives:

1. To give students practice in applying their knowledge of mathematics, science, and
2. Engineering and to expand this knowledge into the vast area of robotics.
3. The students will be exposed to the concepts of robot kinematics, Dynamics, Trajectory planning.
4. Mathematical approach to explain how the robotic arm motion can be described.
5. The students will understand the functioning of sensors and actuators.

Course Outcomes:

	Course outcome	**Cognitive Level as per Bloom's Taxonomy**	**PO**
CO1	Identify various robot configuration and components.	Understanding	PO:1, PO:5, PO:6, PO:7, PO:8
CO2	Select appropriate actuators and sensors for a robot based on specific application.	Applying	PO:2, PO:3, PO:4, PO:6, PO:11
CO3	Carry out kinematic and dynamic analysis for simple serial kinematic chains.	Analyzing	PO:2, PO:3, PO:4, PO:7, PO:12
CO4	Perform trajectory planning for a manipulator by avoiding obstacles.	Evaluating	PO:1, PO:2, PO:3, PO:4, PO:5, PO:8, PO:9, PO:10, PO:11, PO:12

Unit-I:

Introduction:

Automation and Robotics, – An over view of Robotics –Classification by coordinate system and control system.

Components of the Industrial Robot:

Common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, determination of the end effectors.

Outcome: 1.Types of robots and arms.

2. Various classification of robots

Activity: Demo on mechatronics system in mechatronics lab.

Unit-II:

Motion Analysis:

Homogeneous transformations as applicable to rotation and translation – problems.

Manipulator Kinematics:

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

Outcome: 1.Transformations of robot arms.

2. Kinematics of manipulators

Activity: Demo on transformations using simulation mode in cad/cam lab.

Unit-III:

Differential Transformation and Manipulators, Jacobians – problems

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

Outcome: Manipulator dynamics using jacobians.

Activity: Video representing of kinematic and dynamic analysis with simulation.

Unit-IV:

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

Outcome:

1. Trajectory planning with via points.
2. Determination of displacement, velocity and acceleration for a curve.

Activity: Demo of linear and circular interpolation with algorithms.

Unit-V:
Robot Actuators and Feed Back Components:

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

Robot Applications: in Manufacturing: Material Transfer - Material handling, loading and unloading- Processing - spot and continuous arc welding & spray painting - Assembly and Inspection.

Outcome: 1. Difference between various actuating systems.

2. Planning for various manufacturing methods.

Activity: Demo of Electric, pneumatic and hydraulic system.

Text Books:

1. Industrial Robotics / Grover M P, M Weiss, R N Nagel, N G Odrey, Ashish Dutta/ Pearson Edu.
2. Robotics and Control / Mittal R K &Nagrath I J / TMH.

Reference Books:

1. Robotics / Fu K S/ McGraw Hill.
2. Robotic Engineering / Richard D. Klafter, Prentice Hall.
3. Robot Analysis and Intelligence / Asada and Slow time / Wiley Inter Science.
4. Introduction to Robotics / John J Craig / Pearson Edu.

Course Code		L	T	P	Credits
1003173204	OPERATIONS RESEARCH	3	1	0	3

Course Overview:

Importance of operations research in various aspects of engineering applications and its performance for best optimum solutions

Course Objectives:

To learn the importance of Operations Research in the design, planning, scheduling, manufacturing and business applications and to use the various techniques of Operations Research in solving such problems.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Apply linear programming model and assignment model to domain specific situations	Applying	PO:1, PO:2,PO:3, PO:6, PO:10, PO:11, PO:12
CO2	Analyze the various methods under transportation model and apply the model for testing the closeness of their results to optimal results	Evaluating	PO:1,PO:2,PO:3,PO:4, PO:6,PO:10,PO:11,PO:12
CO3	Apply the concepts of PERT and CPM for decision making and optimally managing projects	Applying	PO:1,PO:2,PO:3,PO:6, PO:10,PO:11,PO:12
CO4	Analyze the various replacement and sequencing models and apply them for arriving at optimal decisions	Evaluating	PO:1,PO:2,PO:3,PO:4, PO:6,PO:10,PO:11,PO:12

Unit-I:

Linear Programming Problem:

Introduction to Operations Research – Linear Programming - Mathematical Formulation – Graphical method – Simplex method – Two Phase Simplex method, Big-M method, Duality Simplex method.

Outcome: Solve LPP by different methods for optimum solution

Activity: Perform graphical methods for optimal solution.

Unit-II:

Transportation Problem:

Transportation model – Initial solution by North West corner method – least cost method – VAM. Optimality test – MODI method and stepping stone method – Degeneracy.

Assignment Problem: Formulation – optimal solution – variants of assignment problem- travelling salesman problem.

Sequencing: Introduction – *n* jobs through two machines – *n* jobs through three machines – two jobs through 'm' machines.

Outcome: Estimate optimal solution for transportation and assignment problems.

Activity: Performing various techniques to find out optimal solution.

Unit-III:

Replacement:
Introduction – Replacement of items that deteriorate with time (value of money not changing and changing with time) – Replacement of items that fail suddenly (individual and group replacement policies)

Inventory Control:
Introduction, Types of Inventories, Costs associated with inventories, the concept of EOQ, Deterministic inventory problems with no shortages, with shortages.

Outcome: Analyze the various replacement and sequencing models and apply them for arriving at optimal decisions

Activity: Practical learning of n jobs through 2 & 3 machines and replacement of machineries
Unit-IV:

Queuing System: Queuing system and its structure – Kendall's notation – queuing models - M/M/1: FCFS/∞/∞ - M/M/1: FCFS/n/∞ - M/M/C: FCFS/∞/∞ - M/M/1: FCFS/n/m.

Theory Of Games: Introduction – mini. max (max. mini) – criterion and optimal strategy – solution of games with saddle points – rectangular games without saddle points – 2 x 2 games – dominance principle – m x 2 & 2 x n games – graphical method.

Outcome: Analyze the inventory and queuing theories and apply them in domain specific situations.

Activity: Preparing flow charts for types of inventories and to know practical examples of LIFO, FIFO.

Unit-V:

Dynamic Programming: Introduction – Bellman's principle of optimality – applications of dynamic programming- capital budgeting problem – shortest path problem – linear programming problem.

Outcome: 1.Identify optimal strategy with different gamevalues
2. To study about DPP and its applications.

Activity: video lectures

Text Books:

1. S. D. Sharma, Operation Research, Kedar N ath Ram Nath Publishers, 2015.
2. Hamdy A. Taha, Operations Research An introduction, 10th edition, 2017

Reference Books:

1. Hira D S and Gupta P K, Operations Research, S. Chand & Sons, 2007.
2. Panneerselvan. R., Operation Research, Prentice Hall of India Pvt Ltd. 2006.

Course Code		L	T	P	Credits
1005173206	INTRODUCTION TO DATA BASE MANAGEMENT SYSTEMS	3	1	0	3

Course Overview:

This course introduces database design and creation using a DBMS product. Emphasis is on data dictionaries, normalization, data integrity, data modelling, and creation of simple tables, queries, reports, and forms. Upon completion, students should be able to design and implement normalized database structures by creating simple database tables, queries, reports, and forms.

Course Objectives:

- Provide students with theoretical knowledge and practical skills in the use of database and database management systems in information technology applications.
- The logical design, physical design and implementation of relational databases are covered.

Course Outcomes:

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Describe ER model and normalization for database design.	Analyzing	PO1, PO2, PO4
CO2	Create, maintain and manipulate a relational database using SQL	Applying	PO1, PO2, PO4, PO5
CO3	Design and build database system for a given real world problem	Applying	PO1, PO2, PO4, PO5
CO4	Examine issues in data storage and query processing and can formulate appropriate solutions.	Understand	PO1, PO2

Unit-I:

Introduction to Database Systems:

File System Vs DBMS, Advantages of DBMS, Structure of DBMS, Levels of Data Abstraction (Data Independence),Database Users and Administrators, Different Data Models.

E-R Model:

Overview of Database Design, Entities, Attributes, and Entity Sets, Relationships and Relationship Sets, Additional Features of the ER Model

Outcome: Student will Be able to**:**

1. Describe the Architecture of Database Management Systems
2. Design different ER Models
3. Understand the applications of dbms,difference between filesystems vs dbms, identify the data models understand dbms structure

Activity: Draw ER Diagram for Various Real Time Systems.

Unit-II:

Relational model:

Introduction to the Relational Model, Relational model constraints over relations. Relational Algebra and calculus

Outcome: Student will Be able to:

1. To differentiate the knowledge in TRC & DRC
2. Compare relational model with the structured query language (SQL)
3. Understands the relational algebra concepts, selection, projection,relational calculus which helps in understanding queries

Activity: Tabulate Various Relational Modelsfor Real Time Application.

Unit-III:

SQL Queries:

The Form of Basic SQL Query, Union, Intersect and Except-Nested Queries-Aggregative Operators- Group By and Having Clauses-Null Values-Outer Joins,triggers

Schema Refinement (Normalization):

Purpose of Normalization or schema refinement, concept of functional dependency, normal forms based on functional dependency(1NF, 2NF and 3 NF)

Outcome: Student will Be able to:

1. Design the new database.
2. Master the basic concepts and appreciate the applications of database systems.
3. Master the basics of SQL and construct queries using SQL.

Activity: Design a new Database and normalize the data

Unit-IV:

Overview of Storage and Indexing:

Data on External Storage – File Organization and Indexing– Cluster Indexes, Primary and Secondary Indexes – Index data Structures – Hash Based Indexing – Tree base Indexing.

Outcome: Student will Be able to:

1. Differentiate different indexing techniques in real time.
2. An ability to use and apply current technical concepts and practices in the core information technologies.
3. Be familiar with a commercial relational database system (Oracle) by writing SQLusing the system.
4. Be familiar with the relational database theory, and be able to Write relational algebra expressions for queries

Activity: Create your own data base and connect the front-End and back-End

Unit-V:

Introduction to transaction management, ACID properties, transaction states, concurrent and non-concurrent schedules, requirement of concurrency control, requirement of recovery, log based recovery

Outcome: Student will Be able to:

1. Understands the properties of transaction management.

Activity: Perform Transaction on Various Real Time Concepts

Text Books:

1. Database Management Systems, 3/e Raghuram Krishnan, Johannes Gehrke, TMH
2. Database System Concepts. 6/e Silberschatz, Korth, TMH
3. Database Management System, 6/e RamezElmasri, Shamkant B. Navathe, PEA

Reference Books:

1. Introduction to Database Systems, 8/e C J Date, PEA
2. The Database book principles & practice using Oracle/MySqlNarain Gehani, University Press.
3. Database Principles Fundamentals of Design Implementation and Management, Corlos Coronel, Steven Morris, Peter Robb, Cengage Learning.

Course Code	INTRODUCTION TO PYTHON PROGRAMMING	L	T	P	Credits
1005173207		3	1	0	3

Course Overview:

This course introduces computer programming using the Python programming language which will help you to master the Programming with Python by introducing the Object Oriented programming concepts, creation of Data Structures, Implementation of Functions, and Visualization libraries. Lastly you will get into design, code, test, and debug Python Programming Language Scripts.

Course Outcomes:

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Install Python IDE and run basic Python scripts.	Understand	PO1
CO2	Understand the operators, functions, key Concepts of Object Oriented Programming in python.	Understand	PO1,PO2
CO3	Access Python from various online resources and import packages to the current working environment.	Applying	PO5
CO4	Develop front end GUI using Visualization Libraries and Multithreading techniques.	Analyzing	PO12

Unit-I:

Introduction:

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

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 and order of evaluations

Outcome:

- Understand the Introduction of Python IDE.
- Learn the basics building blocks of python.
- Write the basic programs in python.
- Learn the different types of operators in python

Activity:

Install Python on PCs or through Mobile applications run basic Python Scripts for a given data.

Unit-II:

Control Flow-:if, if-elif-else, for, while, break, continue, pass

Data Structures:

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

Outcome:

- Understand the syntax of conditional statements in python
- Understand the syntax of Data Structures in python

Activity:

Identify Operators and types in Python. Implement Data Structure concepts by writing Python Scripts.

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, name spacing

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

Outcome:

- Understanding Functions implementation using Python.
- Learn the scope or life time of variables in a function.
- Usage of import statement in modules.
- Create a package, import and install PIP package in python

Activity: Using Functions develop simple scripts in Python Programming.

Unit-IV:

Object Oriented Programming OOP in Python: Classes, 'self variable', Methods, Constructor Method, Inheritance, Overriding Methods, Data hiding

Error and Exceptions: Difference between an error and Exception, Handling Exception, try except block, Raising Exceptions, User Defined Exceptions

Outcome:

- Implement the OOP concepts using python
- Understand the Exception handling in python

Activity: Implement OOP concepts in Writing Python Scripts

Unit-V

File handling: Python File(doc and csv) Operation Reading config files in python, Writing log files in python, Understanding read functions, Understanding write functions, Manipulating file pointer using seek ,Programming using file operations

Introduction to Standard libraries: NumPy, Pandas

Outcome:

- Understand standard Libraries and GUI visualization in Python.

Activity: Write various test cases and implement specific test for a given case study.

Text Books:

1. Python Programming: A Modern Approach, Vamsi Kurama, Pearson
2. Learning Python, Mark Lutz, Orielly
3. Complete Reference to Python – TMH-2018
4. Python Programming - Using Problem Solving Approach, Reema Thereja, Oxford University Press

Reference Books:

1. Think Python, Allen Downey, Green Tea Press
2. Core Python Programming, W.Chun, Pearson.
3. Introduction to Python, Kenneth A. Lambert, Cengage
4. http://nptel.ac.in/courses/117106113/34
5. **https://www.python.org/**

Course code		L	T	P	Credits
	WASTE WATER MANAGEMENT				
1001173207		3	1	0	3

Course Overview:

This course will give the student knowledge about Industrial waste water along with managing and treatment methods required for these waste water.

Course Objectives:

The student will be taught

1. The quality of domestic & industrial water requirements and wastewater quantity generation.
2. The treatment methods for industrial wastewater.
3. The common methods of treatment in different industries
4. The operational problems of common effluent treatment plant.

	Course outcome	**Cognitive Level as per Bloom's Taxonomy**	**PO**
CO1	Distinguish between the quality of domestic and industrial water requirements and wastewater quantity generation.	Understanding	PO:1, PO:6, PO:7, PO:11, PO:12
CO2	Impart knowledge on selection of treatment methods for industrial wastewater.	Analyzing	PO:1, PO:2, PO:6, PO:7, PO:12
CO3	Describe the common methods of treatment in different industries	Understanding	PO:1, PO:6, PO:7, PO:11, PO:12
CO4	Explain operational problems of common effluent treatment plant.	Understanding	PO:1, PO:2, PO:4, PO:5, PO:6, PO:7, PO:11, PO:12
CO5	Explain the manufacturing process of various industries.	Evaluating	PO:2, PO:3, PO:4, PO:6, PO:7, PO:11, PO:12

Unit-I:

Industrial Water Quality Analysis:

Wastewater Quality characterization - Physical, Chemical and Biological; unit operations and processes used in water and waste water treatment.

Outcome: Able to identify the characteristics of waste water

Activity/Event:

Seminar on difference between Municipal wastewater and Industrial waste water.

Unit-II:

Miscellaneous Treatment:

Introduction to Advanced water treatments - Adsorption - Ion Exchange - Reverse Osmosis - Electro dialysis - Micro, Ultra & Nano filtration - Chemical oxidation process.

Outcome:

- Able to identify and differentiate the usage between primary, secondary and advanced treatments.
- Able to select which advanced treatment is necessary pertaining to constituents of waste water.

Activity/Event: Seminar on other advanced methods of treatment

Unit-III:

Basic theories of Industrial Wastewater Management:

Measurement of industrial wastewater flow - Industrial wastewater sampling and preservation of samples for analysis - Toxicity of industrial effluents due to Heavy metals - Volume and Strength reduction -Neutralization - Equalization, Stabilization and proportioning.

Outcome:

- Able to understand how to minimize and manage industrial waste before its treatment

Activity/Event:

Analyzing the application of Industrial wastewater management in different industries.

Unit-IV:

Industrial Wastewater Disposal Management:

Discharges into Streams, Lakes and oceans and associated problems - Land treatment - Common Effluent Treatment Plants: advantages and suitability, Limitations and challenges.

Outcome:

- Able to understand the problems by disposal of untreated waste.
- Able to understand the remedies or methods to manage these wastes.

Activity/Event:

Draw CETP from different industries and analyze the differences in it.

Unit-V:

Process and Treatment of specific Industries:

Manufacturing Process and origin, characteristics, effects and treatment methods of liquid waste from Paper and Pulp industries, Tanneries, Sugar Mills, Distillers, Dairy and food processing industries, Fertilizers, Textiles, Steel plants, Pharmaceutical Plants.

Outcome:

- Able to understand different industries manufacturing process along with the waste generated at point source of each unit.
- Able to know the treatment process required for individual industry depending upon the variation of waste from them.

Activity/Event:

Visiting an nearby industry and observing the manufacturing and treatment process

Text Books:

1. Wastewater Treatment by M.N. Rao and A.K. Dutta, Oxford & IBH, New Delhi.
2. Industrial Wastewater Treatment by KVSG Murali Krishna.
3. Industrial Wastewater treatment by A.D. Patwardhan, PHI Learning, Delhi
4. Industrial Water Pollution Control by W. Wesley Eckenfelder, Mc- GrawHill, Third Edition

Reference Books:

1. Wastewater Engineering by Metcalf and Eddy Inc., Tata McGrawhill Co., New Delhi
2. H. S Peavy, D. R. Rowe and George Tchobanoglous, Environmental Engineering, McGraw-Hill International Ed., 1985.
3. Wastewater Treatment- Concepts and Design Approach by G.L. Karia& R.A. Christian, Prentice Hall of India.
4. Wastewater Treatment for Pollution Control and Reuse, by Soli. J Arceivala, Shyam R Asolekar, Mc-Graw Hill, New Delhi; 3rd Edition

Course Code	ENTREPRENEURSHIP DEVELOPMENT	L	T	P	Credits
1099173201	(OPEN ELECTIVE)	3	1	0	3

Course Overview:

To develop and strengthen entrepreneurial quality and motivation in students. To impart basic Entrepreneurial skills and understandings to run a business efficiently and effectively.

Course Objectives: This course gives the

.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Understanding the Entrepreneurship	Understanding	PO:6,PO:8,PO:9
CO2	Understanding the Business Environment	Understanding	PO:6,PO:8,PO:9
CO3	Exposure on Industrial Policies	Understanding	PO:6,PO:8,PO:9
CO4	The Business plan Preparation	Analysis	PO:6,PO:8,PO:9,PO:11,PO:12
CO5	How to Launching of small business, management.	Understanding	PO:11,PO:12

Unit-I:

Entrepreneurial Competence:

Entrepreneurship concept – Entrepreneurship as a Career – Entrepreneurial Personality - Characteristics of Successful, Entrepreneur – Knowledge and Skills of Entrepreneur.

Outcome: Understanding the Entrepreneurship

Activity: Videos on Entrepreneurship

Unit-II:
Entrepreneurial Environment:

Business Environment - Role of Family and Society - Entrepreneurship Development Training and Other Support Organizational Services

Outcome: Understanding the Business Environment

Activity: Videos on Business Environment

Unit-III:

Industrial Policies:

Central and State Government Industrial Policies and Regulations - International Business.

Outcome: Exposure on Industrial Policies

Activity. Video

Unit-IV:

Business Plan Preparation:

Sources of Product for Business - Prefeasibility Study - Criteria for Selection of Product -Ownership - Capital - Budgeting Project Profile Preparation - Matching Entrepreneur with the Project - Feasibility Report Preparation and Evaluation Criteria.

Outcome: The Business plan Preparation

Activity/Event : preparing a business plan preparation

Unit-V:

Launching Of Small Business:

Finance and Human Resource Mobilization Operations Planning - Market and Channel Selection – Growth Strategies - Product Launching – Incubation, Venture capital, IT startups.

Management Of Small Business:

Monitoring and Evaluation of Business - Preventing Sickness and Rehabilitation of Business Units- Effective Management of small Business.

Outcome: How to Launching of small business, management.

Activity/Event : Motivational Videos

Text Books:

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi, 2001.
2. S.S.Khanka, Entrepreneurial Development, S.Chand and Company Limited, New Delhi, 2001.

References

1. Mathew Manimala, Entrepreneurship Theory at the Crossroads, Paradigms & Praxis, Biztrantra ,2nd Edition 2005
2. Prasanna Chandra, Projects – Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill, 1996.
3. P.Saravanavel, Entrepreneurial Development, Ess Pee kay Publishing House, Chennai -1997.
4. Arya Kumar. Entrepreneurship. Pearson. 2012
5. Donald F Kuratko, T.V Rao. Entrepreneurship: A South Asian perspective. Cengage Learning. 2012

Course Code		L	T	P	Credits
	CBCS (MOOCS)				
1003173291		3	1	0	3

MOOCs: It is an online course (Minimum of 12 weeks) to promote advanced knowledge suitable for placement and research.

To award credits, the student should get certificate after they have registered for written exam and successfully passed

(Or)

College will conduct the examination/Viva-voce and award the credits and grades.

In case a student fails in any online course, he/she may be permitted to register for the same course or an alternate course decided by the department committee. The internal marks secured earlier will be nullified if the course is changed. The assessment procedure of MOOCs course remains same as general theory course.

Note: The registered course must not be same as any of the courses listed in the program structure of their regulation till final year.

Course Code		L	T	P	Credits
1099172103	PROFESSIONAL ETHICS AND HUMAN VALUES	2	0	0	0

Course Overview:

Professional Ethics and Human Values subject provides character oriented education that in stills basic values and ethnic value in one's individual professionalism.

Course Objectives:

1. To encourages students to discover what they consider valuable.
2. To move from discrimination to commitment. It is to create an ability to act on any discrimination in a given situation.
3. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
4. To appreciate the rights of others.
5. Making the students aware and sensitive to value system in real life situations. To help the students to discriminate between ephemeral and eternal values.

Course Outcomes:

	Course Outcome	Cognitive level as per Bloom's Taxonomy	PO
CO1	Recognize importance of human values, harmony and ethical behavior in real life situations	Understanding	8
CO2	Describe the core values that shape the ethical behaviour of an engineer	Understanding	8
CO3	Recall basics of professional ethics and human values.	Remembering	8
CO4	Listing sustained happiness through identifying the essentials of human values and skills.	Remembering	8
CO5	Describe the practical importance of trust, mutually satisfying human behaviour and enriching interaction with nature	Understanding	8

Unit-I:

Human Values:

Morals, Values and Ethics – Integrity – Work Ethics – Service Learning – Civic Virtue – Respect for others – Living Peacefully -Caring – Sharing – Honesty –Courage – Value time – Co-

operation – Commitment – Empathy – Self-confidence – Spirituality-Character

Outcome: Seminar

- To understand different types of human values
- To Identifyvalues linked to the ethical behaviour

Activity/Event: Seminar

Unit-II:

Engineering Ethics:

The History of Ethics-Purposes for Engineering Ethics-Engineering Ethics-Consensus and Controversy – Professional and Professionalism –Professional Roles to be played by an Engineer –Self Interest, Customs and Religion-Uses of Ethical Theories-Professional Ethics-Types of Inquiry – Engineering and Ethics- Kohlberg's Theory – Gilligan's Argument –Heinz's Dilemma

Outcome:

- To enable understanding on engineering ethics
- To enable knowledge on professional level ethical theories

Activity/Event: Seminar

Unit-III:

Engineering as Social Experimentation:

Comparison with Standard Experiments – Knowledge gained –Conscientiousness – Relevant Information – Learning from the Past – Engineers as Managers, Consultants, and Leaders – Accountability – Role of Codes – Codes and Experimental Nature of Engineering.

Outcome: Seminar

- To Understand the application of ethics in social experimentation
- To gain knowledge on engineers as different roles

Activity/Event: Case Analysis

Unit-IV:

Engineers' Responsibility for Safety and Risk: Safety and Risk, Concept of Safety – Types of Risks – Voluntary v/s Involuntary Risk- Short term v/s Long term Consequences- Expected Probability- Reversible Effects- Threshold Levels for Risk- Delayed v/s Immediate Risk- Safety and the Engineer – Designing for Safety – Risk-Benefit Analysis-Accidents.

Outcome: Seminar

- To understand the challenge for engineers to create safety to risk
- To enable the knowledge on the risk bearable level

Activity/Event: Seminar

Unit-V:

Engineers' Responsibilities and Rights: Collegiality-Loyalty-Professionalism and Loyalty-Professional Rights –Professional Responsibilities – confidential and proprietary information-Conflict of Interest-Ethical egoism-Collective bargaining-Confidentiality-Acceptance of Bribes/Gifts- when is a Gift and a Bribe-examples of Gifts v/s Bribes-problem solving-interests in other companies- Occupational Crimes-industrial espionage-price fixing-endangering lives-Whistle Blowing-types of whistle blowing-when should it be attempted-preventing whistle blowing. Cross-culture Issues.

Outcome: Seminar

- To enable understanding on engineer's responsibilities
- To enable knowledge on different types of rights of engineers

Activity/Event: Seminar

Text Books:

1. "Engineering Ethics and Human Values" by M.Govindarajan, S.Natarajan and V.S.Senthil Kumar- PHI Learning Pvt. Ltd-2009
2. "Professional Ethics and Morals" by Prof.A.R.Aryasri, Dharanikota Suyodhana-Maruthi Publications
3. "Professional Ethics and Human Values" by A.Alavudeen, R.Kalil Rahman and M.Jayakumaran- Laxmi Publications
4. "Professional Ethics and Human Values" by Prof.D.R.Kiran

Reference Books:

1. "Indian Culture, Values and Professional Ethics" by PSR Murthy-BS Publication
2. "EthicsinEngineering"byMikeW.MartinandRolandSchinzinger–TataMcGraw-Hill–003.
3. "EngineeringEthics"byHarris,PritchardandRabins,CENGAGELearning,IndiaEdition,2009.

Course Code		L	T	P	Credits
1003173221	MACHINE TOOL & METAL CUTTING LAB	0	0	3	2

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 and observe various metal cutting processes

List of Experiments:

1. Introduction of general purpose machine tools like Lathe, Drilling machine, Milling machine, Shaper, Planning Machine, Slotting machine, Surface grinder and Tool and cutter grinder
2. Step turning and taper turning on lathe machine
3. Slotting: To Prepare the maximum four rectangular keyway slots on MS round rod using Slotting Machine
4. Drilling and Tapping
5. Shaping: To Prepare the maximum square from a given MS round rod using shaping Machine
6. Planning: To Prepare the maximum square from a given MS round rod using Planning Machine
7. Milling: To Prepare a Spur gear wheel with given module and no. of teeth on MS round rod using Milling Machine.
8. Surface grinding: Prepare finished surface with a material removal of 5 Microns in thickness
9. Grinding of tool angles: Grind different tool geometry on a single point cutting tool
10. Thread cutting and knurling on lathe machine

Course Code		L	T	P	Credits
1003173222	HEAT TRANSFER LAB	0	0	3	2

Course Objectives:

The laboratory course is aimed to provide the practical exposure to the students with regard to the determination of amount of heat exchange in various modes of heat transfer including condensation & boiling for several geometries

List of Experiments:

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 convection.
7. Determination of heat transfer coefficient in forced convection.
8. Determination of effectiveness of parallel and counter flow heat exchangers.
9. Determination of heat transfer rate in drop and film wise condensation.
10. Determination of critical heat flux.
11. Determination of emissivity of a given surface.
12. Determination of Stefan Boltzmann constant.

Course code		L	T	P	Credits
1003173223	CAE LAB (FEA+CFD)	0	0	3	2

Course Objectives:

1. To impart the fundamental knowledge on using various analytical tools for Engineering Simulation.
2. To know various fields of engineering where these tools can be effectively used to improve the output of a product.
3. To impart knowledge on how these tools are used in Industries by solving some real time problems using these tools.

List of Experiments:

1. Steady state conduction
2. Lumped heat transfer
3. Fin analysis
4. Convective heat transfer – Internal flow (study both velocity and thermal boundary layers)
5. Convective heat transfer – External flow (study both velocity and thermal boundary layers)
6. Radiation heat transfer– Emissivity
7. Determination of deflection and stresses in 2D and 3D trusses and beams.
8. Determination of deflections component and principal and Von-mises stresses in plane stress, plane strain and Axi-symmetric components.
9. Determination of stresses in 3D and shell structures (at least one example in each case)
10. Estimation of natural frequencies and mode shapes, Harmonic response.
11. Steady state heat transfer Analysis of plane
12. Axi symmetric components.

Relevant Software will be used for modeling & analysis

Course Code		L	T	P	Credits
	INDUSTRY ORIENTED MINI PROJECT				
1003173241		**0**	**0**	**3**	**2**

Industry- Oriented Mini Project: The Industry oriented mini project is carried out during the third year second semester vacation. The students have an option to choose their own area of interest which may be related to the course work. Mini project report is evaluated for 100 marks in fourth year first semester before the first mid-term exam. Assessment is done by the supervisor /guide for 60 marks based on the work and mini project report. The remaining 40 marks are allocated for presentation by the student to a committee comprising of the project supervisor and two senior faculty members nominated by Head of the Department

PROGRAM STRUCTURE

FOR

IV-B.Tech

I & II SEMESTERS

DEPARTMENT OF MECHANICAL ENGINEERING

PROGRAM STRUCTURE

IV B.Tech – I-Semester

S. No	Course Code	Course Title	L	T	P	Credits
1	1003174101	CAD/CAM	3	1	0	3
2	1003174102	Automobile Engineering	3	1	0	3
3	100174103	Power Plant Engineering	3	1	0	3
4	**Elective-I**					
	1003174104	Fundamentals of Acoustics &Vibration	3	1	0	3
	1003174105	Optimization and Reliability				
	1003174106	Refrigeration &Air-Conditioning				
	1003174107	Gas Dynamics &Jet Propulsion				
	1003174108	CNC Machine Tools				
	1003174109	Quality and Reliability Engineering				
5	**Elective-II**					
	1003174110	Composite Materials	3	0	0	3
	1003174111	Condition Monitoring				
	1003174112	Computational Fluid Dynamics				
	1003174113	Green Engineering Systems				
	1003174114	Computer Graphics				
	1003174115	Additive Manufacturing				
6	1003174121	CAD/CAM Lab	0	0	3	2
7	**Industry Oriented Laboratory**					
	1003174122	Vibration and Acoustics Lab	0	0	3	2
	1003174123	Simulation Lab (Mat-Lab Tools)				
	1003174124	Mechatronics Lab				
8	1003174131	Mechanical Synthesis Project	0	0	3	3
Total Credits:						22

IV B.Tech – II-Semester

S. No	Course Code	Course Title	L	T	P	Credits
1	1003174201	Production Planning and Control	3	1	0	3
2	**Elective –III**					
	1003174202	Advanced Materials	3	1	0	3
	1003174203	Nano-Technology				
	1003174204	Thermal Equipment Design				
	1003174205	Industrial fire and Safety				
	1003174206	Mechatronics				
	1003174207	Design for Manufacture				
3	1003174208	Un Conventional Machining Processes	3	1	0	3
4	1003174209	Non-Destructive Evaluation	3	1	0	3
(OR)						
	1003174281	Internship	0	0	0	12
5	1003174251	Technical Seminar	0	3	0	2
6	1003174261	Comprehensive Viva	0	0	0	2
7	1003174231	Main Project	0	0	0	10
Total Credits:						**26**

DETAILED SYLLABUS

FOR

IV B.Tech

I SEMESTER

Course Code		L	T	P	Credits
1003174101	CAD/CAM	3	1	0	3

Course Overview: This course introduces you to the foundational knowledge in computer-aided design, manufacture, and the practical use of CNC machines it includes geometric modeling, part programming, group technology and other computer aided inspection techniques.

Course Objectives:

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

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Describe basic structure of CAD workstation, Memory types, input/output devices and display devices and computer graphics	understand	PO1, PO3 PO5,
CO2	Apply knowledge of mathematical concept for geometry manipulation and modelling of curves, surfaces and solids	Apply	PO1, PO2, PO4, PO10, PO12
CO3	Develop a programming for NC operations using various methods available	Apply	PO1, PO2, PO3, PO10, PO11, PO12
CO4	Describe the use of GT and CAPP for the product development	understand	PO1, PO3, PO8, PO12.
CO5	Describe basic structure of CAD workstation, Memory types, input/output devices and display devices and computer graphics	understand	PO1, PO3 PO5,

Unit-I:

Computers in industrial manufacturing, product cycle, CAD / CAM Hardware, basic structure, CPU, memory types, input devices, display devices, hard copy devices, storage devices.

COMPUTER GRAPHICS: Raster scan graphics coordinate system, database structure for graphics modelling, transformation of geometry, 3D transformations, mathematics of projections, clipping, hidden surface removal.

Outcome: The student should be able to know the hardware and various transformations in 3D

Activity: Students will be made to write codes to implement CG algorithms**.**

Unit-II:

GEOMETRIC MODELING: Requirements, geometric models, geometric construction models, curve representation methods, surface representation methods, modeling facilities desired.
DRAFTING AND MODELING SYSTEMS: Basic geometric commands, layers, display control commands, editing, dimensioning, solid modelling.

Outcome: The student should be able to describe the mathematical basis in the technique of representation of geometric entities like surfaces and solid, and the technique of transformation of geometric entities using transformation matrix

Activity: Classroom demonstration of how various concepts like layers, display control applications like simplified representations, drawing customization in high end software like Creo will be performed**.**

Unit – III:

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

Outcome: The student should be able to develop a programming for NC operations using various methods available

Activity: Students will be demonstrated as to how APT programs can be automatically generated in CAD software and how post processing can be used to generate G-Codes. Also students shall be explained the features of CNC machines through demonstration on CNC machines. AV tools shall be used.

Unit-IV:

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

COMPUTER AIDED QUALITY CONTROL: Terminology used in quality control, use of computers in Quality control. Inspection methods- contact and noncontact types, computer aided testing, integration of CAQC with CAD/CAM.
Outcome: The student should be able to describe the use of GT and CAPP for the product development

Activity: Students shall be tasked to give presentations on cellular manufacturing and related techniques

Unit-V:

COMPUTER INTEGRATED MANUFACTURING SYSTEMS: Types of manufacturing systems, machine tools and related equipment, material handling systems, material requirement planning, computer control systems, human labor in manufacturing systems, CIMS benefits.

Outcome: The student should be able to identify the various elements and their activities in the Computer Integrated Manufacturing Systems.

Activity: Students shall be made to give presentations of various systems like PDM, PLM and shall be demonstrated using AV tools regarding CAQC tools like CMM.

Text Books:

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

References:

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

Course Code	AUTOMOBILE ENGINEERING	L	T	P	Credits
1003174102		3	1	0	3

Course Overview:

The course imparts the principles of automobile systems and provides the salient features of safety, emission and service of automobiles.

Course Objectives:

1. The anatomy of the automobile in general
2. The location and importance of each part
3. The functioning of the engine and its accessories, gearbox, clutch, brakes, steering, axles and wheels
4. Suspensions, frame, springs and other connections
5. Emissions, ignition controls, electrical systems & ventilations.
6. The student after undergoing the course, shall visualize the layout of an automobile and its systems like transmission, steering, suspension, braking, safety etc and should know the vehicle troubleshooting.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Memorizing the different parts of the automobile	understand	PO1, PO5, PO6
CO2	Illustrate the working of various parts like engine, transmission, clutch, brakes, gearboxes, differential axle	applying	PO1, PO3,
CO3	Describe the steering and the suspension system operation	understand	PO1, PO5,PO6
CO4	Identify the environmental implications of automobile emissions	evaluate	PO1, PO7, PO8,
CO5	Formulate a strong base for understanding future developments in the automobile industry	analyze	PO7, PO9, PO12

Unit-I:

INTRODUCTION: Components of four wheeler automobile – chassis and body – power unit – power transmission – rear wheel drive, front wheel drive, 4 wheel drive – types of automobile engines, engine construction, turbo charging and super charging – engine lubrication, splash and pressure lubrication systems, oil filters, oil pumps – crank case ventilation – engine service, reboring, decarbonisation, Nitriding of crank shaft.

Outcome: wide exposure of different systems of automobile

Activity: visit the four wheeler repair shop in the student's nearby and observe the peripheral of the four wheeler

Unit-II:

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

Outcome: Wide exposure of the defected parts of the various systems like clutch, gearbox, propeller shaft, rear axles. The dissembling, inspecting various components of the assembly, assembly procedure, dismounting and mounting of the various systems on to the automobile are well known after thorough observation.
Activity: observe the dismounting procedure, dissembling of the gearbox, clutch, rear wheel drive and rear axle of a four wheeler. Observe the cleaning procedure, inspection of each component of the assembly, find out the defects in the spare parts of the assembly, observe the assembly procedure and note down how the assembly is mounted on to the automobile

Unit – III:
STEERING SYSTEM: Steering geometry – camber, castor, king pin rake, combined angle toein, center point steering, types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism, steering gears – types, steering linkages.
SUSPENSION SYSTEM: Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system.
BRAKING SYSTEM: Mechanical brake system, hydraulic brake system, master cylinder, wheel cylinder, tandem master cylinder requirement of brake fluid, pneumatic and vacuum brakes.

Outcome: The steering geometry is well known after observation. The suspension springs, the stiffness of springs, the properties of springs can be analyzed after observation. The brakes, brake shoes, brake drum, master cylinder, wheel cylinder are clearly understood after keen observation.
Activity: Observe the steering geometry and its components, suspension springs, suspension oil changing procedure, braking system line of flow, master cylinder of the four wheeler, wheel cylinder.

Unit-IV:

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

ENGINE SPECIFICATION AND SAFETY SYSTEMS: Introduction- engine specifications with regard to power, speed, torque, no. of cylinders and arrangement, lubrication and cooling etc.
Safety: Introduction, safety systems - seat belt, air bags, bumper, anti lock brake system (ABS), wind shield, suspension sensors, traction control, mirrors, central locking and electric windows, speed control.

Outcome: the electrical wiring system is well known after observation. The student can be able to who the fault with lighting, horn and starting system of the four wheeler. The safety precautions are also observed.

Activity: Observe the starting motor of the four wheeler. Various electrical systems like switch circuit, lighting wiring diagram, horn circuit, wiper mechanism, fuel gauge etc are to be keenly observed in the four wheeler garriage. Observe the operation of the working of seat belt, air bags etc.

Unit-V:

ENGINE EMISSION CONTROL: Introduction – types of pollutants, mechanism of formation, concentration measurement, methods of controlling-engine modification, exhaust gas treatment-thermal and catalytic converters-use of alternative fuels for emission control – National and International pollution standards

ENGINE SERVICE: Introduction, service details of engine cylinder head, valves and valve mechanism, piston connecting rod assembly, cylinder block, crank shaft and main bearings, engine reassembly-precautions.

Outcome: Engine exhaust controls can be found. The servicing of various engine parts can be known.

Activity: The pollution control of the engine exhaust are to be observed. Serving of various parts of the engine.

Text Books:

1. Automotive Mechanics – Vol. 1 & Vol. 2 / Kirpal Singh/standard publishers
2. Automobile Engineering / William Crouse/TMH Distributors
3. Automobile Engineering/P.S Gill/S.K. Kataria& Sons/New Delhi.

References:

1. Automotive Engines Theory and Servicing/James D. Halderman and Chase D. Mitchell Jr.,/ Pearson education inc.
2. Automotive Engineering / K Newton, W.Steeds& TK Garrett/SAE
3. Automotive Mechanics: Principles and Practices/ Joseph Heitner/Van Nostrand Reinhold
4. Automobile Engineering / C Srinivasan/McGrawHill

Course Code	POWER PLANTENGINEERING	L	T	P	Credits
1003174103		3	1	0	3

Course Overview:

The course is aimed at providing knowledge of power generation through different prime movers viz steam, ICGT, Hydro, nuclear and hybrid systems along with their economics and environmental considerations.

Course Objectives:

The course is aimed at providing knowledge of power generation through different prime movers viz steam, ICGT, Hydro, nuclear and hybrid systems along with their economics and environmental considerations.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Discuss the functions of the components of Steam power plant.	Understanding	1,6,7,912
CO2	Distinguish among Diesel and gas power plants.	Understanding	1,6,7,912
CO3	Study the layout of hydro power plant and estimate the power developed.	Remembering	1,6,7,9,12
CO4	Identify elements and their functions and operations of nuclear power plants	Remembering	1,6,7,9,12
CO5	Analyze economics of power plants and list factors affecting the power plants and interpret the performance of power plants based on load variations	Analyzing	1,4,6,7,12

Unit-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 equipment's, 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, cooling towers and heat rejection,corrosion and feed water treatment.

Outcome:

The student should be able to identify elements and their functions and operations of steam power plants.

Activity:

Visit websites of NTPC, BHEL, NHPC, NPCIL, GEDA, SUZLON, GE, SIEMENS,

ENERCON and KPC etc and find out the technical information about their machineries or Plants.

Unit-II:

INTERNAL COMBUSTION AND GAS TURBINE POWER PLANTS:

DIESEL POWER PLANT: Plant layout with auxiliaries – fuel supply system, air starting equipment, super charging.

GAS TURBINE PLANT: Introduction – classification - construction – layout with auxiliaries, combined cycle power plants and comparison.

Outcome: The student can able to identify elements and their functions and operations of steam power plants.

Activity:

Download technical specifications/ catalogues, videos or any other suitable presentations on gas turbine power plant

Unit – 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 – typical layouts – plant auxiliaries – plant operation pumped storage plants.

Outcome: The student can able to recognize the layout of hydro power plant and estimate the power developed.

Activity:

Download technical specifications/ catalogues, videos or any other suitable presentations on Hydro power plant.

Unit-IV:

NUCLEAR POWER STATION: Nuclear fuel – breeding and fertile materials – nuclear reactor – reactor operation.

TYPES OF REACTORS: Pressurized water reactor, boiling water reactor, sodium-graphite reactor, fast breeder reactor, homogeneous reactor, gas cooled reactor, radiation hazards and shielding – radioactive waste disposal.

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, co-ordination of hydro-electric and nuclear power stations, co-ordination of different types of power plants.

Outcome:
After Completion of this unit the student can able to explain working principle of different types of nuclear power plant and combined power cycles.

Activity:
Prepare list of various major power plants installed in AP along with their total capacity.

Unit-V:
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.

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.

Outcome: The student can able to calculate the load factor, capacity factor, average load and peak load on a power plant.
Activity:
Prepare charts of different high pressure boilers, gas turbine cycles, steam turbine power plant etc. on half imperial drawing sheet. Attach the same with term work.

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

References:
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.

Course Code		L	T	P	Credits
1003174104	FUNDAMENTALS OF ACOUSTICS AND VIBRATIONS (Department Elective-1.1)	3	1	0	3

Course Overview: This course briefs about basic terms in acoustics and vibrations. The course highlights from basics to multi degree of freedom systems to mode shapes in vibrations. In acoustics the course discusses wave propagation to measurement and noise control techniques.

Course Objectives:

1. To understand terminology in vibration and acoustics
2. Able to understand various systems about mode shapes.
3. Able to understand measurement and noise control methods.

	Course Outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Contrasts between various terms in acoustics and vibrations	Understanding	PO1, PO6
CO2	Analyse various degrees of systems in vibrations	Analyzing	PO2, PO3, PO4
CO3	Articulates mode shapes pattern encountered in day to day applications	Applying	PO4, PO5, PO12
CO4	Assess noise control methods by relating to measurement techniques	Evaluation	PO5, PO7, PO12

Unit-I:

INTRODUCTION

Relevance of and need for vibrational analysis – Basics of SHM - Mathematical modelling of vibrating systems - Discrete and continuous systems - single-degree freedom systems - free and forced vibrations, damped and undamped systems.

Outcome: Understands basics of vibration systems with various systems.

Activity:

Demonstration of free and forced vibration systems at Lab

Unit-II:

MULTI DEGREE FREEDOM SYSTEMS

Free and forced vibrations of multi-degree freedom systems in longitudinal, torsional and lateral modes - Matrix methods of solution- normal modes – Orthogonality principle-Energy methods, Eigen values and Eigen vectors

Outcome: Analyse multi degree freedom systems in vibration.

Activity: Animated representation of multi degree freedom vibration systems.

Unit-III:

CONTINUOUS SYSTEMS

Torsional vibrations - Longitudinal vibration of rods - transverse vibrations of beams - Governing equations of motion - Natural frequencies and normal modes - Energy methods, Introduction to non linear and random vibrations.

Outcome: Contrasts vibrations with physical working models.

Activity:

Animated representation of modal frequencies of vibration system

Unit-IV:

BASICS OF ACOUSTICS

Speed of Sound, Wavelength, Frequency, and Wave Number, Acoustic Pressure and Particle Velocity, Acoustic Intensity and Acoustic Energy Density, Spherical Wave propagation, Directivity Factor and Directivity Index, Levels and the Decibel, Addition and subtraction of Sound levels, Octave Bands, Weighted Sound Levels.

Outcome:

Understands wave phenomenon and its relation with acoustics.

Activity:

Demonstration for basics in acoustics at lab.

Unit-V

NOISE MEASUREMENT AND CONTROL

Sound Level Meters, Intensity Level Meters, Octave Band Filters Acoustic Analyzers, Dosimeter, Measurement of Sound Power, Impact of noise on humans, A-Weighting, Noise control strategy, sound absorption and insulation.

Outcome:

Analyses measurement methods in acoustics

Activity:

Demonstration in sound analyses.

Text Books:

1. S.S.Rao, “Mechanical Vibrations ", 5th Edition, Prentice Hall, 2011.
2. L.Meirovitch, “Elements of vibration Analysis", 2nd Edition, McGraw-Hill, New York, 1985.

Reference Books:

1. W.T. Thomson, M.D. Dahleh and C Padmanabhan, “Theory of Vibration with Applications”, 5th Edition,Pearson Education, 2008.
2. M.L.Munjal, “Noise and Vibration Control”, World Scientific, 2013.
3. Beranek and Ver, “Noise and Vibration Control Engineering: Principles and Applications”, John Wiley and Sons, 2006.
4. Randall F. Barron, “IndustrialNoise Controland Acoustics”,Marcel Dekker, Inc., 2003.

Course Code		L	T	P	Credits
1003174105	OPTIMIZATION AND RELIABILITY (Department Elective-1.2)	3	1	0	3

Course Overview: The subject introduces to the student the concepts of product optimization, product failure, and certain areas of warranty, failure etc. The Course is very useful for any aspiring engineering student who wants to excel in the area of product design, product failure criteria estimation, and also issues like warranty etc.

Course Objectives:

1. The aim of this course is to provide students with a basic understanding of the approaches and techniques to assess and improve process and/or product reliability.
2. The objectives are to introduce the principles and techniques of Statistical distributions and their practical uses in product and/or process design and estimation of product warranty period
3. To understand techniques of modern reliability engineering tools.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	The student will understand and comprehend the concepts of optimization and develop problem equation for a given scenario	Understanding	PO-6
CO2	The student will understand , apply, solve an engineering problem from a numerical point of view	Remembering	PO-4
CO3	The student shall be versed with Genetic programming methods to solve a engineering problem	Understanding	PO-5
CO4	The student will be able to develop a problem formulation for a cantilever beam problem, and solve it	Applying	PO-1
CO5	The student will be well acquainted with concepts of reliability, warranty and product failure	Remembering	PO-2

Unit-I:

CLASSICAL OPTIMIZATION TECHNIQUES: Single variable optimization with and without constraints, multi – variable optimization without constraints, multi – variable optimization with constraints – method of Lagrange multipliers, Kuhn-Tucker conditions, merits and demerits of classical optimization techniques.

Outcome: The student will understand and comprehend the concepts of optimization and develop problem equation for a given scenario

Activity: develop equations for a given problem in the context of optimization

Unit-II:

NUMERICAL METHODS FOR OPTIMIZATION: Nelder Mead's Simplex search method, Gradient of a function, Steepest descent method, Newton's method, Pattern search methods, conjugate method, types of penalty methods for handling constraints, advantages of numerical methods.
Outcome: The student will understand, apply, solve an engineering problem from a numerical point of view.

Activity: solve a heat engineering problem using any of the methods discussed in the unit

Unit-III:

GENETIC ALGORITHM (GA) : Differences and similarities between conventional and evolutionary algorithms, working principle, reproduction, crossover, mutation, termination criteria, different reproduction and crossover operators, GA for constrained optimization, draw backs of GA,
GENETIC PROGRAMMING (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP.

MULTI-OBJECTIVE GA: Pareto's analysis, Non-dominated front, multi – objective GA, Non dominated sorted GA, convergence criterion, applications of multi-objective problems.
Outcome: The student shall be versed with Genetic programming method to solve a engineering problem

Activity: develop a Genetic algorithm problem formulation and arrive at the solution for a given scenario

Unit-IV:

APPLICATIONS OF OPTIMIZATION IN DESIGN AND MANUFACTURING SYSTEMS: Some typical applications like optimization of path synthesis of a four-bar mechanism, minimization of weight of a cantilever beam, optimization of springs and gears, general optimization model of a machining process, optimization of arc welding parameters, and general procedure in optimizing machining operations sequence.
Outcome: The student will be able to develop a problem formulation for a cantilever beam problem, and solve it
Activity: Develop a solution for a cantilever problem with the defined constraints

Unit-V

RELIABILITY: Concepts of Engineering Statistics, risk and reliability, probabilistic approach to design, reliability theory, design for reliability, numerical problems, hazard analysis.
Outcome: The student will be well acquainted with concepts of reliability, warranty and product failure
Activity: Analyze the Failure modes of a calculator and find its life time

Text Books:

1. Optimization for Engineering Design – Kalyanmoy Deb, PHI Publishers
2. Engineering Optimization – S.S.Rao, New Age Publishers
3. Reliability Engineering by L.S.Srinath
4. Multi objective genetic algorithm by Kalyanmoy Deb, PHI Publishers.

Reference Books:

1. Genetic algorithms in Search, Optimization, and Machine learning – D.E.Goldberg, Addison-Wesley Publishers
2. Multi objective Genetic algorithms - Kalyanmoy Deb, PHI Publishers
3. Optimal design – Jasbir Arora, Mc Graw Hill (International) Publishers
4. An Introduction to Reliability and Maintainability Engineering by CE Ebeling, Waveland PrintersInc., 2009
5. Reliability Theory and Practice by I Bazovsky, Dover Publications, 2013.

Course Code 1003174106	REFRIGERATION AND AIR CONDITIONING (Department Elective-1.3)	L	T	P	Credits
		3	1	0	3

Course Overview:

At the end of the course the students should be able to:

After undergoing the course the student should be in a position to analyze various refrigerating cycles and evaluate their performance. The student also should be able to perform cooling load calculations and select the appropriate process and equipment for the required comfort and industrial air-conditioning.

Course objectives:

The course is to understand the basic cycles of various refrigerating systems, their performance evaluation along with details of system components and refrigerant properties. The course is also aimed at imparting knowledge of psychrometric properties, processes which are used in air-conditioning systems for comfort and industrial applications.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Acquire knowledge of various air refrigeration cycles and their analysis.	Understanding	1, 2,3, 6, 12
CO2	Illustrate the performance improvement methods in VCR systems.	Understanding	1, 2,3, 6, 12
CO3	Outline the refrigerant characteristics & components of the VCR system.	Remembering	1, 2, 6, 7, 8,12
CO4	Apply the working principles of vapour absorption & Discuss the various non-conventional methods of refrigeration.	Applying	1, 2, 3, 12
CO5	Analyze air-conditioning processes using the principles of psychrometry and Evaluate cooling and heating loads in an air-conditioning system	Applying	1, 2,3,5 6, 7, 8, 12

Unit-I:

INTRODUCTION TO REFRIGERATION: Necessity and applications – unit of refrigeration and C.O.P. – Mechanical refrigeration – types of ideal cycles of refrigeration. air refrigeration: bell coleman cycle - open and dense air systems – refrigeration systems used in air craft's and problems.

Outcome: The students will be able to understand basic refrigeration cycles and the refrigeration systems.

Activity: Identify refrigeration system used in air-craft

Unit-II:

VAPOUR COMPRESSION REFRIGERATION: Working principle and essential components of the plant – simple vapour compression refrigeration cycle – COP – representation of cycle on T-S and p-h charts – effect of sub cooling and super heating – cycle analysis – actual cycle influence of various parameters on system performance – use of p-h charts – numerical problems.

Outcome: The students will be able to understand the working of VCR system and effects of refrigeration parameters like subcooling and superheating

Activity: Prepare charts on various cycles and processes used in VCRS

Unit-III:

REFRIGERANTS – Desirable properties – classification - refrigerants used – nomenclature – ozone depletion – global warming.

VCR SYSTEM COMPONENTS: Compressors – general classification – comparison – advantages and disadvantages. condensers – classification – working principles evaporators – classification – working principles expansion devices – types – working principles.

Outcome: The students will be able to differentiate various refrigerants used in refrigerating system and their impact on the environment. Also study working of the different components used in VCRS.

Activity: Demonstrate domestic refrigeration system, To study effects of various refrigerants on the environment.

Unit-IV:

VAPOR ABSORPTION SYSTEM: Calculation of maximum COP – description and working of NH system and Li Br –water (Two shell & Four shell) System, principle of operation three fluid absorption system, salient features.

STEAM JET REFRIGERATION SYSTEM: Working Principle and basic components. principle and operation of (i) thermoelectric refrigerator (ii) vortex tube.

Outcome: Students will be able to study various non-conventional refrigeration systems.

Activity: Fabricate vortex tube and thermoelectric refrigerator

Unit-V

INTRODUCTION TO AIR CONDITIONING: Psychometric properties &processes – characterization of sensible and latent heat loads – need for ventilation, consideration of infiltration – load concepts of RSHF, GSHF- problems, concept of ESHF and ADP temperature.
Requirements of human comfort and concept of effective temperature- comfort chart –comfort air conditioning – requirements of industrial air conditioning, air conditioning load calculations.

AIR CONDITIONING SYSTEMS: Classification of equipment, cooling, heating humidification and dehumidification, filters, grills and registers, fans and blowers. heat pump – heat sources – different heat pump circuits.

Outcome: Students will be able to study and design various air conditioning systems.

Activity: Estimation of cooling load for given application. To study Impact of condenser exit temperature on the environment.

Text Books:

1. A Course in Refrigeration and Air conditioning / SC Arora & Domkundwar / Dhanpatrai
2. Refrigeration and Air Conditioning / CP Arora / TMH.

Reference Books:

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

Course Code 1003174107	GAS DYNAMICS AND JET PROPULSION (Department Elective-1.4)	L	T	P	Credits
		3	1	0	3

Course Overview:

Up on successful completion of this course the student should be able to analyze the gas flow in different situations with and without friction, with and without heat transfer in particular jet propulsion and rocket engineering applications.

Course Objectives:

The purpose of this course is to provide the student with the knowledge of basic principles of gas dynamics and its importance in jet propulsion applications.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Students be able to understand density variation in fluid motion.	Understanding	PO1
CO2	Students be able to identify isoentropic flow and analyze the ideal behavior of gases in one dimensional.	Applying	PO2,PO3 ,P10
CO3	Students be able to analyze gas flows with and without friction.	Analyzing	PO10
CO4	Students be able to analyze gas flows with and without heat.	Analyzing	PO2,PO4
CO5	Students able to describe jet propulsion engines and basic concepts of rocket propulsion.	Analyzing	PO1,PO2 ,PO9

Unit-I:

INTRODUCTION TO GAS DYNAMICS: control volume and system approaches acoustic waves and sonic velocity – mach number - classification of fluid flow based on mach number - mach cone-compressibility factor - general features of one dimensional flow of a compressible fluid - continuity and momentum equations for a control volume.

Outcome: Students be able to understand density variation in fluid motion.

Activity: Demonstration of various compressible flows.

Unit-II:

ISENTROPIC FLOW OF AN IDEAL GAS: basic equation - stagnation enthalpy, temperature, pressure and density stagnation, acoustic speed - critical speed of sound-dimensionless velocity-governing equations for isentropic flow of a perfect gas - critical flow

area - stream thrust and impulse function. Steady one dimensional isentropic flow with area change-effect of area change on flow parameters- chocking convergent nozzle - performance of a nozzle under decreasing back pressure -De lavel nozzle - optimum area ratio effect of back pressure - nozzle discharge coefficients - nozzle efficiencies.

Outcome: Students be able to identify isoentropic flow and analyze the ideal behavior of gases in one dimensional.

Activity: A technical seminar on by students distinguishing isoentropic and real behavior of gases.

Unit-III:

SIMPLE FRICTIONAL FLOW: adiabatic flow with friction in a constant area duct-governing equations - fanno line limiting conditions - effect of wall friction on flow properties in an Isothermal flow with friction in a constant area duct-governing equations - limiting conditions.
Steady one dimensional flow with heat transfer in constant area ducts- governing equations - Rayleigh line entropy change caused by heat transfer - conditions of maximum enthalpy and entropy
Outcome: Students be able to analyze gas flows with and without friction.

Activity: A technical seminar by students on identifying dissipation terms involve in fluid motion.

Unit-IV:

EFFECT OF HEAT TRANSFER ON FLOW PARAMETERS: Intersection of Fanno and Rayleigh lines. Shock waves in perfect gas properties of flow across a normal shock - governing equations - Rankine Hugoniat equations - Prandtl's velocity relationship - converging diverging nozzle flow with shock thickness - shock strength.

Outcome: Students be able to analyzegas flows with and without heat.
Activity: Video demonstration by students identifying shock waves involving in aerodynamics.

Unit-V

PROPULSION: Air craft propulsion: - types of jet engines - energy flow through jet engines, thrust, thrust power and propulsive efficiency turbojet components-diffuser, compressor, combustion chamber, turbines, exhaust systems.
Performance of turbo propeller engines, ramjet and pulsejet, scramjet engines. Rocket propulsion – rocket engines, Basic theory of equations - thrust equation - effective jet velocity - specific impulse - rocket engine performance - solid and liquid propellant rockets - comparison of various propulsion systems.

Outcome: Students able to describe jet propulsion engines and basic concepts of rocket propulsion.

Activity: Performing an impulse momentum activity by students applied to rocket motion.

Text Books:

1. Compressible fluid flow /A. H. Shapiro / Ronald Press Co., 1953
2. Fundamentals of compressible flow with aircraft and rocket propulsion/S. M. Yahya/New Ageinternational Publishers
3. Fundamental of Gas dynamics-2nd edition/ M J Zucker/ Wiley publishers

Reference Books:

1. Elements of gas dynamics / HW Liepman& A Roshko/Wiley
2. Aircraft & Missile propulsion /MJ Zucrow/Wiley
3. Gas dynamics / M.J. Zucrow& Joe D.Holfman / Krieger Publishers

Course Code		L	T	P	Credits
1003174108	CNC MACHINE TOOLS (Department Elective-1.5)	3	1	0	3

Course Overview:

This course covers the fundamentals and concepts of the NC and CNC machining, NC part programming, Programming through CAD/CAM, and interpolators for linear and circular interpolation. It also covers the tooling for CNC machines, direct numerical control systems and adaptive control systems for machining processes like turning and grinding operations, microcontrollers for CNC machines.

Course Objectives:

1. To understand the basic fundamentals of numerical control (NC) machine tools and computer numerical control (CNC) machine tools.
2. To learn computer aided part programming.
3. To understand the principle of interpolation and various interpolators for linear and circular interpolation.
4. To learn tooling for computer numerical control machines, direct numerical control machines and adaptive control systems.
5. To learn various microcontrollers for computer numerical control machine tools.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Describe the features of numerical control and computer numerical control machine tools	Understanding	PO1, PO5
CO2	Develop the numerical control and computer aided part programming	Applying	PO1, PO2, PO5
CO3	Distinguish the interpolators for linear and circular interpolation	Analyzing	PO1, PO2
CO4	Analyse the tooling systems for computer numerical control machines and adaptive control for machining processes	Analyzing	PO1, PO2, PO4, PO5, PO7
CO5	Describe the various microcontrollers and select the appropriate microcontrollers for computer numerical control machines	Applying	PO1, PO2, PO3, PO4 PO5

Unit-I:

Features of NC Machines Fundamentals of numerical control, advantage of NC systems, classification of NC systems, point to point, NC and CNC, incremental and absolute, open and

closed loop systems, Features of NC Machine Tools, design consideration of NC machine tool, methods of improving machine accuracy. Systems Drives and Devices: Hydraulic motors, DC motors, stepping motors and AC motors, feedback devices, encoders, Induction tachometers.

Outcome: Recognize the advantages of numerical control and computer numerical control machine tools and understand the principle of feedback devices and encoders

Activity: Measure the speed of lathe spindle with tachometer and build the closed loop system to know the spindle speed for conventional lathe

Unit-II:

NC PART PROGRAMMING: Manual programming-Basic concepts, Point to Point contour programming, canned cycles, parametric programming.
COMPUTER-AIDED PROGRAMMING: General information, APT programming, Examples APT programming problems (2D machining only). NC programming on CAD/CAM systems.
Outcome: To develop NC and computer aided part programme for various machining processes
Activity: Prepare the CNC part programme to perform the step turning operation

Unit-III:

POST PROCESSORS: Introduction to post processors, necessity of post processors, general structure of a post processor, functions of a post processor. Automatic tool path generation.

INTERPOLATORS: DDA integrator, hardware interpolators for linear and circular interpolator, DDA software interpolators and CNC software interpolators, the reference pulse technique, sample data technique.

Outcome: Describe the interpolation and distinguish the various interpolators for linear and circular interpolation
Activity: Students presentation on automatic tool path generation and interpolation

Unit-IV:

TOOLING for CNC MACHINES: Inter changeable tooling system, preset and qualified tools, coolant fed tooling system, modular fixturing, quick change tooling system, automatic head changers.

DNC SYSTEMS and ADAPTIVE CONTROL: Introduction, type of DNC systems, advantages and disadvantages of DNC, adaptive control with optimization, Adaptive control with constraints, Adaptive control of machining processes like turning, grinding.

Outcome: Explain the tooling system for CNC machines and advantages of adaptive control system

Activity: Prepare the adaptive control system to measure the cutting tool wear in turning operation

Unit-V

MICRO CONTROLLERS: Introduction, Hardware components, I/O pins, ports, external memory, counters, timers and serial data I/O interrupts. Selection of Micro Controllers, Embedded Controllers, Applications and Programming of Micro Controllers. Programmable Logic Controllers (PLC's): Introduction, Hardware components of PLC, System, basic structure, principle of operations, Programming mnemonics timers, Internal relays and counters, Applications of PLC's in CNC Machines.

Outcome: Understand the various microcontrollers and PLC's.

Activity: Fabricate the micro switches to give the automatic feed of 2 mm/rev on conventional lathe machine.

Text Books:

1. Computer Control of Manufacturing Systems / YoramKoren / Mc Graw Hill Int.1983.
2. Machining Tools Hand Book Vol 3, (Automation & Control)/ Manfred Weck / John Wiley and Sons, 1984.

Reference Books:

1. Design of machine tools/ S.K. Basu and D.K. Pal/ Fifth edition/Oxford & IBH Publication, 2009.
2. CNC Programming for Machining/ Kumar Kaushik, RanjanChikesh, Davim J. Paulo/Springer, 2020.

Course Code	QUALITY AND RELIABILITY ENGINEERING	L	T	P	Credits
1003174109	(Department Elective-1.6)	3	1	0	3

Course Overview: The course will give the student the basic knowledge and the essential tools of quality engineering that are used by organizations across

Course Objectives:

1. The aim of this course is to provide students with a basic understanding of the approaches and techniques to assess and improve process and/or product quality and reliability.
2. The objectives are to introduce the principles and techniques of Statistical Quality Control and their practical uses in product and/or process design and monitoring
3. To understand techniques of modern reliability engineering tools.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	The student will be able to understand the concepts of quality and the fundamentals of science of quality engineering	Remembering	PO 3
CO2	The student will be able to draw and construct control charts	Understanding	PO 1
CO3	the student will be able to infer from sampling plans and determine the quality parameter levels	Remembering	PO 5
CO4	the student will be able to draw a house of quality for a given scenario	Applying	PO 2
CO5	The student will comprehend the concept of reliability with a significant emphasis on a design of a given component	Understanding	PO 6

Unit-I:

Quality value and engineering – quality systems – quality engineering in product design and production process – system design – parameter design – tolerance design, quality costs – quality improvement.

Outcome: The student will be able to understand the concepts of quality and the fundamentals of science of quality engineering

Activity: browse the website of a company and understand their quality policies

Unit-II:

Statistical process control *X*, R, p, c charts, other types of control charts, process capability, process capability analysis, process capability index. (SQC tables can be used in the examination)

Outcome: The student will be able to draw and construct control charts

Activity: Draw a variable chart for screw production process

Unit-III:

Acceptance sampling by variables and attributes, design of sampling plans, single, double, sequential and continuous sampling plans, design of various sampling plans.

Outcome: the student will be able to infer from sampling plans and determine the quality parameter levels

Activity: solve a problem on inspection plan for a given scenario

Unit-IV:

Loss function, tolerance design – N type, L type, S type; determination of tolerance for these types. online quality control – variable characteristics, attribute characteristics, parameter design.

Quality function deployment – house of quality, QFD matrix, total quality management concepts. Quality information systems, quality circles, introduction to ISO 9000 standards.

Outcome: the student will be able to draw a house of quality for a given scenario

Activity: draw a QFD model for a car repair scenario

Unit-V

Reliability – Evaluation of design by tests - Hazard Models, Linear, Releigh, Weibull. Failure Data Analysis, reliability prediction based on weibull distribution, Reliability improvement.

Complex system, reliability, reliability of series, parallel & standby systems & complex systems & reliability prediction and system effectiveness.

Maintainability, availability, economics of reliability engineering, replacement of items, maintenance costing and budgeting, reliability testing.

Outcome: The student will comprehend the concept of reliability with a significant emphasis on a design of a given component

Activity: estimate the life cycle time of a watch for a given data

Text Books:

1. Quality Engineering in Production Systems / G Taguchi /McGraw Hill
2. Reliability Engineering/ E.Bala Guruswamy /Tata McGraw Hill,
3. Statistical Quality Control : A Modern Introduction/ Montgomery/Wiley

Reference Books:

1. Jurans Quality planning & Analysis/ Frank.M.Gryna Jr. / McGraw Hill.
2. Taguchi Techniques for Quality Engineering/ Philipposs/ McGraw Hill,
3. Reliability Engineering / LS Srinath / Affiliated East West Pvt. Ltd.,
4. Statistical Process Control/ Eugene Grant, Richard Leavenworth / McGraw Hill.
5. Optimization & Variation Reduction in Quality / W.A. Taylor / Tata McGraw Hill
6. Quality and Performance Excellence/ James R Evans/ Cengage learning

Course Code		L	T	P	Credits
1003174110	COMPOSITE MATERIALS (Department Elective-2.1)	3	0	0	3

Course Overview:

The course covers a broad range of composite materials and their properties. Different matrix and reinforcement's material are mentioned as it has their own significance at end user applications. Included different fabrication methods and ways to control mechanical and surface properties by considering different parameters. Studies included to predict the composite material properties by ROM by considering the size, shape, arrangements of fibers, dispersions, density, etc.). Different failure criteria are discussed to estimate the failure modes, finally course ended by covering the wide range of applications in different industries.

Course Objectives:

1. Understands the concept of composite, differentiate the different types of composite and their reinforcements.
2. Understand the importance of size and shape of the particulate fiber, purpose of coupling agents and functions of matrix materials. Design different nano composites reinforced with short fiber and long fiber.
3. Develop different composites, by understanding the different methods of fabrication techniques.
4. Predict the properties of different composites by understanding the concepts of ROM, properties of individual constituents and compare those properties with the conventional materials.
5. Apply the different failure theories and evaluate composite laminates for different failure modes. Study the different applications of composites to meet various engineering requirements.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	On completion of this course, students will be able to understand the concept of composites, can differentiate MMC's, PMS's, CMC's, able to tell the available reinforcing materials and their uses.	Applying	PO1,PO6, PO8
CO2	On completion of the topic, students are able to differentiate different types of reinforcement's, matrix materials, and use of coupling agents. Able to explain different nano composites.	Applying	PO1, PO5, PO12
CO3	On completion of the topic, students are able to explain different fabrication techniques to fabricate polymer composite materials	Analysing	PO1, PO12

CO4	On completion of the topic, students are able to know the use of particular reinforcements to the particular matrix material and able to estimate the properties of a composite by ROM technique.	Applying	PO2, PO12
CO5	On completion of the topic, students are able to know different failure theories and applications of different composite material.	Analysing	PO2, PO5,PO10

Unit-I: Introduction: History and basic concept of composites. Definition and Classification of Composites, MMC, PMC, CMC. Reinforcing fibres- Natural fibres (cellulose, jute, coir etc), boron, carbon, ceramic glass, aramids, polyethylene (UHMWPE), polybenzthiazoles etc.

Outcome: On completion of the topic, students will be able to understand the concept of composites, can differentiate MMC's, PMS's, CMC's, able to tell the available reinforcing materials and their uses.

Activity: Visit any website and prepare a one- or two-page report on MMC's, PMC's and CMC's.

Unit-II: Fundamental concepts:
Particulate fillers-importance of particle shape and size. Matrix resins-thermoplastics and thermosetting matrix resins. Coupling agents-surface treatment of fillers and fibres, significance of interface in composites. Nano composites, short and continuous fibre reinforced composites, critical fibre length, and anisotropic behaviour.
Outcome: On completion of the topic, students are able to differentiate different types of reinforcement's, matrix materials, and use of coupling agents. Able to explain different nano composites.
Activity: List out few reinforcing materials and mention their influence on composite material.

Unit-III: Fabrication techniques: pultrusion, filament winding, prepreg technology, injection and compression moulding, bag moulding, resin transfer moulding, reaction injection moulding.

Outcome: On completion of the topic, students are able to explain different fabrication techniques to fabricate polymer composite materials.

Activity: Prepare a chart to compare each and every fabrication method on their technical specifications and applications.

Unit-IV: Properties and performance of composites: Properties and microstructure of high-strength fiber materials (glass, carbon, polymer, ceramic fibers) and matrix materials (polymer, metal, ceramic, and carbon matrices). Specific strength and stiffness of high-performance composites. Rule of mixtures. Stress, strain transformations.

Outcome: On completion of the topic, students are able to know the use of particular reinforcements to the particular matrix material and able to estimate the properties of a composite by ROM technique.
Activity: Prepare a list of reinforcing materials and matrix materials along with their properties and compare to conclude for best combination of matrix and reinforcement.

Unit-V: Failure criteria: Hygrothermal stresses, bending of composite plates, analysis of sandwich plates, buckling analysis of laminated composite plates, inter-laminar stresses, First Order Shear Deformation Theory (FSDT). Applications: Industrial, aerospace, automobile, house hold etc.

Outcome: On completion of the topic, students are able to know different failure theories and applications of different composite material.

Activity: Take any one failure criteria and relate it to practical conditions. Prepare list of various major industries which are producing composite materials and list of major industries using composite materials.

Text Books:

1. Steven L. Donaldson, ASM Handbook Composites Volume 21, 2001.
2. Krishan K. Chawla, Composite Materials, Science and Engineering, Springer, 2001.
3. Suresh G. Advani, E. Murat Sozer, Process Modelling in Composites Manufacturing, 2nd Ed. CRC Press, 2009

Course Code		L	T	P	Credits
1003174111	**CONDITION MONITORING (Department Elective-2.2)**	3	0	0	3

Course Overview:

Condition monitoring (CM) is the process of monitoring a parameter of condition in machinery (vibration, temperature etc.), in order to identify a significant change which is indicative of a developing fault. It is a major component of predictive maintenance. The use of condition monitoring allows maintenance to be scheduled, or other actions to be taken to prevent consequential damages and avoid its consequences.

Course Objectives:

- This course is designed to introduce the benefits and opportunities of machine health Monitoring and covers a range of techniques.
- The students will be exposed to a range of techniques from Vibration based methods, Thermography, Oil conditions, Debris and ultrasonic monitoring.
- Using overall vibration, vibration limit zones, broadband vibration bandwidth, alert levels, typical severity guidelines, recording overall vibration, using overall vibration for fault finding, trending overall vibration.
- Identifying Resonance, Hammer Test, Self-Excitation, Exciter Testing. Reducing Resonance - Effects of Frequency, Stiffness, Mass, Damping, Isolation

	Course outcome	**Cognitive Level as per Bloom's Taxonomy**	**PO**
CO1	Identify the principles and commonly used paradigms and techniques of computer graphics	Remembering	PO1
CO2	Apply mathematics and logic to develop computer programs for elementary graphics operations	Understanding	PO5,PO3
CO3	Explain the core concepts of viewing, clipping, parametric curves and spot lighting	Understanding	PO5,PO1
CO4	Articulate the concepts of 3D transformations and hidden surface elimination	Applying	PO5,PO1, PO2,PO4
CO5	Execute basic graphics application programs including animation	Applying	PO5

UNIT-I

BASICS OF VIBRATION: Basic motion: amplitudes, period, frequency, basic parameters: displacement, velocity, acceleration, units (including dB scales) and conversions, Mass, spring and damper concept, Introduction to SDOF and MDOF systems, Natural frequencies and resonance, Forced response.

Outcome: At the end of this unit students will be able to synthesize the basic vibration problems and develop mathematical models using Mass, spring and damper concepts.
Activity: Determination of the natural frequency of the SDOF system in the Laboratory.

UNIT-II

VIBRATION MEASUREMENTS AND ANALYSIS: Transducers and mounting methods, data acquisition using instrumentation recorders/data loggers, time domain signal analysis, orbit analysis, Filters, Frequency domain analysis (Narrow band FFT analysis), Nyquist criteria, Sampling, aliasing, windowing and averaging.

VIBRATION MEASUREMENT AND ANALYSIS: Use of phase; bode, polar and waterfall plots, constant percentage bandwidth analysis (1/3 and 1/1 Octave analysis), envelope detection /spike energy analysis, cepstral analysis, advances in analysis (PC based and portable instruments for vibration analysis).

Outcome: At the end of this unit students will be able to use different methods for measuring and analyzing vibrations.

Activity: Measure the vibration amplitude of a SDOF system using a Data acquisition system or any other vibration analysis software**.**

UNIT-III

Fault Diagnosis, Interpreting vibration measurements for common machine faults, imbalance, misalignment, mechanical looseness, bearing and gearing faults, faults in induction motors, resonances, some case studies, static and dynamic balancing, international standards for vibration condition monitoring.

THERMOGRAPHY: The basics of infrared thermography, differences in equipment and specific wave length limitations, application of ir to: electrical inspection, mechanical inspection, energy conservation, how to take good thermal images, hands-on demonstrations focusing on proper camera settings and image interpretation, analysis of thermal images and report generation, study of thermography applications

Outcome: At the end of this unit students will be able to identify faults using vibration analysis and thermography techniques.

Activity: Identify the faults in bearings using vibration analysis.

UNIT-IV

OIL AND WEAR DEBRIS ANALYSIS: Basics of oil analysis, monitoring condition of oil, lubricant analysis, physio – chemical properties, moisture, tan tbn, wear debris analysis, particle counting, spectroscopy, uses & limitations, ferrography wear particle analysis, concept of ferrography, principle particle classification, size, shape, composition, concentration, analysis procedure, sampling & analytical ferrography equipments, severity rating.

Outcome: At the end of this unit students will be able to apply the knowledge of oil and wear debris analysis for identifying faults in machine components.

Activity: Identify the faults in bearings using oil and wear debris analysis.

UNIT-V

ULTRASONIC MONITORING AND ANALYSIS: Ultrasonic monitoring (leak, crack and thickness) basics of ultrasonic monitoring , ultrasonic theory, test taking philosophy, ultrasonic theory, mathematics of ultrasound, equipment and transducers, inspection parameters and calibration, immersion theory, equipment quality control, flaw origins and inspection methods, UT Procedure familiarization, and study recommendations, application of ultrasound to: air leaks, steam trap testing, bearing lubrication, electrical inspection, case studies.

Outcome: At the end of this unit, students will be able to apply the knowledge of ultrasonic monitoring methods to identify faults like air leaks, steam trap testing, bearing lubrication, electrical inspection etc.

Activity: Conduct a student seminar on fault diagnosis of machines using Ultrasonic monitoring techniques.

Text Books:

1. The Vibration Analysis Handbook/J I Taylor (1994)/Vibration consultants Incorporate Publishers
2. Machinery Vibration Condition Monitoring/Lynn/Butterworth(1989)

References:

1.Machinery Vibration: Measurement and Analysis/Victor Wowk /Mc GrawHill Professional
2. Mechanical fault diagnosis and condition monitoring/RA Collacott(1977) /Chapman and Hall
3. The Vibration Monitoring Handbook/Charles W Reeves/Coxmoor publishing company

Course Code		L	T	P	Credits
1003174112	COMPUTATIONAL FLUID DYNAMICS (Department Elective-2.3)	3	0	0	3

Course Overview: This Course provides an in-depth introduction to Computational Fluid Dynamics, Principles of governing equations and their derivations, classification of partial differential equations (PDEs), boundary conditions, discretization and analysis techniques used to solve computational problems of fluid mechanics and heat transfer.

Course Objectives:

The course aims at applying various numerical techniques for solving different engineering problems involving fluid flow.

UNIT-I

ELEMENTARY DETAILS IN NUMERICAL TECHNIQUES: Number system and errors, representation of integers, fractions, floating point arithmetic, loss of significance and error propagation, condition and instability, computational methods for error estimation, convergence of sequences.

Outcome: The student should be able to carryout stability assessment and estimate errors using various computational methods.

Activity: Estimate the error for any two successive iterations for a simple laplacian equation using any numerical method.

UNIT – II

APPLIED NUMERICAL METHODS: Solution of a system of simultaneous linear algebraic equations, iterative schemes of matrix inversion, direct methods for matrix inversion, direct methods for banded matrices.

REVIEW OF EQUATIONS GOVERNING FLUID FLOW AND HEAT TRANSFER: Introduction, conservation of mass, Newton's second law of motion, expanded forms of navier-stokes equations, conservation of energy principle, special forms of the Navier-stokes equations.

Outcome: The student should gain command over applying various numerical techniques to solve PDE's associated with governing equations applied in various engineering problems.

Activity: Deduce any one governing partial differential equation to algebraic equation by using any one numerical technique.

UNIT – III

Steady flow, dimensionless form of momentum and energy equations, stokes equation, conservative body force fields, stream function - vorticity formulation.
Finite difference applications in heat conduction and convention – heat conduction, steady heat conduction in a rectangular geometry, transient heat conduction, finite difference application in convective heat transfer, closure.

Outcome: The student should be familiarized with momentum, energy, conservation laws and

principles that are applied to conduction and convection problems using FDM approach.
Activity: Derive the boundary conditions for lid driven cavity using FDM approach.

UNIT – IV

Finite differences, discretization, consistency, stability, and fundamentals of fluid flow modelling: introduction, elementary finite difference quotients, implementation aspects of finite-difference equations, consistency, explicit and implicit methods.

Introduction to first order wave equation, stability of hyperbolic and elliptic equations, fundamentals of fluid flow modelling, conservative property, the upwind scheme.

Outcome: The student should be able to understand the concept of discretization and apply suitable CFD scheme according to the defined fluid flow problem.

Activity: Model a simple rectangular fluid flow channel and estimate the pressure drop using Analysis Fluent

UNIT –V

FINITE VOLUME METHOD: Approximation of surface integrals, volume integrals, interpolation and differentiation practices, upwind interpolation, linear interpolation and quadratic interpolation.

Outcome: The student should be able to apply Finite volume approach to solve various fluid flow and heat transfer problems.

Activity: Employ any one interpolation technique to solve a simple CFD problem that is self-defined.

Text Books:

1. Numerical heat transfer and fluid flow / Suhas V. Patankar/Butter-worth Publishers
2. Computational fluid dynamics - Basics with applications /John. D. Anderson / Mc Graw Hill.

References:

1. Computational Fluid Flow and Heat Transfer/ Niyogi/Pearson Publications
2. Fundamentals of Computational Fluid Dynamics /Tapan K. Sengupta / Universities Press.
3.Computational fluid dynamics: An introduction, 3rd edition/John.F Wendt/Springer publishers

Course Code		L	T	P	Credits
1003174113	GREEN ENGINEERING SYSTEMS (Department Elective-2.4)	3	0	0	3

Course Overview: This course provides a simple understanding of green engineering systems. The course contains the details of solar radiation, its storage and application, Biomass, Geothermal energy, Ocean energy. The energy efficient systems and processes also being addressed in this course.

Course Objectives:

The course aims to highlight the significance of alternative sources of energy, green energy systems and processes and provides the theory and working principles of probable sources of renewable and green energy systems that are environmentally friendly.

	Course Outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Distinguish various types of solar thermal collectors	analyzing	1,7
CO2	Describe the working of a photovoltaic system and wind energy conversion system	understanding	1,7
CO3	Analyze the operation of fuel cells and biomass conversion technologies	analyzing	1,6,7
CO4	Elaborate on ocean, geothermal, electrical and Mechanical systems	creating	1,6,7
CO5	Utilize concept of green building and energy management	applying	1,6,7

UNIT-I

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

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

Outcome: Distinguish various types of solar thermal collectors

Activity: student has to prepare solar cell and calculate energy as per requirement

UNIT – II

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

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

Outcome: Describe the working of a photovoltaic system and wind energy conversion system

Activity: Demonstrating solar applications model and show working of wind turbine to produce power

UNIT – III

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

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

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

Outcome: Analyze the operation of fuel cells and biomass conversion technologies

Activity: Demonstrate model on biomass that are using at house

UNIT –IV

ENERGY EFFICIENT SYSTEMS:

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

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

Outcome: Elaborate on ocean, geothermal, electrical and Mechanical systems

Activity: prepare model on both Electrical and Mechanical system that are used by green engineers

UNIT-V

ENERGY EFFICIENT PROCESSES: Environmental impact of the current manufacturing practices and systems, benefits of green manufacturing systems, selection of recyclable and environment friendly materials in manufacturing, design and implementation of efficient and sustainable green production systems with examples like environmental friendly machining,

vegetable based cutting fluids, alternate casting and joining techniques, zero waste manufacturing.

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

Outcome: Understanding selection of eco-friendly material, machine and process for manufacturing

Activity: Showing equipments and process for Environmental friendly manufacturing process

Text Books:

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

References:

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

Course Code		L	T	P	Credits
1003174114	COMPUTER GRAPHICS (Department Elective-2.5)	3	0	0	3

Course Overview:

This course is an introductory course in Computer Graphics, and covers a wide range of the field of interactive computer graphics at all levels of abstraction Core topics include: essential mathematics, the GPU pipeline,2-D and 3-D modeling and transformations, viewing transformations, projections, image processing, rendering. It follows a standard textbook in the field, with additional material.

Course Objectives:

1. To introduce the use of the components of a graphics system and become familiar with building approach of graphics system components and algorithms related with them.
2. Provide an understanding of how to scan convert the basic geometrical primitives, how to transform the shapes to fit them as per the picture definition.
3. Provide an understanding of mapping from world coordinates to device coordinates, clipping, and projections.
4. To learn the basic principles of 3-dimensional computer graphics.
5. To comprehend and analyze the fundamentals of animation, virtual reality, underlying technologies, principles, andApplications.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Identify the principles and commonly used paradigms and techniques of computer graphics	Remembering	PO1
CO2	Apply mathematics and logic to develop computer programs for elementary graphics operations	Understanding	PO5,PO3
CO3	Explain the core concepts of viewing, clipping, parametric curves and spot lighting	Understanding	PO5,PO1
CO4	Articulate the concepts of 3D transformations and hidden surface elimination	Applying	PO5,PO1, PO2,PO4
CO5	Execute basic graphics application programs including animation	Applying	PO5

UNIT – I

INTRODUCTION: Application areas of computer graphics, overview of graphic system, video-display devices, raster-scan systems, random scan systems, graphics monitors and workstations and input devices.

Outcome:
The student should be able to identify the principles and commonly used paradigms and techniques of computer graphics
Activity: Demonstration of various devices used for computer Graphics

UNIT-II

OUTPUT PRIMITIVES: Points and lines, line drawing algorithms, midpoint circle algorithm, Filled area primitives: scan-line polygon fill algorithm, boundary-fill and flood-fill algorithm.

2-D GEOMETRICAL TRANSFORMATIONS: Translation, scaling, rotation, reflection and shear transformation matrix representations and homogeneous coordinates, composite transformations, transformations between coordinates

Outcome:
The student should be able to apply mathematics and logic to develop computer programs for elementary graphics operations
Activity: Practice any o midpoint circle algorithm algorithm in Computer Laboratory

UNIT -III

2-D VIEWING: The viewing pipe-line, viewing coordinate reference frame, window to view-port coordinate transformations, viewing function, Cohen-Sutherland and Cyrus-beck line clipping algorithms, Sutherland Hodgeman polygon clipping algorithm

3-D OBJECT REPRESENTATION: Spline representation, Hermite curve, Bezier curve and B-spline curve, Polygon surfaces, quadric surfaces, Solid modelling Schalars – wire frame, CSG, B-rep. Bezier and B-spline surfaces, Basic illumination models, shading algorithms

Outcome: The student should be able to explain the core concepts of viewing,clipping,parametric curves and spot lighting

Activity: Development of Bezier curve using computer programming

UNIT -IV

3-D GEOMETRIC TRANSFORMATIONS: Translation, rotation, scaling, reflection and shear transformation and composite transformations. Visible surface detection methods: Classification, back-face detection, depth buffer, scan-line, depth sorting

Outcome:
The student should be able to articulate the concepts of 3D transformations and hidden surface elimination

Activity: Demonstration of back-face detection in computer Laboratory

UNIT-V

COMPUTER ANIMATION: Design of animation sequence, general computer animation functions, raster animation, computer animation language, key frame system, motion specification

Outcome:
The student should be able to execute basic graphics application programs including animation
Activity: Practice any animation software in computer system

Text Books:

1. Computer Graphics C version/ Donald Hearn and M. Pauline Baker/Pearson/PHI
2. Computer Graphics Principles & practice-second edition in C/ Foley, VanDam, Feiner and Hughes/Pearson Education

References:

1. Computer Graphics Second edition/ Zhigandxiang, Roy Plastock, Schaum's outlines/Tata Mc-Graw hill edition.
2. Procedural elements for Computer Graphics/David F Rogers/Tata Mc Graw hill, 2nd edition.
3. Principles of Interactive Computer Graphics/ Neuman and Sproul/TMH.
4. Computer Graphics/ Steven Harrington/TMH

Course Code		L	T	P	Credits
1003174115	ADDITIVE MANUFACTURING (Department Elective-2.6)	3	0	0	3

Course Overview: Additive manufacturing (AM) is a rapidly growing industry that allows for rapid prototyping and the creation of more complex and functional parts, including end-use parts and traditional manufacturing tooling. AM encompasses a variety of build methods, such as material jetting and material extrusion. An understanding of the AM basics is useful for anyone working in the manufacturing industry. AM methods often streamline manufacturing processes and improve products and profitability.

Course Objectives: The course aims at the importance of Additive Manufacturing, classifications, models, specifications of various Additive Manufacturing Techniques. To learn the different tools, soft-wares required and the applications of Additive Manufacturing.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Select a suitable liquid based Rapid prototyping process based on the application of the product.	Applying	PO1,PO6, PO8
CO2	Select solid based Rapid prototyping process based on the application of the product.	Applying	PO1, PO5, PO12
CO3	Compare and contrast between the SLS and 3DP rapid prototyping processes	Analysing	PO1, PO12
CO4	Choose a rapid tooling process based on the specific requirement of a component	Applying	PO2, PO12
CO5	Analyse stl file problems and find solution and repair	Analysing	PO2, PO5,PO10

UNIT – I

INTRODUCTION: Prototyping fundamentals, historical development, fundamentals of rapid prototyping, advantages and limitations of rapid prototyping, commonly used terms, classification of RP process.

LIQUID-BASED RAPID PROTOTYPING SYSTEMS: Stereo lithography Apparatus (SLA): models and specifications, process, working principle, photopolymers, photo polymerization, layering technology, laser and laser scanning, applications, advantages and disadvantages, case studies. Solid Ground Curing (SGC): models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

Outcome: After completion of this unit, the students will be able to determine a suitable Liquid based RP system based on the product requirements.

Activity: Prepare a physical model representing the various steps involved in Solid Ground Curing technique. Conduct a student seminar on the ethical issues and security like 3D printers in cyber crime.

UNIT-II

SOLID-BASED RAPID PROTOTYPING SYSTEMS: Laminated object manufacturing (LOM) - models and specifications, process, working principle, applications, advantages and disadvantages, case studies. Fused deposition modelling (FDM) - models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

Outcome: After completion of this unit, the students will be able to determine a suitable solid based RP system based on the product requirements.

Activity: Students will be given a practice session on Fused Deposition Modeling 3D printers in the laboratory.

UNIT – III

POWDER BASED RAPID PROTOTYPING SYSTEMS: Selective laser sintering (SLS): models and specifications, process, working principle, applications, advantages and disadvantages, case studies. Three-dimensional printing (3DP): models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

RAPID TOOLING: Introduction to rapid tooling (RT), conventional tooling Vs RT, Need for RT. rapid tooling classification: indirect rapid tooling methods: spray metal deposition, RTV epoxy tools, Ceramic tools, investment casting, spin casting, die casting, sand casting, 3D Keltool process. Direct rapid tooling: direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP.

Outcome: After completion of this unit, the students will be able to determine a suitable powder based RP system based on the product requirements. They will get insight of the merits of rapid tooling over conventional tooling.

Activity: Prepare a model of a 3 D printing machine working on LOM technology.

UNIT – IV

RAPID PROTOTYPING DATA FORMATS: STL Format, STL File Problems, consequence of building valid and invalid tessellated models, STL file Repairs: Generic Solution, other Translators, Newly Proposed Formats.

RAPID PROTOTYPING SOFTWARE'S: Features of various RP software's like Magics, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3 D doctor.

Outcome: After completion of this unit, the students will be able to analyse the stl file problems and choose a specific software for repair.

Activity: Conduct a poster presentation activity on the evolutionary development of softwares used in 3 D printing. Conduct a practice session on an open source software of 3D printing.

UNIT –V

RP APPLICATIONS: Application in engineering, analysis and planning, aerospace industry, automotive industry, jewellery industry, coin industry, GIS application, arts and architecture. RP medical and bioengineering applications: planning and simulation of complex surgery, customized implants & prosthesis, design and production of medical devices, forensic science and anthropology, visualization of bimolecular.

Outcome: After completion of this unit, the students will be able to recognize the scope of 3D printing technology and its application in engineering and biomedical industries.

Activity: Conduct a student seminar on the scope of 3 D printing technology in Biomedical and Bio engineering applications.

Text Books:

1. Rapid prototyping: Principles and Applications /Chua C.K., Leong K.F. and LIM C.S/World Scientific publications

References:

1. Rapid Manufacturing / D.T. Pham and S.S. Dimov/Springer
2. Wohlers Report 2000 /Terry T Wohlers/Wohlers Associates
3. Rapid Prototyping & Manufacturing / Paul F.Jacobs/ASME Press
4. Rapid Prototyping / Chua &Liou.

Course Code	CAD/CAM LAB	L	T	P	Credits
1003174121		0	0	3	2

Course Objectives:

1. To impart the fundamental knowledge on using various design & analytical tools like NX design, CATIA, ANSYS, FLUENT, Hyperworks, etc., for Engineering Simulation
2. To know various fields of engineering where these tools can be effectively used to improve the output of a product
3. To impart knowledge on how these tools are used in Industries by solving some real time problems using these tools.

List of Experiments

1. **DRAFTING:** Development of part drawings for various components in the form of orthographic and isometric representation with dimensioning and tolerances. scanning and plotting. study of script, DXE and IGES files.

2. **PART MODELING:** Generation of various 3D models through protrusion, revolve, shell sweep. creation of various features. Study of parent child relation. feature based and boolean based modelling surface and assembly modeling.Study of various standard translators. design simple components.

3. Analysis of 2D and 3D designed components using any one of the analysis packages given in the references.

4. a)Study of various post processors used in NC Machines.
   b)Machining of simple components on NC lathe and Mill by transferring NC Code / from CAM package. Through RS 232.
   c)Practice on CNC Sinutrain Turning
   d)Practice on CNC Sinutrain Milling
   e)CNC programming for turned components using FANUC Controller
   f)CNC programming for milled components using FANUC Controller
   g)Automated CNC Tool path & G-Code generation using Pro/E/MasterCAM

Any suitable packages among the following to be provided to cater to drafting, machining, modeling& analysis.

CATIA, Pro-E, NX Design, ANSYS, Abaqus FEA, Hyperworks, NISA, CAEFEM, Gibbs CAM, Master CAM etc.

Course outcomes:

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

1. The student will be able to appreciate the utility of the tools like ANSYS or FLUENT in solving real time problems and day to day problems.
2. Use of these tools for any engineering and real time applications
3. Acquire knowledge on utilizing these tools for a better project in their curriculum as well as they will be prepared to handle industry problems with confidence when it matters to use these tools in their Employment.

Course Code		L	T	P	Credits
1003174122	VIBRATIONS AND ACOUSTICS LAB	0	0	3	2

Course Objectives:

1. Able to determine natural frequency of beams, plates and cavity.
2. Able to evaluate vibration measuring techniques.
3. Able to evaluate methods in reducing vibration and noise.

List of Experiments

1. Determine the natural frequency of a given cantilever beam in free vibration when excited at a location.
2. Determine the natural frequency of a simply supported beam in free vibration when excited at a location.
3. Determine the natural frequency of a given cantilever beam using a roving hammer method for three locations in free vibration.
4. Determine the natural frequency of a given cantilever beam using roving accelerometer method for three locations in free vibration.
5. Evaluate the effect of damping with various materials for a given cantilever specimen in free vibration.
6. Damp a given MS cantilever beam at its first mode excited under free vibration.
7. Determine the structural vibrations of a given plate.
8. Determine the natural frequencies for a given cavity within a band of 20Hz to 200Hz.
9. Determine the structure borne noise of a wooden plate.
10. Evaluate the effect of structure borne noise when a wooden plate is clamped with gypsum board
11. Determination of Damping co-efficient and natural frequency for a given cantilever beam using impact hammer

Course Code		L	T	P	Credits
1003174123	SIMULATION LAB(MATLAB)	0	0	3	2

Course Objectives:

To impart programming exposure on the various functions in Matlab. Also, to impart knowledge on the solving capabilities on various numerical problems.

1. MATLAB basics,
2. Dealing with vectors and matrices,
3. Graphing-Functions of one variable and two Variables
4. Neural Network Tool box – Training and testing
5. Basic plotting: Creating simple plots, Adding titles, axis labels, and annotations.
6. Construction of 3D graphs and contours using Matlab
7. Dealing with array operations and Linear equations
8. Programming in MATLAB,M-File Scripts.
9. M-File functions.
10. Control flow and operators

Course Code		L	T	P	Credits
1003174124	MECHATRONICS LAB	0	0	3	2

Course Objectives:

1. To impart knowledge in Measure load, displacement and temperature using analog and digital sensors.
2. To develop PLC programs for control of traffic lights, water level, lifts and conveyor belts.
3. To Simulate and analyse PID controllers for a physical system using MATLAB.
4. To Develop pneumatic and hydraulic circuits using Automaton studio.

List of Experiments

1. DYNA 1750 Transducers Kit :-
   a. Characteristics of LVDT
   b. Principle & Characteristics of Strain Gauge
   c. Characteristics of Summing Amplifier
   d. Characteristics of Reflective Opto Transducer
2. PLC PROGRAMMING
   a. Ladder programming on Logic gates, Timers& counters
   b. Ladder Programming for digital & Analogy sensors
   c. Ladder programming for Traffic Light control, Water level control and Lift control Modules
3. AUTOMATION STUDIO software
   a. Introduction to Automation studio & its control
   b. Draw & Simulate the Hydraulic circuit for series & parallel cylinders connection
   c. Draw & Simulate Meter-in, Meter-out and hydraulic press and clamping.
4. MATLAB Programming
   a. Sample programmes on Matlab
   b. Simulation and analysis of PID controller using SIMULINK

Course Outcomes:

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

1. Measure load, displacement and temperature using analogue and digital sensors.
2. Develop PLC programs for control of traffic lights, water level, lifts and conveyor belts.
3. Simulate and analyse PID controllers for a physical system using MATLAB.
4. Develop pneumatic and hydraulic circuits using Automaton studio.

Course Code		L	T	P	Credits
1003174131	Mechanical Synthesis Project	0	0	3	3

Course Objectives:

1. To impart the fundamental knowledge on design and fabrication of mechanical mechanisms

2. To know various fields of engineering where these design and fabrication tools can be effectively used to improve the output of a product

3. To impart knowledge on how these procedures are used in Industries by solving some real time problems

Procedure:

Mechanical synthesis of project consists of two phases as follows:

Phase-1: Design of Mechanical Synthesis project: Development of mechanism for executing the required output with the input selected. Develop the links and assembly drawing of mechanism in the form of orthographic drawing with dimensioning and tolerances

Phase-2: Fabrication of Mechanical Synthesis project: Fabrication of various parts of mechanism through various manufacturing techniques like welding, cutting, machining, forming etc. Assembly of various components as per assembly drawing, Study and record the output of equipment with theoretical design values for project validation

Course outcomes:

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

1.The student will be able to appreciate the knowledge of design of components using design of synthesis principles.

2. Acquire the manufacturing knowledge on utilizing practical facilities for development of mechanical synthesis project

Note:

Evaluation process: Out of a total 100 marks for the Mechanical Synthesis Project, 50 marks shall be for internal evaluation and 50 marks for the end semester examination. The end semester examination (Viva – Voce) shall be conducted by the committee. The committee consists of an external examiner, head of the Department and Co-ordinator of Mechanical synthesis Project. The evaluation of Mechanical Synthesis Project work shall be conducted at the end of the IV year I semester along with laboratory examinations. The internal evaluation shall be on the basis of two seminars given by each student on the topic of his mechanical synthesis project and evaluated by an internal committee

DETAILED SYLLABUS

FOR

IV B.Tech

II SEMESTER

Course Code	PRODUCTION PLANNING AND CONTROL	L	T	P	Credits
1003174201		3	1	0	3

Course Overview: The course is designed to introduce the student to concepts of demand, supply, and the role of production planning to meet the demand of the customers while reducing the inventory, waiting times and inventory costs.

Course Objectives:

This subject provides students with

1.An understanding of the concepts of production and service systems;

2. The ability to apply principles and techniques in the design, planning and control of these systems to optimize /make best use of resources in achieving their objectives.

3. Identify different strategies employed in manufacturing and service industries to plan production and control inventory.

4. Measure the effectiveness, identify likely areas for improvement, develop and implement improved planning and control methods for production systems.

	Course Outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	The student will understand the concepts of demand, supply and the need for the production planning across all industries	Understanding	PO 2
CO2	The student will comprehend the concepts of demand forecasting and the quantitative methods to meet the market demand	Understanding	PO 1
CO3	The student will understand the basics of workflow and becomes well acquainted with line balancing and mixed model production theories	Remembering	PO 7
CO4	The student will understand the basics of workflow and becomes well acquainted with line balancing and mixed model production theories	Remembering	PO 6
CO5	The student will become fully comfortable with the dispatching concepts and its auxiliary functions.	Understanding	PO 4

Unit-I:

Introduction: Definition – objectives and functions of production planning and control – elements of production control – types of production – organization of production planning and control department – internal organization of department.

Outcome: The student will understand the concepts of demand, supply and the need for the production planning across all industries

Activity: Visit a industry, and particularly their production planning department to understand

how the external demand is converted in to the production target

Unit-II:

Forecasting – importance of forecasting – types of forecasting, their uses – general principles of forecasting – forecasting techniques – qualitative methods and quantitative methods.

Outcome: The student will comprehend the concepts of demand forecasting and the quantitative methods to meet the market demand.

Activity: Watch YouTube videos on delphi's method of forecasting

Unit – III:

Inventory management – functions of inventories – relevant inventory costs – ABC analysis – VED analysis – EOQ model – Inventory control systems – P–Systems and Q-Systems Introduction to MRP I, MRP II, ERP, LOB (Line of Balance), JIT and KANBAN system.

Outcome: The student will be well versed with ABC and VED analysis to prioritize the production targets.

Activity: Develop a ABC and VED analysis for a production function when the demand is specified

Unit-IV:

Routing – definition – routing procedure –route sheets – bill of material – factors affecting routing procedure, schedule –definition – difference with loading Scheduling policies – techniques, standard scheduling methods.

Line Balancing, aggregate planning, chase planning, expediting, controlling aspects.

Outcome: The student will understand the basics of workflow and becomes well acquainted with line balancing and mixed model production theories

Activity: Design a production system for a given demand and product mix

Unit-V:

Dispatching – activities of dispatcher – dispatching procedure – follow up – definition – reason for existence of functions – types of follow up, applications of computer in production planning and control.

Outcome: The student will become fully comfortable with the dispatching concepts and its auxiliary functions.

Activity: visit a logistics firm and understand how the dispatching functions are performed.

Text Books:

1. Elements of Production Planning and Control / Samuel Eilon/Universal Book Corp.
2. Manufacturing, Planning and Control/PartikJonssonStig-Arne attsson/TataMcGrawHill

References:

1. Inventory Control Theory and Practice / Martin K. Starr and David W. Miller/Prentice-Hall
2. Production Planning and Control/Mukhopadyay/PHI.
3. Production Control A Quantitative Approach / John E. Biegel/Prentice-Hall
4. Production Control / Franklin G Moore & Ronald Jablonski/ Mc-GrawHill
5. Production and Operations Management/Shailendra Kale/McGraw Hill
6. Production and Operations Management/Ajay K Garg/McGraw Hill

Course Code		L	T	P	Credits
1003174202	**ADVANCED MATERIALS (Department Elective-3.1)**	3	1	0	3

Course Overview: This course focuses on composites, advanced alloys and engineering ceramics. The course explores the technologies used in the manufacturing and processing of advanced materials and develop an understanding of the relationships between composition, microstructures, processing, performance and applications.

Course Objectives:

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

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Properties of constituents, classification of composites and their suitability for the structural applications.	Remember, Understanding	PO1
CO2	Categorize and process of different PMC, MMC & CCC with their applications	Understand, Apply	PO1, PO3
CO3	Compute micromechanical analysis of Lamina.	Analyze, Evaluate	PO4
CO4	Smart materials and their applications.	Understand	PO1
CO5	Nano materials in comparison with bulk materials.	Understand, Apply	PO1, PO12

Unit-I:

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

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

Outcome: Properties of constituents, classification of composites and their suitability for the structural applications.

Activity: The student has to identify various composite materials and their applications.

Unit-II:

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

MANUFACTURING METHODS: Autoclave, tape production, moulding methods, filament winding, hand layup, pultrusion, RTM.

Outcome: Categorize and process of different PMC, MMC & CCC with their applications
Activity: At the end of the unit the student can prepare a composite model using any manufacturing method mentioned above.

Unit-III:

MACROMECHANICAL ANALYSIS OF A LAMINA: Introduction, generalized Hooke's law, reduction of Hooke's law in three dimensions to two dimensions, relationship of compliance and stiffness matrix to engineering elastic constants of an orthotropic lamina, laminate-laminate code.
Outcome: Compute micromechanical analysis of Lamina.
Activity: At the end of the unit the student should be able to analyze the micromechanical analysis of a lamina.

Unit-IV:

FUNCTIONALLY GRADED MATERIALS: Types of functionally graded materials-classification different systems-preparation-properties and applications of functionally graded materials.

SHAPE MEMORY ALLOYS: Introduction-shape memory effect-classification of shape memory alloys composition-properties and applications of shape memory alloys.

Outcome: Smart materials and their applications.
Activity: The student can identify various smart materials and shape memory alloys used in engineering application.

Unit-V:

NANO MATERIALS: Introduction-properties at nano scales-advantages & disadvantages-applications in comparison with bulk materials (nano – structure, wires, tubes, composites). state of art nano advanced- topic delivered by student.

Outcome: Nano materials in comparison with bulk materials.
Activity: At the end of the unit the student should be able to analyze the different nano materials and their structure with their applications.

Text Books:

1. Nano material /A.K. Bandyopadyay/New age Publishers
2. Material science and Technology: A comprehensive treatment/Robert W.Cahn,/VCH
3. Engineering Mechanics of Composite Materials / Isaac and M Daniel/Oxford University Press

References:

1. Mechanics of Composite Materials / R. M. Jones/ Mc Graw Hill Company, New York, 1975.
2. Analysis of Laminated Composite Structures / L. R. Calcote/Van NostrandRainfold,NY 1969
3.Analysis and performance of fibre Composites /B. D. Agarwal and L. J. Broutman /Wiley-Interscience, New York, 1980
4. Mechanics of Composite Materials - Second Edition (Mechanical Engineering) /AutarK.Kaw / CRC Press

Course Code		L	T	P	Credits
1003174203	NANO TECHNOLOGY (Department Elective-3.2)	3	1	0	3

Course Overview: This course is to provide an insight into the fundamentals of Nano science and nanotechnology. The course provides basics of nano materials, quantum mechanics and statistical mechanics. The intended course covers the whole spectrum of nano materials ranging from overview, synthesis, properties, and characterization of nano phase materials. To provide knowledge of various industrial applications of nanotechnology.
Course Objectives:

On successful completion of the course, students should be able to: Understand the basic scientific concepts of nanoscience. Understand the properties of nano materials, characterization of materials, synthesis and fabrication. Understand the applications of nano technology in various science, engineering and technology fields.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Discuss the fundamental principles of nanotechnology and their application to biomedical engineering.	Remembering	PO1
CO2	Apply engineering and physics concepts to the nano-scale and non-continuum domain.	Understanding	PO 1
CO3	choose appropriate synthesis technique to synthesize quantum nanostructures of desired size, shape and surface properties	Understanding	PO 6
CO4	Evaluate state-of-the-art, characterization methods for nanomaterials, and determine nanomaterial safety and handling methods required during characterization.	Analyzing	PO7
CO5	Discuss applications of nanomaterials and implication of health and safety related to nanomaterials.	Remembering	PO6 ,PO12

Unit-I:

INTRODUCTION: History of nano science, definition of nano meter, nano materials, nano technology. Classification of nano materials. Crystal symmetries, crystal directions, crystal planes. Band structure.
Outcome: Learn the importance of nanotechnology about the background on Nanoscience
Activity: Prepare the any two nano materials

Unit-II:

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

Outcome: Learn the properties of different fields

Activity: To conduct mechanical properties of nano composits

Unit-III:

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

Outcome: Understand the synthesis of non materials and their application and the impact of non materials on environment

Activity: To manufacture different specimens with varying compositions of nano particles

Unit-IV:

CHARECTERIZATION TECHNIQUES: X-Ray diffraction and Scherrer method, scanning electron microscopy, transmission electron microscopy, scanning probe microscopy, atomic force microscopy, piezo response microscopy, X-ray photoelectron spectroscopy, XANES and XAFS, angle resolved photoemission spectroscopy, diffuse reflectance spectra, photoluminescence spectra, Raman spectroscopy.

Outcome: Apply their learned knowledge to develop Nanomaterials. To emphasize the importance of nanotechnology in healthcare

Activity: To know the homogeneous distribution of nano particles mixed with other materials

Unit-V:

CARBON NANO TECHNOLOGY: Characterization of carbon allotropes, synthesis of diamond – nucleation of diamond, growth and morphology. Applications of nano cry stalling diamond films, grapheme, applications of carbon nano tubes.

APPLICATIONS OF NANO TECHNOLOGY: Applications in material science, biology and medicine, surface science, energy and environment. Applications of nano structured thin fins, applications of quantum dots.

Outcome: Discuss and evaluate state-of-the-art characterization methods for nanomaterials, and determine nonmaterial safety and handling methods required during characterization apply nanotechnology in the field of energy systems

Activity: To conduct various Characterization of nano materials using for the applications of biology and medicine, surface science, energy and environment

Text Books:

1. Nano science and nano technology by M.S Ramachandra Rao, Shubra Singh, Wiley publishers.

References:

1. Introduction to Nano Technology by Charles P. Poole, Jr., Frank J.Owens, Wiley publishers.
2. Nanotechnology by Jermy J Ramsden, Elsevier publishers.
3. Nano Materials- A.K.Bandyopadhyay/ New Age Introdu.
4. Nano Essentials- T.Pradeep/TMH.
5. Nanotechnology the Science of Small by M.A Shah, K.A Shah, Wiley Publishers.
6. Principles of Nanotechnology by PhaniKumar,Scitech.

Course Code	THERMAL EQUIPMENT DESIGN	L	T	P	Credits
1003174204	(Department Elective-3.3)	3	1	0	3

Course Overview: This course is intended to impart knowledge of principles of thermal equipment design and analyze the heat exchangers modes of operations.

Course Objectives:

1. To formulate suitable mathematical equation in Cartesian, cylindrical and spherical coordinate system subjected to various boundary conditions.
2. To study the mechanism of convection heat transfer by 3 modes namely Conduction, Convection, Radiation and their governing equations.
3. To enumerate the phenomena of radiation heat transfer subjected to various laws of radiation.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Apply the basic laws of heat transfer to account for the consequence of heat transfer in thermal analyses of engineering systems to analyze problems involving steady and transient state heat conduction in simple geometries and to design an extended surface for heat transfer enhancement.	Applying	PO:1, PO:2, PO:3, PO:4,
CO2	Evaluate heat transfer coefficients for natural convection, forced convection and for a phase change process.	Analyzing	PO:1, PO:2,, PO:4,
CO3	Design and develop a heat exchanging system for the basic engineering applications by analyzing its performance	Analyzing	PO:1, PO:2, PO:3, PO:4,
CO4	Construct electrical analogy networks through basic principles of radiation to estimate the radiative heat exchange between the bodies.	Analyzing	PO:1, PO:2, PO:4,
CO5	List out the advantages, applications and types of steam nozzles and condensers.	Applying	PO:1, PO:4

Unit-I:

Classification of heat exchangers: Introduction, Recuperation & Regeneration – Tubular heat exchangers: double pipe, shell & tube heat exchanger, Plate heat exchangers, Gasketed plate heat exchanger, spiral plate heat exchanger, Lamella heat exchanger, extended surface heat exchanger, Plate fin, and Tubular fin.

Outcome: The student will be able to

1Study the temperature distribution in different heat exchangers.
2Evaluate effectiveness of heat exchanger.

Activity: Perform an experimental investigation on a parallel flow and counter flow heat exchanger for the same inputs and compare the LMTD.

Unit-II:

Basic Design Methods of Heat Exchanger: Introduction, Basic equations in design, Overall heat transfer coefficient – LMTD method for heat exchanger analysis – parallel flow, counter flow, multipass, cross flow heat exchanger design calculations.

Double Pipe Heat Exchanger: Film Coefficient for fluids in annulus, fouling factors, calorific temperature, average fluid temperature, the calculation of double pipe exchanger, Double pipe exchangers in series-parallel arrangements.

Outcome: The student will be able to

1.Design and analyze various methods of heat exchange techniques,

2. Evaluate effectiveness of heat exchanger.

Activity: Perform an experimental investigation on a parallel flow and counter flow heat exchanger for the same inputs and compare the LMTD.

Unit-III:

Shell & Tube Heat Exchangers: Tube layouts for exchangers, baffle Heat exchangers, calculation of shell and tube heat exchangers – shell side film coefficients, Shell side equivalent diameter, the true temperature difference in a 1-2 heat exchanger, influence of approach temperature on correction factor, shell side pressure drop, tube side pressure drop, Analysis of performance of 1-2 heat exchanger, and design calculation of shell & tube heat exchangers. Flow arrangements for increased heat recovery, the calculations of 2-4 exchangers.

Outcome: The student will be able to

1. Study the temperature distribution in Shell & Tube Heat Exchangers.
2. Evaluate effectiveness of heat exchanger.

Activity: Perform an experimental investigation on a parallel flow and counter flow heat exchanger for the same inputs and compare the LMTD.

Unit-IV:

Condensation of single vapors: Calculation of a horizontal condenser, vertical condenser, De-super heater condenser, vertical condenser – sub-cooler, horizontal condenser – sub

cooler, vertical reflux type condenser, condensation of steam.

Vaporizers, Evaporators and Reboilers: Vaporizing processes, forced circulation vaporizing exchangers, natural circulation vaporizing exchangers, calculations of a reboiler.

Outcome: The student is able to classify different types of steam condensers and reaction turbines alongside calculations involved in determining the overall performance of the units.

Activity: Demonstration of reaction turbine in hydraulic machines laboratory (or) Preparation of a cooling tower model.

Unit-V:

Extended Surfaces: Longitudinal fins, weighted fin efficiency curve, calculation of a double pipe fin efficiency curve, calculation of a double pipe finned exchanger, calculation of a longitudinal fin shell and tube exchanger.

Direct Contact Heat Exchanger: Cooling towers, relation between wet bulb & dew point temperatures, the Lewis number, and classification of cooling towers, cooling tower internals and the roll of fill, Heat balance, heat transfer by simultaneous diffusion and convection. Analysis of cooling tower requirements, Design of cooling towers, Determination of the number of diffusion units, calculation of cooling tower performance.

Outcome: The student will be able to estimate efficiency and effectiveness of various types of fins and able to analyze condensers working.

Activity:

1. Perform an experimental study along the length of a fin using free and forced convention approach at various heat loads.
2. Estimate the time lag by quenching a hot billet in water/oil.

Text Books:

1. Process Heat Transfer – D.Q. Kern, TMH.
2. Cooling Towers by J.D. Gurney
3. Heat Exchanger Design – A.P.Fraas& M.N. Ozisick. John Wiely& sons, New York.

References:

1. Saunders, E.A.D., “Heat Exchangers Selection Design and Construction”, Longman Scientific and Technical, N.Y., 2001.
2. Kays, V.A. and London, A.L., “Compact Heat Exchangers”, McGraw Hill, 2002.
3. Holger Martin, “Heat Exchangers” Hemisphere Publ. Corp., Washington, 2001.
4. Kuppan, T., “Heat Exchanger Design Handbook”, Macel Dekker, Inc., N.Y., 2000
5. Seikan Ishigai, “Steam Power Engineering, Thermal and Hydraulic Design Principles”, Cambridge Univ. Press, 2001.

Course Code		L	T	P	Credits
1003174205	INDUSTRIAL FIRE AND SAFETY (Department Elective-3.4)	3	1	0	3

Course Overview:

The course is designed to impart the knowledge of safety, safety related concepts and laws to the student.

Course Objectives:

To create awareness among students about Fire safety and Fire prevention and also guide them to become safety officers with modern techniques of fire fighting. This has the blending mixture of both Learning and Skills.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	The student will understand the basic need for fire and safety requirements in any given setting like kitchen, manufacturing unit, petrol bunk	Remembering	PO 2
CO2	The student shall be well acquainted with safety equipment like fire engines, masks, hose pipes etc. He/she will be able to identify the safety equipment needed for a given setting like a testing laboratory	Understanding	PO 5
CO3	Understand the history, background, and the purpose of making the laws from a safety standpoint.	Understanding	PO 4
CO4	The student will appreciate the variety of fire equipment and understand their need/use for a given problem	Remembering	PO 8
CO5	The student will appreciate the variety of fire equipment accessories and understand their need/use for a given problem.	Remembering	PO 7

Unit-I:

Fundamentals of industrial safety, Different types of safety systems and equipments, Safety policy and safety terminology

Outcome: The student will understand the basic need for fire and safety requirements in any given setting like kitchen, manufacturing unit, petrol bunk

Activity: Visit a petrol bunk and observe the safety protocols being implemented to avoid fire accidents

Unit-II:

Emergency planning, Safety inventory systems, Safety survey, Occupational health hazards, Safety organization and duties of a safety officer

Outcome: The student shall be well acquainted with safety equipment like fire engines, masks, hose pipes etc. He/she will be able to identify the safety equipment needed for a given setting like a testing laboratory.

Activity: Visit the website of a safety statutory body like OSHA and understand the various safety related terms and definitions

Unit-III:

Accident prevention methods, Safety committee, Accident investigation, Safety management systems, Laws related to safety (Factories ACT 1948 Explosive ACT, Electricity ACT etc.)

Outcome: Understand the history, background, and the purpose of making the laws from a safety standpoint

Activity: Visit the internet and read the original law as enacted. Give some changes that are needed i the laws for the present day industrial needs

Unit-IV:

Classification of fire, Portable fire extinguishers, Pumps and primers, Foam, Hose and hose fittings, Water relay systems, Breathing apparatus

Outcome: The student will appreciate the variety of fire equipment and understand their need/use for a given problem.

Activity: Visit a nearby industry and observe the fire equipment installed therein

Unit-V:

Fire protective clothing, Ladders, Ropes and lines, Fire prevention, Fire fighting codes and standards, Electrical fire hazards, Structures under fire

Outcome: The student will appreciate the variety of fire equipment accessories and understand their need/use for a given problem.

Activity: Visit a nearby factory and observe the fire equipment installed therein

Text Books:

1. Industrial safety management By: L.M. Deshmukh, Publishers: Tata McgrawHill ,New Delhi,Year: 2006
2. Industrial safety health and environment Management system,By: R.K. Jain & Sunil S. Rao,Publishers: Khanna Publishers, Year: 2008
3. Fire Protection And Prevention,By: Brendra Mohan San, Publishers: UBS Publishers & Distributors Pvt Ltd,Year of Publication: 2008
4. Hand Book Of Fire Technology,By: R.S. Gupta,Publishers: Orient Longman Publishers, Year of Publication: 2005
5. Hand Book Of Fire And Explosion Protection Engineering,By: Dennis P Nolan, Publishers: Crest Publishing House,Edition: 1st Edition,

Course Code	MECHATRONICS (Department Elective-3.5)	L	T	P	Credits
1003174206		3	1	0	3

Course Overview:

Mechatronics is an interdisciplinary engineering field that combines principles from mechanics, electronics, computer engineering, robotics and automatic control. They gain basic knowledge of engineering processes, product design as well as the use of digital electronics or computer-aided design (CAD) software.

Course Objectives:

To make the student

- Understand various elements of a mechatronic system and how they integrate.
- Understand the concept of signal conditioning and digital signal Processing.
- Know various components of hydraulic and pneumatic systems.
- Know the working of electrical actuation systems.
- Learn how different types of control systems are used for various practical applications

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Identification of different sensors, transducers, signal conditioning techniques	Applying	1,3,12
CO2	Understanding and designing mechatronic motion logic control system and the key elements in its design	Creating	1,2,6,12
CO3	Develop a PLC programming techniques with Microprocessor, ladder diagram for different logic Gates	Creating	1,2,5,6
CO4	Understanding image fundamentals and how digital images can be processed, Image enhancement techniques and its application	Understanding	1,4,5,6
CO5	Design and Implementation of Micro Mechatronics System	Creating	1,3,4,7

UNIT-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.

Outcome: Understanding and designing of various measurement and control systems with the working of sensors.

Activity: Demonstration of the functioning of a measurement device using sensors in the lab.

UNIT-II

Solid state electronic devices - PN junction diode, BJT, FET, DIAC, TRIAC and LEDs. Analog signal conditioning, operational amplifiers, noise reduction, filtering.

Outcome: Understanding and designing of various PN junction diodes and signal processing.

Activity: Demo of PN junction diodes working in the lab.

UNIT-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.

Outcome: Ability to understand and design mechatronic motion logic control system and the key elements in its design

Activity: Take to Mechatronics lab to demonstrate sensors and Demo of Electric, pneumatic and hydraulic system

UNIT-IV

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.

Outcome: Develop a PLC programming techniques with Microprocessor, ladder diagram for different logic Gates

Activity: Student has to develop PLC program for various applications at lab**.**

UNIT-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.

Dynamic models and analogies, System response. Process Controllers – Digital Controllers, Programmable Logic Controllers, Design of mechatronics systems & future trends.

Outcome: Design and Implementation of Micro Mechatronics System
Activity: Student has to design model of various sensors and Lithography

Text Books:

1. MECHATRONICS Integrated Mechanical Electronics Systems/KP Ramachandran, GK Vijaya Raghavan& MS Balasundaram/WILEY India Edition

References:

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 / Devdasshetty/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

Course Code	DESIGN FOR MANUFACTURE	L	T	P	Credits
1003174207	(Department Elective-3.6)	3	1	0	3

Course Overview:
This course aims to provide a comprehensive overview of Manufacturing designs currently practicing and those which need further modification. It starts with fundamentals of each design procedures including tolerances to be given for machining, sheet metal work, joining work, Automation of machine tool assemblies.

Course Objectives:
- The students are to be exposed to the concepts of various manufacturing methods with sheet metal, joining methods, automation
- They will learn basic principles of these manufacturing methods and will be able to design new methods
- They will understand the advantages and disadvantages of these manufacturing methods.
- To make aware the developments and future trends in manufacturing methods and designs.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Conceptual understanding of manufacturing designs, product design, case studies	Applying	PO1, PO7
CO2	Machining processes, tolerance used for machining, design recommendations of machined parts.	Design	PO1, PO3, PO5
CO3	Conceptual observation of casting processes, extrusion, sheet metal work	Design	PO1, PO3
CO4	Applications of metal joining processes like welding, drop forging	Applying	PO1, PO7
CO5	Design procedures of workstations by automation	Design	PO1, PO12

Unit-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.

Outcome: The student able to know the concepts of manufacturing design procedures, product designs, case studies

Activity: The student is to perform a case study on any production process near his reach of stay

Unit-II:

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

Outcome: The student knowsthe concept of tolerance, surface finish, general design processes for some of the machines

Activity: Design a pattern for tolerance, adopt methods for surface finish.

Unit-III:

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

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

Outcome: The student understands the concepts of casting methods. Solidification of metals, simulation in casting

Activity: simulate a casting design in software, make a forging machine part.

Unit-IV:

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

Outcome: Expertise in various types of joining processes of metals. Design for forging.

Activity: Performwelding operation in your laboratory on various metals- report on the type of electrode or joining media used for the metal joints

Unit-V:

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.

Outcome: Get expertise on the design considerations for machining and joining of plastics

Activity: Perform simulation of any injection moulding.

Text Books:

1. Design for manufacture, John cobert, Adisson Wesley.1995
2. Design for Manufacture byBoothroyd,
3. Design for manufacture, JamesBralla

References:

1. ASM Hand book Vol.20

Course Code	UNCONVENTIONAL MACHINING PROCESSES	L	T	P	Credits
1003174208		3	1	0	3

Course Overview: To learn about various unconventional machining processes, the various process parameters and their influence on performance and their applications

Course Objectives:

1.The course aims in identifying the classification of unconventional machining processes.
2. To understand the principle, mechanism of metal removal of various unconventional machining processes.
3. To study the various process parameters and their effect on the component machined on various unconventional machining processes.
4. To understand the applications of different processes.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Describe the need and importance of non-traditional machining methods	Understanding	1,2,6,7,12
CO2	Design and analyze the surface finish and material removal in electro chemical grinding, electro chemical machining	Analyzing	1,2,3,6,7,12
CO3	Estimate the material removal rate and effect of process parameters in EDM and Electric discharge grinding and wire cut EDM process	Evaluation	1,2,6,7,12
CO4	Analyze the material removal rate in Electron Beam Machining and Laser Beam Machining processes and identify the effect of process parameters.	Analyzing	1,2,6,7,12
CO5	Apply the basic principle, equipment, process variables and mechanics of metal removal in abrasive jet machining and water jet machining	Applying	1,2,6,7,12

Unit-I:

INTRODUCTION: Need for non-traditional machining methods-classification of modern machining processes – considerations in process selection, applications.

Ultrasonic machining – Elements of the process, mechanics of material removal, MRR process parameters, economic considerations, applications and limitations.

Outcome:
After completion of course, the student shall understand the need and importance of non-traditional machining methods

Activity: To Demonstrate the Ultrasonic machining process using animation and videos

Unit-II:

ELECTRO – CHEMICAL MACHINING: Fundamentals of electro chemical machining, electrochemical grinding, electro chemical honing and deburring process, metal removal rate in ECM, Tool design, Surface finish and accuracy, economic aspects of ECM – Simple problems for estimation of metal removal rate, fundamentals of chemical, machining, advantages and applications.

Outcome: After completion of course, the student shall understand the surface finish and material removal in electro chemical grinding, electro chemical and identify the effect of process parametersThe student is able to identify the process parameters, their effect and applications

Activity: To Demonstrate the electro chemical machining using animation and videos

Unit – III:

THERMAL METAL REMOVAL PROCESSES: General principle and applications of Electric Discharge Machining, Electric Discharge Grinding and wire EDM – Power circuits for EDM, Mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, surface finish and machining accuracy, characteristics of spark eroded surface

Outcome: After completion of course, the student shall understand the material removal rate and effect of process parameters in EDM and Electric discharge grinding and wire cut EDM process and identify the effect of process parametersThe student is able to identify the process parameters, their effect and applications

Activity: To Demonstrate the Electric Discharge Machining using animation and videos

Unit-IV:

Electron Beam Machining, Laser Beam Machining - Basic principle and theory, mechanics of material removal, process parameters, efficiency & accuracy, applications

Plasma Machining: Application of plasma for machining, metal removal mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries.

Outcome: After completion of course, the student shall understand the material removal rate in Electron Beam Machining and Laser Beam Machining processes and identify the effect of process parametersThe student is able to identify the process parameters, their effect and applications

Activity: To Demonstrate the Electron Beam Machining, Laser Beam Machining and Plasma Machining using animation and videos

Unit-V:

Abrasive jet machining, Water jet machining and abrasive water jet machining: Basic principles, equipments, process variables, mechanics of material removal, MRR, application and limitations, magnetic abrasive finishing, abrasive flow finishing, Electro stream drilling, shaped tube electrolytic machining.

Outcome: After completion of course, the student shall understand the basic principle, equipment, process variables and mechanics of metal removal in abrasive jet machining and water jet machining. The student is able to identify the process parameters, their effect and applications

Activity: To Demonstrate the Abrasive jet machining and Water jet machining using animation and videos

Text Books:

1. Fundamentals of Machining Processes-Conventional and non – conventional processes/Hassan Abdel – Gawad El-Hafy/CRC Press-2016.

References:

1. Modern Machining Process / Pandey P.C. and Shah H.S./ TMH.
2. New Technology / Bhattacharya A/ the Institution of Engineers, India 1984.
3. Non Traditional Manufacturing Processes / Benedict /

Course Code		L	T	P	Credits
1003174209	NON DESTRUCTIVE EVALUATION	3	1	0	3

Course Overview:

This course aims to provide a comprehensive overview of NDT techniques currently practiced and those which are on the horizon. It starts with fundamentals of each NDT techniques, including ultrasound, eddy current, magnetic particle, x-ray and optics. Testing of products according to NDT standards. Practical cases to select suitable NDT methods.

Course Objectives:

- The students are to be exposed to the concepts of various NDE techniques using radiography, ultrasonic's, liquid penetrates, magnetic patches and Eddy currents
- They will learn basic principles of these methods and will be able to select appropriate NDT methods
- They will understand the advantages and disadvantages of these techniques.

	Course outcome	Cognitive Level as per Bloom's Taxonomy	PO
CO1	Students will be able to understand the basic concepts of different types of Non – Destructive Testing methods.	Understand	1,2
CO2	Students will be able to explain the working principle of Radiographic testing and Ultrasonic Testing, and use it for industrial needs.	Understand	1,2,3,4,5,6,8, 10
CO3	Students will be able to demonstrate Liquid Penetrant Test, Eddy Current Testing and Magnetic Particle Inspection on various samples.	Apply	1,2,9
CO4	Differentiate various defect types and select the appropriate NDT methods for better evaluation.	Analyze	1,2
CO5	Students will be able to distinguish different NDT methods and recommend the suitable one for industrial application.	Analyze & Evaluate	1,4,12

Unit-I:

Introduction to non-destructive testing: Radiographic test, Sources of X and Gamma Rays and their interaction with Matter, Radiographic equipment, Radiographic Techniques, Safety Aspects of Industrial Radiography

Outcome:

Have a complete theoretical understanding of the radiographic testing, interpretation and evaluation. Select the appropriate technique and exposure time for a better imaging. Follow proper safety precautions to avoid radiation hazards.

Activity:

Conducting a seminar for a group of students to share the knowledge among themselves.

Unit-II:

Ultrasonic test: Principle of Wave Propagation, Reflection, Refraction, Diffraction, Mode Conversion and Attenuation, Sound Field, Piezo-electric Effect, Ultrasonic Transducers and their Characteristics, Ultrasonic Equipment and Variables Affecting Ultrasonic Test, Ultrasonic Testing, Interpretations and Guidelines for Acceptance, Rejection - Effectiveness and Limitations of Ultrasonic Testing.

Outcome:
Have a basic knowledge of ultrasonic testing which enables them to perform inspection of samples. Experiment Calibration and evaluate the component for imperfections.

Activity:
Finite Element Method (FEM) Simulation on ultrasonic wave propagation using programming or FE analysis software.

Unit – III:

Liquid Penetrant Test: Liquid Penetrant Test, Basic Concepts, Liquid Penetrant System, Test Procedure, Effectiveness and Limitations of Liquid Penetrant Testing,

Eddy Current Test: Principle of Eddy Current, Eddy Current Test System, Applications of Eddy Current Testing Effectiveness of Eddy Current Testing.

Outcome:
Acquire knowledge in identifying surface defects by applying these methods on regular and conducting materials

Activity:

Inspection of welds using solvent removable visible dye penetrant. Inspection on non magnetic/magnetic materials by eddy current method.

Unit-IV:
Magnetic Particle Test: Magnetic Materials, Magnetization of Materials, Demagnetization of Materials, Principle of Magnetic Particle Test, Magnetic Particle Test Equipment, Magnetic Particle Test Procedure, Standardization and Calibration, Interpretation and Evaluation, Effective Applications and Limitations of the Magnetic Particle Test

Outcome:
Acquire knowledge in identifying surface defects on ferro magnetic materials
Activity:
Discovering the Magnetic Field: Determine and draw (with arrows) the magnetic field pattern when you place a magnetic on the clear frame of the magnetic field demonstrator. In part 2, use what you learned about the field lines from one magnet to draw the field lines of three.

Unit-V:

Infrared And Thermal Testing: Introduction and fundamentals to infrared and thermal testing– Heat transfer –Active and passive techniques –Lock in and pulse thermography–Contact and non contact thermal inspection methods–Heat sensitive paints –Heat sensitive papers –-thermally

quenched phosphors liquid crystals –techniques for applying liquid crystals –other temperature sensitive coatings –Inspection methods –Infrared radiation and infrared detectors–thermo mechanical behavior of materials–IR imaging in aerospace applications, electronic components, Honey comb and sandwich structures–Case studies.

Industrial Applications of NDE: Span of NDE Activities Railways, Nuclear, Non-nuclear and Chemical Industries, Aircraft and Aerospace Industries, Automotive Industries, Offshore Gas and Petroleum Projects, Coal Mining Industry, NDE of pressure vessels, castings, welded constructions

Outcome:
Have a basic understanding with case studies on different surface NDE techniques and apply them for inspecting materials in accordance with industry specifications and standards.

Activity:
Field visit will help students to do the trial inspection

Text Books:

1. Non-destructive test and evaluation of Materials/J Prasad, GCK Nair/TMH Publishers
2. Ultrasonic testing of materials/ H Krautkramer/Springer
3. Non-destructive testing/Warren, J Mc Gonnagle / Godan and Breach Science publishers
4. Non-destructive evaluation of materials by infrared thermography / X. P. V. Maldague, Springer-Verlag, 1st edition, (1993)

References:

1. Ultrasonic inspection training for NDT/ E. A. Gingel/Prometheus Press,
2. ASTM Standards, Vol 3.01, Metals and alloys
3. Non-destructive, Hand Book – R. Hamchand

Course Code		L	T	P	Credits
1003173281	INTERNSHIP	0	0	0	12

Internship: Internships help students to acquire in depth knowledge about a particular topic related to the program of study. Such extensive work is expected to create a platform for a job or further research in the chosen area. Interested students may opt for a full semester Internship during the fourth year second semester. Such students shall be exempted for equivalent theory course credits during that semester and the corresponding credits are awarded through the Internship. A self-study report, duly authorized by the industry supervisor / guide, shall be submitted at the end of the fourth year second semester. Internship report is evaluated for 400 marks in total. Internal assessment is done by the academic supervisor/guide for 100 marks based on the work and presentation of the internship report. The assessment for 300 marks is evaluated and awarded by a panel of members consisting of Head of the Department, Senior Faculty and Industry Expert.

Course Code		L	T	P	Credits
	TECHNICAL SEMINAR				
1003173251		**0**	**3**	**0**	**2**

Technical Seminar: For Technical seminar, the student shall collect the information on a specialized topic and prepare a technical report, showing his/her understanding over the topic, and submit to the department, which shall be evaluated by the Departmental Committee consisting of Head of the Department, seminar supervisor and a senior faculty member. The seminar report shall be evaluated for 50 marks. There shall be no external examination for seminar.

Course Code		L	T	P	Credits
1003173261	COMPREHENSIVE VIVA	0	0	0	2

Comprehensive Viva: The Comprehensive Viva aims to assess the students' understanding in various subjects he / she studied during the B.Tech course of study. Comprehensive Viva is conducted for a total of 50 marks. It shall be conducted in IV Year II Semester. The Comprehensive Viva–Voce will be conducted by a Committee consisting of Head of the Department, & senior faculty members of the Department.

Course Code		L	T	P	Credits
1003173231	MAIN PROJECT	0	0	0	10

Main Project: Out of total 200 marks for the project work, 80 marks shall be for Internal Evaluation and 120 marks for the external assessment. The Internal Evaluation shall be on the basis of two mid-term project reviews conducted during the progress of the project. The End Semester Examination (Viva-Voce) shall be conducted by the committee consists of an External Examiner, Head of the Department (internal examiner) and a senior faculty of the Department. The evaluation of project work shall be conducted at the end of the IV year..