ANNAMALAI UNIVERSITY

Annamalainagar - 608002

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MANUFACTURING ENGINEERING

(DST-FIST-Level-2 & UGC-SAP-DRS-Phase-2 Department)

B.E. Mechanical Engineering (Manufacturing)

Choice Based Credit System

2022-23

ANNAMALAI UNIVERSITY

FACULTY OF ENGINEERING AND TECHNOLOGY

B. E. (Four - Year) Degree Programme (FULL - TIME)

Choice Based Credit System (CBCS)

REGULATIONS 2022

1. Condition for Admission

Candidates for admission to the first year of the four year B.E. Degree programmes shall be required to have passed the final examination of the plus 2 Higher Secondary Course with Mathematics, Physics and Chemistry as courses of study and candidates who have passed the Higher Secondary Examination through vocational stream under Engineering, conducted by the Board of Secondary Education, Government of Tamil Nadu or an examination of any other authority accepted by the Syndicate of this University as equivalent thereto. They shall satisfy the conditions regarding qualifying marks, age and physical fitness as may be prescribed by the Syndicate of the Annamalai University from time to time.

Candidates who have passed the Diploma programme in Engineering of the State Board of Technical Education, Tamil Nadu will be eligible for admission to the second year of the four year degree programme in B.E. under the lateral entry scheme provided they satisfy other conditions.

2. Branches of Study in B.E.

BRANCH I	-	Civil Engineering
BRANCH II	-	Civil and Structural Engineering
BRANCH III	-	Mechanical Engineering
BRANCH IV	-	Mechanical Engineering (Manufacturing)
BRANCH V	-	Electrical and Electronics Engineering
BRANCH VI	-	Electronics and Instrumentation Engineering
BRANCH VII	-	Chemical Engineering
BRANCH VIII	-	Computer Science and Engineering
BRANCH IX	-	Information Technology
BRANCH X	-	Electronics and Communication Engineering
BRANCH XI	-	Computer Science and Engineering (Artificial Intelligence and Machine Learning)
BRANCH XII	-	Computer Science and Engineering (Data Science)

3. Courses of Study and Scheme of Examinations

The courses of study with respective syllabi and the scheme of Examinations are given separately.

4. Choice Based Credit System (CBCS)

The curriculum includes Humanities / Social Sciences /Management, Basic Sciences, Engineering Sciences, Professional Core, Professional/Programme Electives and Open Electives in addition to Seminar & Industrial Training and Project. Each semester curriculum shall normally have a blend of theory, practical and theory cum practical courses. The total credits for the entire degree Programme is **173 (132** for lateral entry students).

5. Eligibility for the Degree

A candidate shall be eligible for the degree of Bachelor of Engineering if the candidate has satisfactorily undergone the prescribed courses of study for a period of four academic years and has passed

the prescribed examinations in all the four academic years. For the award of the degree, a student has to earn a minimum of 173 credits (132 for lateral entry students).

Serve in any one of the Co-curricular activities such as

- National Cadet Corps (NCC)
- National Service Scheme (NSS)
- National Sports Organization (NSO) and
- Youth Red Cross (YRC)

For at least one year. The students enrolled in any one of the co-curricular activities (NCC / NSS / NSO / YRC) will undergo training for about 80 hours and attend a camp of about seven days. The training shall include classes on hygiene and health awareness and also training in first-aid. While the training activities will normally be during weekends, the camp will normally be during vacation period.

(or)

Enrol as a student member of a recognized professional society such as

- Student Chapters of Institution of Engineers (India)
- Student Chapters of other Professional bodies like ICI, ISA, IIChE, IEEE, SAE, ASHRAE, CSI and IWS

5.1 B.E (Honours) Degree

A student shall be eligible to get Under Graduate degree with Honours, if he/she completes an additional 20 credits. Thus the total credits are 193. Out of 193 credits (152 credits for lateral entry students), 20 credits must be earned by studying additional course offered by the same or allied Departments (listed in Annexure) in the fifth, sixth and seventh semesters.

5.2 B.E Degree with Minor Engineering

A student shall be eligible to get Under Graduate degree with additional Minor Engineering, if he/she completes an additional 20 credits. Out of the 193 credits, 20 credits must be earned from the courses offered by any one of the Departments (listed in Annexure) in the Faculty of Engineering and Technology in fifth, sixth and seventh semesters.

6. Assignment of Credits for Courses

Each course is normally assigned one credit per hour of lecture/tutorial per week and half credit for one hour for laboratory or practical or drawing course per week.

7. Duration of the Programme

A student is normally expected to complete the B.E. programme in four years but in any case not more than seven years from the time of admission.

8. Registration for Courses

A newly admitted student will automatically be registered for all the courses prescribed for the first, second and third semesters without any option.

Every other student shall enrol for the courses intended to be credited in the succeeding semester in the current semester itself by completing the registration form indicating the list of courses. This registration will be done a week before the last working day of the current semester.

A student is required to earn 173 (132 for lateral entry students) credits in order to be eligible for obtaining the degree. However the student is entitled to enjoy an option to earn either more or less than the total number of credits prescribed in the curriculum of a particular semester on the following guidelines:

8.1 Slow Learners

The **slow learners** may be allowed to withdraw certain courses with the approval by the Head of the Department and those courses may be completed by them in the fifth year of study and still they are eligible to be awarded with I Class. A student can withdraw a maximum of 2 courses per semester from IV semester to VII semester and take up those courses in the fifth year of study. However, courses withdrawn during odd semesters (V and VII) must be registered in the odd semester of fifth year and courses withdrawn during even semesters (IV and VI) must be registered in the even semester of fifth year.

8.2 Advanced Learners

The **advanced learners** may be allowed to take up the open elective courses of eighth semester in sixth and seventh semesters one in each to enable them to pursue industrial training/project work in the entire eighth semester period provided they should register those courses in the fifth semester itself. Such students should meet the teachers offering those elective courses themselves for clarifications. No specific slots will be allotted in the time table for such courses.

9. Project Work

The student typically registers for project at the end of seventh semester and completes it at the end of the eighth semester along with the courses prescribed for study in the eighth semester. However a student who has registered and successfully completed the courses of eighth semester by acquiring additional credits in the earlier semesters can attempt to spend his/her period of study in an industry and complete his/her project work, submit the project report and appear for viva-voce examination at the end of eighth semester.

10. Mandatory Induction Program

A 3-week long induction program for the UG students entering the institution, right at the start is proposed. Normal classes start only after the induction program is over. The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

- Physical Activity
- Creative Arts
- Imparting Universal Human Values
- Literary Activities
- Conduct of crash courses on soft skills
- Lectures by Eminent People
- Visits to Local Area
- Familiarization to Dept./Branch & Innovative practices

11. Electives

The elective courses fall under two basic categories: Professional Electives and Open Electives.

11.1 Professional Elective Courses

The Professional Elective courses are offered in the concerned branch of specialization and a student can choose the Professional Elective courses with the approval of the Head of the Department concerned.

11.2 Open Elective Courses

Apart from the various Professional elective courses, a student must study **five** open elective courses of which the student may opt to study either that offered by the Department concerned or from the open elective courses offered by any other Department in the Faculty of Engineering & Technology, with the approval of the Head of the concerned Department and the Head of the Department offering the course. In case the student opts to study an open elective offered by a neighbouring Department in the Faculty, it shall be handled by the faculty of that Department offering the chosen open elective.

A student may be required to choose Intellectual Property Rights (IPR) and Cyber Security as open electives anywhere between fifth and eighth semesters as part of the requirements of the study.

11.3 MOOC (SWAYAM) Courses

The student can be permitted to earn not more than 40 % of his/her total credits (that is 69 credits) by studying Massive Open Online Courses (MOOCs) offered through the SWAYAM Portal of UGC with the approval of the Head of the Department concerned and the Dean of the Faculty. The courses will be considered as equivalent to elective courses from the fifth to the eighth semesters and the credits earned through MOOC courses may be transferred and considered for awarding Degree to the student concerned.

A student who earns 3 or more credits from a 12 week MOOC course through SWAYAM portal (Syndicate Resolution No.:14 dated 10.05.2019) shall be exempted from studying the elective course and permitted to transfer the credits. Besides the student may be permitted to claim for the conversion to the next higher grade in accordance with the Syndicate Resolution No.: 31 dated 09.09.2020

11.4 Value Added Courses

A student can study one or more value added courses being offered by the other Departments of Study either within the Faculty or any other Faculty in the University in any semester of the B.E degree programme except First Year, with the restriction that only one Value added Course can be registered at a time.

11.5 Extra One Credit Courses

One credit courses shall be offered by a Department with the prior approval from the Dean of the Faculty.

For one credit courses, a relevant potential topic may be selected by a committee consisting of the Head of the Department concerned and the Board of Studies member from the Department and a senior faculty member from the Department concerned. An expert from industry familiar with the topic chosen may be accordingly invited to handle classes for the students. The details of the syllabus, time table and the name of the industrial expert may be sent by the above committee to the Dean for approval. The credits earned through the extra one credit courses shall be over and above the total credit requirement prescribed in the curriculum for the award of the degree. Students can take a maximum of two extra one credit courses (one each in VI and VII semesters). They shall be allowed to take extra one credit courses offered in other Departments with the permission of Head of the Department offering the courses. A separate mark sheet shall be issued for extra one credit courses.

11.6 Skill Related /Naan Mudhalvan

A student is required to study **Three** open elective courses One each in the fifth, sixth and seventh semester of study as part of acquiring skills in the specified field. The student shall pursue the open electives listed in the Naan Mudhalvan portal against the respective semesters. However alternatively the student shall choose the open electives from the list tabled relating to the respective programmes with the approval of the Head of the Department concerned and Dean of the Faculty.

12. Assessment

12.1. Theory Courses

The break-up of Continuous Assessment for the theory courses relates to evaluating the performance under the five Course Outcomes uniformly with 5 Marks for each outcome spread over Two Mid-Semester tests and One Assignment, totalling to 25 Marks. Similarly the break-up mark for University End Semester exams involves evaluating the performance under the five Course Outcomes with 15 Marks for each Outcome, totalling to 75 Marks.

The break-up of continuous assessment and examination marks for theory courses is as follows:

First assessment (Mid-Semester Test-I Covering Units I & II)	:	8 marks
Second assessment (Mid-Semester Test-II Covering Units III, IV & V)	:	12 marks
Third Assessment (Assignment Covering Units I, II, III, IV & V)	:	5 marks
End Semester Examination	:	75 marks

The break-up of Continuous Assessment for the theory course titled Basic Engineering in the II semester that involves two disciplines requires evaluating the performance under the five Course Outcomes, with 3 for one discipline and two for the other, uniformly with 5 Marks for each outcome spread over Two Mid-Semester tests and One Assignment, totalling to 25 Marks. Similarly the break-up mark for University End Semester exams involves evaluating the performance under the five Course Outcomes with 15 Marks for each Outcome, totalling to 75 Marks.

12.2 Practical Courses

The break-up of Continuous Assessment for the practical courses involves evaluating the performance under the five Course Outcomes uniformly with 8 Marks for each outcome spread over Two tests and Record work, totalling to 40 Marks. Similarly the break-up mark for University End Semester exams relates to evaluating the performance under the five Course Outcomes with 12 Marks for each Outcome, totalling to 60 Marks

The break-up of continuous assessment and examination marks for Practical courses is as follows:

First Assessment (Test-I Relating to Cycle I)	:	15 marks
Second Assessment (Test-II Relating to Cycle II)	:	15 marks
Maintenance of Record book	:	10 marks
End Semester Examination	:	60 marks

12.3 Theory cum Practical Course

The break-up of Continuous Assessment for the theory cum practical courses necessitates to evaluating the performance as being followed for the theory and practical courses individually and requires the students to clear each component separately. The average of the marks secured by the student in the theory and practical courses and the appropriate grade relating to the average shall be assigned to the student.

12.4 Project Work

The continuous assessment marks for the project work will be 40 and to be assessed by a review committee consisting of the project guide and a minimum of two members nominated by the Head of the Department. One of the committee members will be nominated as the Chairman by the Head of the Department. The Head of the Department may be a member or the Chairman. At least two reviews should be conducted during the semester by the review committee. The student shall make presentation on the progress made before the committee. 60 marks are allotted for the project work and viva voce examination at the end of the semester.

12.5 Industrial Internship

After attending the internship during the semester vacation of II / III year for a period of 4 weeks duration in each year, the student has to submit a report and appear for the viva-voce exam along with the V/VII semester end semester examinations.

13. Substitute Assessment

A student, who has missed, for genuine reasons accepted by the Head of the Department, one or more of the assessments of a course other than the final examination, may take a substitute assessment for any one of the missed assessments. The substitute assessment must be completed before the date of the third meeting of the respective class committees.

A student who wishes to have a substitute assessment for a missed assessment must apply to the Dean / Head of the Department within a week from the date of the missed assessment.

14. Student Counsellors (Mentors)

To help the students in planning their course of study and for general advice on the academic programme, the Dean / Head of the Department will attach a certain number of students to a member of the faculty who shall function as student counsellor for those students throughout their period of study. Such student counsellors shall advise the students, give preliminary approval for the courses to be taken by the students during each semester and obtain the final approval of the Dean / Head of the Department.

15. Class Committee

For all the branches of study during the first two semesters, a common class committee will be constituted by the Dean of the faculty. From among the various teachers teaching the same common course to different classes during each semester of the first year, the Dean shall appoint one of them as course coordinator.

The composition of the class committee during first and second semesters will be as follows:

- Course coordinators of all courses.
- All the Heads of the Sections, among whom one may be nominated as Chairman by the Dean.
- The Dean may opt to be a member or the Chairman.

For each of the higher semesters, separate class committees will be constituted by the respective Head of the Departments.

The composition of the class committees from third to eighth semester will be as follows:

- Teachers of the individual courses.
- A seminar coordinator (for seventh semester only) shall be appointed by the Head of the Department
- A project coordinator (for eighth semester only) shall be appointed by the Head of the Department from among the project supervisors.
- One Professor or Associate Professor, preferably not teaching the concerned class, appointed as Chairman by the Head of the Department.
- The Head of the Department may opt to be a member or the Chairman.

The class committee shall meet three times during the semester. The first meeting will be held within two weeks from the date of class commencement in which the type of assessment like test, assignment etc. for the third assessment and the dates of completion of the assessments will be decided.

The second meeting will be held within a week after the completion of the first assessment to review the performance and for follow-up action.

The third meeting will be held after all the assessments but before the University semester examinations are completed for all the courses, and at least one week before the commencement of the examinations. During this meeting the assessment on a maximum of 25 marks for theory/40 marks for seminar/ industrial training, practical and project work will be finalized for every student and tabulated and submitted to the Head of the Department (to the Dean in the case of I & II Semester) for approval and transmission to the Controller of Examinations.

16. Attendance Requirements

The students with 75% attendance and above are permitted to appear for the University examinations. However, the Vice Chancellor may give a rebate / concession not exceeding 10% in attendance for exceptional cases only on Medical Grounds.

17. Temporary Break of Study

A student is permitted to go on break of study for a maximum period of one year either as two breaks of one semester each or a single break of one year.

If a student wishes to apply for break of study, the student shall apply to the Dean in advance, in any case, not later than the last date of the first assessment period. The application duly filled by the student shall be submitted through the Head of the Department. In the case of short term employment/ training/ internship, the application for break of study shall be approved and forwarded by the Head of the Department concerned to the Dean.

However, the student must complete the entire programme within the maximum period of seven years.

18. Procedure for Withdrawing from the Examinations

A student can withdraw from all the examinations of the semester only once during the entire programme on valid grounds accepted by the University. Such withdrawal from the examinations of a semester will be permitted only if the candidate applies for withdrawal at least 24 hours before the commencement of the last examination. The letter grade 'W' will appear in the mark sheet for such candidates.

19. Passing and Declaration of Examination Results

All assessments of all the courses on an absolute marks basis will be considered and passed by the respective results passing boards in accordance with the rules of the University. Thereafter, the Controller of Examinations shall convert the marks for each course to the corresponding letter grade as follows, compute the Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA), and prepare the mark sheets.

90 to 100 marks	:	Grade 'S'
80 to 89 marks	:	Grade 'A'
70 to 79 marks	:	Grade 'B'
60 to 69 marks	:	Grade 'C'
55 to 59 marks	:	Grade 'D'
50 to 54 marks	:	Grade 'E'
Less than 50 marks	:	Grade 'RA'
Withdrawn from the examination	:	Grade 'W'

A student who obtains less than 30 / 24 marks out of 75 / 60 in the theory / practical examinations respectively or is absent for the examination will be awarded grade RA.

A student who earns a grade of S, A, B, C, D or E for a course, is declared to have successfully completed that course. Such a course cannot be repeated by the student.

A student who is detained for lack of attendance must re-register for and repeat the courses in the respective semester.

A student who obtains letter grade RA in the mark sheet must reappear for the examination of the courses except for Honours courses.

A student who obtains letter grade W in the mark sheet must reappear for the examination of the courses.

The following grade points are associated with each letter grade for calculating the grade point average and cumulative grade point average.

S - 10; A - 9; B - 8; C - 7; D - 6; E - 5; RA - 0

Courses with grade RA / W are not considered for calculation of grade point average or cumulative grade point average.

A student can apply for re-evaluation of one or more of his examination answer papers within a week from the date of issue of mark sheet to the student on payment of the prescribed fee per paper. The application must be made to the Controller of Examinations with the recommendation of the Head of the Department.

After the results are declared, mark sheets will be issued to the students. The mark sheet will contain the list of courses registered during the semester, the grades scored and the grade point average for the semester.

GPA is the sum of the products of the number of credits of a course with the grade point scored in that course, taken over all the courses for the semester, divided by the sum of the number of credits for all courses taken in that semester.

OGPA/CGPA is similarly calculated considering all the courses taken from the time of admission.

20. Awarding Degree

After successful completion of the programme, the degree will be awarded based on OGPA/CGPA.

The conversion of OGPA/CGPA (from I semester to VIII Semester) to the corresponding Percentage of marks may be calculated as per the following formula:

Percentage of marks = (OGPA/CGPA - 0.25) x 10

Where $OGPA/CGPA = \frac{\sum C_i GP_i}{\sum C_i}$

C_i- Credit hours of a course

GP_i - Grade Point of that course

20.1 Honours Degree

The student requires to earn a minimum of 193 credits within four years (152 credits within three years for lateral entry students) from the time of admission, pass all the courses in the first attempt from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students) and obtain a OGPA/CGPA of 8.25 or above to obtain the Honours Degree.

The student is required to complete 6 elective courses, 2 each in the V, VI and VII semesters with a stipulation that 2 of the 6 courses need to be of 4 credits each, while the remaining 4 has to be of 3 credits each, thus totalling to 20 credits, the choice being approved by the Head of the Department concerned and the Dean of the Faculty.

However, if the student either does not clear the extra course(s) relating to become eligible for the Honours Degree or discontinues it in any of the semesters, then the student may revert to the category of the First Class with Distinction or First class, provided the student is eligible for that respective category. The student may claim for revised mark sheet, paying the stipulated fee in order that the unsuccessful appearance or discontinuity of the course(s) is not reflected in the new mark sheet.

20.2 First Class with Distinction

To obtain B.E Degree First Class with Distinction, a student must earn a minimum of 173 Credits within four years (132 credits within three years for lateral entry students) from the time of admission, by passing all the courses in the first attempt from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students) and obtain a CGPA of 8.25 or above.

20.3 First Class

To obtain B.E Degree First Class, a student must earn a minimum of 173 credits within ***five*** years (132 credits within ***four*** years for lateral entry students) from the time of admission and obtain a OGPA/CGPA of 6.75 or above for all the courses from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students).

20.4 Second Class

For Second Class, the student must earn a minimum of 173 credits within **seven** years (132 credits within **six** years for lateral entry students) from the time of admission.

20.5 B.E Degree with Minor Engineering

The student shall be given an option to earn a Minor Engineering Degree in another discipline of Engineering not related to his/her branch of study at the end of the first year provided the student clears all the subjects in the first year in the first attempt and secures a OGPA/CGPA of not less than 7.5

The student is required to earn an additional 20 credits starting from the third semester in the sense he/she requires to complete 6 elective courses, 2 each in the V, VI and VII semesters with a stipulation that 2 of the 6 courses need to be of 4 credits each, while the remaining 4 has to be of 3 credits each, thus totalling to 20 credits, the choice being approved by the Head of the Department concerned and the Dean of the Faculty.

The rules for awarding the B.E degree in First Class with Distinction or in First Class or in Second Class apply in the same manner for B.E Degree with Minor Engineering.

However the student who opts for Honours Degree is not entitled to pursue B.E Degree with Minor Engineering and vice-versa

21. Ranking of Candidates

The candidates who are eligible to get the B.E. degree with Honours will be ranked together on the basis of OGPA/CGPA for all the courses of study from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students).

The candidates who are eligible to get the B.E. degree in First Class with Distinction will be ranked next after those with Honours on the basis of OGPA/CGPA for all the courses of study from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students).

The candidates passing with First Class will be ranked next after those with distinction on the basis of OGPA/CGPA for all the courses of study from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students).

The ranking of candidates will be done separately for each branch of study.

22. Transitory Regulations

The University shall have powers to revise or change or amend the regulations, the scheme of examinations, the courses of study and the syllabi from time to time.

Wherever there had been change of syllabi, examinations based on the existing syllabi will be conducted for three consecutive times after implementation of the new syllabi in order to enable the students to clear the arrears. Beyond that the students will have to take up their examinations in equivalent courses, as per the new syllabi, on the recommendations of the Head of the Department concerned.

ANNEXURE

S.No.	Branch of Study in B.E	Honours Elective Courses from Same and Allied Departments of	Minor Engineering Courses from Other Departments of
1	Civil Engineering	1. Civil Engineering 2. Civil and Structural Engineering.	1. Mechanical Engineering 2. Electrical Engineering 3. Chemical Engineering 4. Computer Science and Engineering 5. Computer Science and Engineering (Artificial Intelligence and Machine Learning) 6. Computer Science and Engineering(Data Science) 7. Mechanical (Manufacturing) Engineering. 8. Electronics and Instrumentation Engineering 9. Information Technology 10. Electronics and Communication Engineering.
2	Civil and Structural Engineering		
3	Mechanical Engineering	1. Mechanical Engineering 2. Mechanical (Manufacturing) Engineering.	1. Civil Engineering 2. Civil and Structural Engineering. 3. Electrical Engineering 4. Chemical Engineering 5. Computer Science and Engineering 6. Computer Science and Engineering (Artificial Intelligence and Machine Learning) 7. Computer Science and Engineering (Data Science) 8. Electronics and Instrumentation Engineering. 9. Information Technology 10. Electronics and
4	Mechanical (Manufacturing) Engineering.		

S.No.	Branch of Study in B.E	Honours Elective Courses from Same and Allied Departments of	Minor Engineering Courses from Other Departments of
			Communication Engineering.
5	Electrical and Electronics Engineering	1. Electrical Engineering 2. Electronics and Instrumentation Engineering 3. Electronics and Communication Engineering	1. Civil Engineering 2. Civil and Structural Engineering. 3. Mechanical Engineering 4. Chemical Engineering 5. Mechanical (Manufacturing) Engineering.
6	Electronics and Instrumentation Engineering.		
7	Chemical Engineering	1. Chemical Engineering 2. Pharmacy 3. Electronics and Instrumentation Engineering	1. Civil Engineering 2. Mechanical Engineering 3. Electronics and Instrumentation Engineering. 4. Information Technology 5. Civil and Structural Engineering. 6. Electrical Engineering 7. Electronics and Communication Engineering. 8. Mechanical (Manufacturing) Engineering. 9. Computer Science and Engineering 10. Computer Science and Engineering (Artificial Intelligence and Machine Learning) 11. Computer Science and Engineering(Data Science)

S.No.	Branch of Study in B.E	Honours Elective Courses from Same and Allied Departments of	Minor Engineering Courses from Other Departments of
8	Computer Science and Engineering	1. Computer Science and Engineering. 2. Information Technology 3. Electronics and Communication Engineering 4. Computer Science and Engineering(Artificial Intelligence and Machine Learning) 5. Computer Science and Engineering(Data Science)	1. Civil Engineering 2. Mechanical Engineering 3. Mechanical (Manufacturing) Engineering. 4. Civil and Structural Engineering. 5. Chemical Engineering
9	Information Technology		
10	Electronics and Communication Engineering.	1. Electrical Engineering 2. Electronics and Instrumentation Engineering 3. Electronics and Communication Engineering	1. Civil Engineering 2. Civil and Structural Engineering. 3. Mechanical Engineering 4. Chemical Engineering 5. Mechanical (Manufacturing) Engineering.
11	Computer Science and Engineering (Artificial Intelligence and Machine Learning)	1. Computer Science and Engineering. 2. Information Technology 3. Electronics and Communication Engineering 4. Computer Science and Engineering(Artificial Intelligence and Machine Learning) 5. Computer Science and Engineering(Data Science)	1. Civil Engineering 2. Mechanical Engineering 3. Mechanical (Manufacturing) Engineering. 4. Civil and Structural Engineering. 5. Chemical Engineering
12	Computer Science and Engineering (Data Science)		

DETAILS OF COURSE CODE

S. No	Code (3rd and 4th Digits)	Details	Code (5th and 6th Digits)	Details
1	ET	Common Course for the faculty	HS	Humanities Theory
2	CE	Civil Engg. Course	HP	Humanities Practical
3	CZ	Civil and Structural Engg. course	BS	Basic Science Theory
4	ME	Mechanical Engg. Course	BP	Basic Science Practical
5	MM	Mechanical Engg (Manufacturing). Course	ES	Engineering Science Theory
6	EE	Electrical and Electronics Engg. Course	SP	Engineering Science Practical
7	EI	Electronics and Instrumentation Engg. course	PC	Professional Core Theory
8	CH	Chemical Engg. course	CP	Professional Core Practical
9	CS	Computer Science and Engg. course	PE	Professional Elective Theory
10	IT	Information Technology course	EP	Professional Elective Practical
11	EC	Electronics and Communication Engg. course	IT	Internship /Industrial Training
12	AI	Computer Science and Engineering (Artificial Intelligence and Machine Learning)	OE	Open Elective Theory
13	DS	Computer Science and Engineering (Data Science)	PV	Project and Viva-voce
14	YY	Code of the Program concerned (S. No 02 to S.No.13)		

The first two digits relate to the year from which the Regulations commence
7th digit represents the semester and 8th and 9th digits represent the serial number of courses.

ANNAMALAI UNIVERSITY

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MANUFACTURING ENGINEERING

(DST-FIST-Level-2 & UGC-SAP-DRS-Phase-2 Department)

COURSES OF STUDY AND SCHEME OF EXAMINATIONS (REGULATION 2022-23)

SEMESTER I									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
22ETBS101	**BS-I**	Mathematics-I	3	1	-	25	75	100	4
22ETBS102	**BS-II**	Physics	3	1	-	25	75	100	4
22ETBS103	**BS-III**	Chemistry	3	1	-	25	75	100	4
22ETES104	**ES-I**	Programming for Problem Solving	2	1	-	25	75	100	3
22ETHS105	**HS-I**	Heritage of Tamils தமிழர் மரபு	1	-	-	25	75	100	1
22ETHP106	**HSP-I**	Communication Skills and Language Laboratory	-	-	3	40	60	100	1.5
22ETSP107	**ESP-I**	Engineering Workshop Practices	-	-	3	40	60	100	1.5
22ETSP108	**ESP-II**	Electrical Wiring and Earthing Practice Laboratory	-	-	3	40	60	100	1.5
						Total Credits			**20.5**

SEMESTER II									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
22ETHS201	**HS-II**	English	3	1	-	25	75	100	4
22ETBS202	**BS-IV**	Mathematics-II	3	1	-	25	75	100	4
22ETES203	**ES-II**	Basic Engineering*	4	-	-	25	75	100	4
22ETHS204	**HS-III**	Tamils and Technology தமிழரும் தொழில்நுட்பமும்	1	-	-	25	75	100	1
22ETBP205	**BSP-I**	Physics Laboratory	-	-	3	40	60	100	1.5
22ETBP206	**BSP-II**	Chemistry Laboratory	-	-	3	40	60	100	1.5
22ETSP207	**ESP-III**	Computer Programming Laboratory	-	-	3	40	60	100	1.5
22ETSP208	**ESP-IV**	Engineering Graphics	2	-	3	40	60	100	3
						Total Credits			**20.5**

*** Civil & Mechanical for Circuit Branches**
Mechanical & Electrical for Civil, Civil & Structural and Chemical
Civil & Electrical for Mechanical & Manufacturing

SEMESTER III

Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
22ETBS301	**BS-V**	Mathematics - III	3	1	-	25	75	100	4
22ETES302	**ES-III**	Environmental Studies	3	-	-	25	75	100	3
22ETES303	**ES-IV**	Engineering Mechanics	3	-	-	25	75	100	3
22MMPC304	**PC-I**	Mechatronics and Fluid Power Systems	3	-	-	25	75	100	3
22MMPC305	**PC-II**	Thermodynamics	3	-	-	25	75	100	3
22MMPC306	**PC-III**	Metal Cutting and Machine Tools	3	-	-	25	75	100	3
22MMSP307	**ESP-V**	Electrical and Electronics Lab	-	-	3	40	60	100	1.5
22MMCP308	**PCP-I**	Manufacturing Technology Lab – I	-	-	3	40	60	100	1.5
22MMCP309	**PCP-II**	Machine Drawing	-	-	3	40	60	100	1.5
							Total Credits		**23.5**

SEMESTER IV

Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
22ETBS401	**BS-VI**	Probability, Random Processes and Numerical Methods	3	-	-	25	75	100	3
22MMES402	**ES-V**	Industrial Management and Engineering	3	-	-	25	75	100	3
22MMPC403	**PC-IV**	Mechanics of Machines	3	-	-	25	75	100	3
22MMPC404	**PC-V**	Metrology and Measurements	3	-	-	25	75	100	3
22MMPC405	**PC-VI**	Metal Joining and Non-Destructive Testing	3	-	-	25	75	100	3
22MMPC406	**PC-VII**	Metal Casting Technology	3	-	-	25	75	100	3
22MMHS407	**HS-IV**	Universal Human Values	2	1		25	75	100	3
22MMCP408	**PCP-III**	Manufacturing Technology Lab – II	-	-	3	40	60	100	1.5
22MMCP409	**PCP-IV**	Thermodynamics Lab	-	-	3	40	60	100	1.5
						Total Credits			**24**

Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming V Semester.

SEMESTER V									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**C A**	**FE**	**Total**	**Credits**
22MMPC501	**PC-VIII**	Engineering Materials and Metallurgy	3	-	-	25	75	100	3
22MMPC502	**PC-IX**	Strength of Materials	2	-	-	25	75	100	2
22MMPC503	**PC-X**	Fluid Mechanics and Hydraulics Machinery	3	-	-	25	75	100	3
22MMPC504	**PC-XI**	Operations Management	3	-	-	25	75	100	3
22MMPE505	**PE-I**	Professional Elective – I	3	-	-	25	75	100	3
22MMPE506	**PE-II**	Professional Elective – II	3	-	-	25	75	100	3
22MMOE507	**OE-I**	Open Elective – I	3	-	-	25	75	100	3
22MMCP508	**PCP-V**	Machine Theory Lab	-	-	3	40	60	100	1.5
22MMCP509	**PCP-VI**	Mechatronics and Metrology Lab	-	-	3	40	60	100	1.5
22ETIT510	**IT-I**	Internship (during summer vacation at the end of Fourth Semester)	***Four** weeks during the summer vacation at the end of **IV Semester***				100	100	4.0
						Total Credits			**27**

SEMESTER VI									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
22MMPC601	**PC-XII**	Metal Forming Technology	3	-	-	25	75	100	3
22MMPC602	**PC-XIII**	Design of Machine Elements	3	-	-	25	75	100	3
22MMPE603	**PE-III**	Professional Elective – III	3	-	-	25	75	100	3
22MMPE604	**PE-IV**	Professional Elective – IV	3	-	-	25	75	100	3
22MMPE605	**PE-V**	Professional Elective – V	3	-	-	25	75	100	3
22MMOE606	**OE-II**	Open Elective – II	3	-	-	25	75	100	3
22MMES607	**ES-VI**	Introduction to Python Programming	2	2	-	40	60	100	2
22MMCP608	**PCP-VII**	Manufacturing Technology Lab – III	-	-	3	40	60	100	1.5
22MMCP609	**PCP-VIII**	Hydraulics and Strength of Materials Lab	-	-	2*2	40	60	100	1.5
						Total Credits			**23**

Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming VII Semester.

SEMESTER VII									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
22ETHS701	**HS-III**	Engineering Ethics	3	-	-	25	75	100	2
22MMPC702	**PC-XIV**	Computer Integrated Manufacturing	3	-	-	25	75	100	3
22MMPC703	**PC-XV**	Operations Research	3	-	-	25	75	100	3
22MMPE704	**PE-VI**	Professional Elective –VI	3	-	-	25	75	100	3
22MMPE705	**PE-VII**	Professional Elective –VII	3	-	-	25	75	100	3
22MMOE706	**OE-III**	Open Elective – III	3	-	-	25	75	100	3
22MMCP707	**PCP-IX**	Design & Automation Lab	-	-	3	40	60	100	1.5
22ETIT708	**IT-II**	Internship (during summer vacation at the end of Sixth Semester)	***Four** weeks during the summer vacation at the end of **VI Semester***				100	100	**4.0**
						Total Credits			**22.5**

SEMESTER VIII									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
22MMOE801	**OE-IV**	Open Elective - IV	3	-	-	25	75	100	3
22MMOE802	**OE-V**	Open Elective - V	3	-	-	25	75	100	3
22MMPV803	**PV-I**	Project Work and Viva-voce	-	PR	S	40	60	100	6
				10	2				
						Total Credits			**12**

L	No. of Lecture Hours	**TR**	No. of Hours for Discussion on Industrial Training
T	No. of Tutorial Hours	**S**	No. of Seminar Hours on Industrial Training / Project
P	No. of Practical Hours	**PR**	No. of Hours for Discussion on Project work
CA	Continuous Assessment Marks	**FE**	Final Examination Marks
Credits	Credit points allotted to that course	**Total**	Total Marks

HS	Humanities and Social Sciences including Management courses
BS	Basic Science courses
ES	Engineering Science Courses
CA	Continuous Assessment Marks
FE	Final Exam Marks

V SEMESTER: LIST OF PROFESSIONAL ELECTIVES

Sl. No.	Name of the Course	Category
1.	Composite Materials	**PE-I**
2.	Process Planning & Cost Estimation	
3.	Energy Conservation & Management	
4.	MEMS & NEMS	
5.	Design of Jigs, Fixtures and Press Tools	**PE-II**
6.	Surface Engineering & Tribology	
7.	Artificial Intelligence	
8.	Internal Combustion Engines	

VI SEMESTER: LIST OF PROFESSIONAL ELECTIVES

Sl. No.	Name of the Course	Category
1.	Total Quality Management & Reliability Engineering	**PE-III**
2.	Sustainable Development & Manufacturing	
3.	Modern Manufacturing Strategies	
4.	Product Design & Development	
5.	Non Traditional Manufacturing Processes	**PE-IV**
6.	Micro and Nano Machining	
7.	Machine Tool Design	
8.	Intelligent Industrial Robotics	
9.	Automobile Engineering	**PE-V**
10.	Heat and Mass Transfer	
11.	Refrigeration & Air Conditioning	
12.	Power Plant Engineering	
13.	Thermal Concepts for Manufacturing Engineers	

VII SEMESTER: LIST OF PROFESSIONAL ELECTIVES

Sl. No.	Name of the Course	Category
1.	Additive Manufacturing Technologies	**PE-VI**
2.	Smart Manufacturing	
3.	Materials Characterization Techniques	
4.	Electronics Manufacturing Technology	
5.	Advanced Manufacturing Technologies	**PE-VII**
6.	Design of Transmission Systems	
7.	Finite Element Analysis	
8.	Engineering Failure Analysis	

OPEN ELECTIVES:

Sl. No.	Name of the Course	Category
1.	Fundamentals of Soft Computing	OE
2.	Maintenance and Safety Engineering	OE
3.	Renewable Energy Technology	OE
4.	Engineering Economics	OE
5.	Sensors and Control Systems in Manufacturing	OE
6.	Supply Chain Management	OE
7.	Materials Science & Engineering	OE
8.	Nano Materials Technology	OE
9.	Smart Materials	OE
10.	Constitution of India	OE
11.	Entrepreneurship	OE
12.	An Introduction to Gender and Gender Equality	OE
13.	Yoga Studies	OE
14.	National Service Scheme	OE
15.	National Cadet Corps	OE
16.	Robotics Simulation for Manufacturing	OE
17.	Industry 4.0	OE
18.	Electric Systems for E-Mobility (Mechanical)	OE
19.	Machine Learning	OE
20.	Powering IOT using Arduino / Raspberry PI	OE

HONOURS ELECTIVES:

Sl. No.	Name of the Course	Credits
1.	Mechanical Behaviour of Materials	4
2.	Design for Manufacturing and Assembly	3
3.	Precision Engineering and Nano-Technology	3
4.	Robotics and Automations	4
5.	Plant Layout and Material Handling	3
6.	Maintenance Management	3

MINOR ENGINEERING ELECTIVES:

Sl. No.	Name of the Course	Credits
1.	Manufacturing Processes	3
2.	Manufacturing Technology	4
3.	Total Quality Management & Reliability Engineering	3
4.	Computer Integrated Manufacturing Systems	3
5.	Metrology and Measurements	3
6.	Non- Destructive Testing	4

S E M E S T E R - I

22ETBS101	MATHEMATICS – I	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To familiarize definite integrals and its application in finding area and volume.
- To Introduce the fundamentals of functions of several variables.
- To make the student to learn infinite series and its nature.
- To impart knowledge about Vector calculus.
- To provide the concept of eigen values and eigen vectors of a real matrix and its properties of great utility in many branches of engineering.

UNIT - I INTEGRAL CALCULUS

Evaluation of definite integrals and their properties-Applications of definite integrals to evaluate surface areas and volumes of revolutions. Improper integral-Beta and Gamma functions and their properties.

UNIT – II FUNCTIONS OF SEVERAL VARIABLES

Rolle's theorem-Mean value theorem. Indeterminate forms-L'Hospital's rule, Functions of two variables: Taylor's and Maclaurin's series expansions-Maxima and minima for functions of two variables.

UNIT - III SEQUENCES AND SERIES

Convergence of sequence and series- tests for convergence: Comparison test(only for series with positive terms)-D'Alembert's ratio test-Cauchy's root test-Integral test-Leibnitz's test(Alternating series).

UNIT – IV VECTOR CALCULUS (DIFFERENTIATION)

Gradient, divergence and curl- Directional derivative-unit normal vector-Irrotational and solenoidal vectors- Expansion formulae for operators involving

UNIT - V MATRICES

Rank of a matrix- Symmetric, skew- Symmetric and orthogonal matrices-Characteristic equation- Eigen values and Eigen vectors –Cayley-Hamilton Theorem-Diagonalization of symmetric matrices by Orthogonal transformation.

TEXT BOOKS:

1. Veerarajan T., "Engineering Mathematics for First Year", Tata McGraw-Hill, New Delhi, 2008.
2. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 36th Edition, 2010

REFERENCE BOOKS:

1. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9th publishers, Reprint,2002.Edition, Pearson
2. Erwin kreyszig, "Advanced Engineering Mathematics", 9 Edition, John Wiley &Sons,2006.

3. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill New

COURSE OUTCOMES:

At the end of this course, students will able to

1. Solve improper integrals using Beta and Gamma functions.
2. Evaluate the extreme values for functions of two variables.
3. Analyze the convergence of infinite series.
4. Understand vector differentiation and Recognize solenoidal and irrotational fields.
5. Solve eigen values and eigen vectors of a real matrix and Orthogonal transformation of a matrix.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	2	2	-	-	-	-	-	-	-	-	-	-

22ETBS102	PHYSICS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To understand the ray of light to undergo the phenomenon of interference diffraction and polarization.
- To understand the principle and various application of laser.
- To develop knowledge in crystal structure and its properties.
- To understand the energy quantization of subatomic particles like electron.
- Rationalize the law of conservation of energy in solar water heater and solar cells.

UNIT - I WAVE OPTICS

Huygens' Principle, superposition of waves and interference of light by wave front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer and Mach-Zehnder interferometer. Fraunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision; diffraction gratings and their resolving power.

UNIT - II LASERS

Introduction – Principles of Laser – Stimulated emission, Properties of laser beams: mono- chromaticity, coherence, directionality and brightness Einstein's theory of, stimulated emission A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO2), solid- State lasers (ruby, Neodymium), dye lasers, laser speckles, applications of lasers in science, engineering and medicine.

UNIT - III CRYSTAL PHYSICS

Introduction to solid Materials – Crystal structure – Geometry of lattice unit cell – Bravais' lattice – crystal systems, Crystal structures of Materials –(Cordination number, Atomic radius, packing factor and packing density) – Types of crystal Lattice (Simple Cubic,

Body Centered Cubic, Face Centered Cubic and Hexagonal Closed Packed) Miller Indices and their calculations - Finding Miller indices of crystal planes.

UNIT - IV QUANTUM MECHANICS

Heisenberg uncertainity Principle –CDual nature of Matter and radiation – De Broglie's Wave length – Wave Velocity and group velocity. The wave Equation, Schrödinger's time dependent and independent wave equations - The Wave function and its physical significance - The particle in a box Problem (one dimensional box) - Energy quantization – Eigen values and Eigen functions.

UNIT - V ENERGY PHYSICS

Introduction to energy sources - Energy sources and their availability (Conventional and Non- conventional energy sources) solar energy – Methods of Harvesting solar energy – Solar heat collector, solar water heater and solar cells. Wind energy – Basic principle and components of wind energy Conversion system (WECS) – Application of wind energy. Biomass - Biogas Generation - Classification of Biogas plants –Properties and application of Biogas.

TEXT BOOKS:

1. Arumugam.M. "Engineering Physics", Anuradha agencies, 2nd Edition, 1997.
2. John Twidell& Tony Weir, " Renewable Energy Resources" , Taylor & Francis, 2005.
3. Avadhanulu. M.N. and Kshirsagar P.G., "A Text Book of Engineering Physics", S. Chand & Company Ltd., 7th Enlarged Revised Ed., 2005.
4. Gaur R.K. and Gupta S.L., "Engineering Physics", Dhanpat Rai Publishers, New Delhi, 2003.
5. Rai.G.D. , "Solar Energy Utilization" Volume-1 & 2 by - Khanna Publishers, New Delhi.
6. Pajput. R. K. Non – Conventional energy sources and Utilization - S . Chand Publication – 2013.

REFERENCE BOOKS:

1. Rajendran.V , "Engineering Physics", Tata McGraw Hill publishers, 2009.
2. Rai G.D., "Non-conventional Energy sources", Khauna Publications, 1993.
3. Mani. P. "Engineering Physics", Dhanam Publication, Chennai, 2011.
4. Agarwal.M.P, "Solar Energy", S.Chand& Co., I Edn, New Delhi, 1983.

COURSE OUTCOMES:

1. At the end of the course the student will be able to
2. Gain knowledge on the construction of different types of interferometer.
3. Description on different types of laser and its application.
4. Analyze the importance of packing factor in different crystal system.
5. Evaluate the quantum mechanical concept of wave velocity and group velocity.
6. Compared the different energy resource and their availability.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	-	3	2	-	-	-	-	-	1	-	-	-
CO2	3	2	-	-	2	1	1	-	-	-	-	-	-	-	-
CO3	3	1	1	-	-	1	-	-	-	-	-	-	-	-	-
CO4	2	1	2	2	1	1	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	1	2	1	-	-	1	-	1	-	-	-

22ETBS103	CHEMISTRY	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To understand water treatment techniques and basic knowledge on surface chemistry.
- To provide knowledge on electrochemical cells and chemistry involved in corrosion.
- To learn various processes involved in fuel refining and mechanism involved in energy storage devices.
- To develop knowledge about synthesis of various types of polymers and nano materials.
- To get basic knowledge on refractories, lubricants and spectroscopical techniques.

UNIT – I WATER CHEMISTRY AND SURFACE CHEMISTRY

Hardness of water – Softening of hard water by ion exchange method – Boiler feed water – boiler troubles – Internal treatment methods – Estimation of hardness by EDTA method – Desalination of brackish water – Reverse Osmosis. Disinfection of water – Break point chlorination – Adsorption – Types of Adsorption – Freundlich and Langmuir adsorption isotherms – Applications of adsorption.

UNIT – II ELECTROCHEMISTRY AND CORROSION

Electrode potential – Electrochemical cell – Measurement of EMF – Nernst equation for cell EMF – Concentration cells – Electrochemical series – Conductometry – Conductance, Cell constant – Types of conductometric titrations. Potentiometry – Principle of acid base titration. Corrosion – Dry and wet corrosion – Galvanic, concentration cell and pitting corrosion – Control of corrosion by Cathodic protection method.

UNIT – III FUELS AND STORAGE DEVICES

Fuels – Classification – Calorific values – HCV and LCV – Analysis of coal – Proximate and ultimate analysis – Refining of petroleum. Cracking – Fixed bed – Synthetic petrol – Fischer – Tropsch process – Flue gas analysis by Orsat apparatus. Batteries – Primary and secondary – Dry cell – Lead acid storage battery –Ni-Cd battery – Lithium battery – H2-O2 fuel cell.

UNIT – IV POLYMERS AND NANO MATERIALS

Polymers – Types of polymerization – Addition, condensation and copolymerisation – Mechanism of addition polymerization (Free radical). Plastics – Thermoplastics and thermosetting plastics – Preparation, properties and uses of polyethylene, polyvinyl chloride, polystyrene, Nylon and bakelite. Nanochemistry – Introduction to nano materials. Synthesis –

Precipitation, sol- Gel process, electrodeposition and chemical vapour deposition methods. Carbon nano tubes, fullerenes, nano wires and nano rods.

UNIT – V ENGINEERING MATERIALS AND SPECTROSCOPIC TECHNIQUES

Refractories – Classification, characteristics (Refractoriness, RUL, Thermal spalling, porosity) and uses, Lubricants – Classification, properties (cloud and pour point, flash and fire point, viscosity index) and applications. Principles of spectroscopy – Beer – Lambert's Law – UV – Visible and IR spectroscopy – Basic principles and instrumentation (block diagram) – Fluorescence and its applications in medicine.

TEXT BOOKS:

1. Jain, P.C. and Monica Jain (2010) "Engineering Chemistry" DhanpatRai& Sons, New Delhi.
2. Dara, S.S. and Umare, S.S. (2014) "Text Book of Engineering Chemistry" S. Chand & Co. Ltd., New Delhi.
3. Gopalan, R., Venkappaya, D. and Nagarajan, S. (2008) "Engineering Chemistry" Tata McGraw Publications Ltd., New Delhi.
4. Puri, B.R., Sharma, L.R. and Pathania, M.S. (2013) "Principles of Physical Chemistry" Vishal Publication Company, New Delhi.
5. Sharma, Y.R. (2010) "Elementary Organic Spectroscopy, Principle and Chemical Applications" , S. Chand Publishers, New Delhi.
6. Asim K Das and Mahua Das (2017) "An Introduction to Nanomaterials and Nanoscience" CBS Publishers & Distributors Pvt. Ltd., New Delhi.

COURSE OUTCOMES:

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

1. Develop innovative methods in soft water production for industrial uses and about adsorption analysis.
2. Describe the concept of electrochemistry and its applications; corrosion and its controlling methods.
3. Understand the properties of fuels and applications of energy storage devices.
4. Synthesis various polymers and understand about nanomaterials.
5. Gain knowledge on refractories, lubricants and understand the concepts of certain spectroscopical techniques.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	2	-	3	1	-	-	-	-	-	-	-	-	-
CO2	3	2	1	-	-	1	1	-	-	-	-	-	-	-	-
CO3	3	-	-	2	2	-	1	-	-	-	-	-	-	-	-
CO4	2	-	1	-	1	1	1	-	-	-	-	-	-	-	-
CO5	3	1	-	-	2	1	-	-	-	-	-	-	-	-	-

22ETES104	**PROGRAMMING FOR PROBLEM SOLVING**	**L**	**T**	**P**	**C**
		2	**1**	**0**	**3**

COURSE OBJECTIVES:

- To understand the fundamentals of C programming

- To provide students with understanding of code organization and functional hierarchical decomposition using complex data types.
- To understand how to break a large problem into smaller parts, writing each part as a module or function
- To effectively utilize structures and pointers in problem solving
- To enable students to take up Systems programming or Advanced C programming course.

UNIT – I FUNDAMENTALS OF PROGRAMMING

Introduction to Programming, Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.), Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.

UNIT - II EXPRESSIONS AND CONTROL STRUCTURES

Arithmetic Expressions and Precedence, Conditional Branching and Loops, Writing and evaluation of Conditionals and consequent Branching, Iteration and Loops.

UNIT – III ARRAYS

Arrays: Arrays (1-D, 2-D), Character arrays and Strings, Basic Algorithms: Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required).

UNIT – IV FUNCTIONS

Function: Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference, Recursion: Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

UNIT – V FILES AND STRUCTURES

Structure: Structures, Defining structures and Array of Structures, Pointers: Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation). File handling (only if time is available, otherwise should be done as part of the lab).

TEXT BOOKS:

1. Byron Gottfried, “Schaum's Outline of Programming with C” ,McGraw-Hill.
2. E. Balaguruswamy, “Programming in ANSI C”, TataMcGraw-Hill.

REFERENCE BOOKS:

1. Brian W. Kernighan and Dennis M. Ritchie, “The C Programming Language”, Prentice Hall ofIndia.

COURSE OUTCOMES:

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

1. Formulate algorithms, draw flowcharts and write pseudocode for solving arithmetic and logical problems.

2. Develop C programs using branching and looping statements.
3. Implement searching and sorting algorithms and analyze the order of complexities.
4. Define and call simple functions by value and by reference and also to write recursive functions.
5. Utilize structures, pointers and files in C programming.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	3	2	-	-	-	-	-	-	-	-	-	-	-
CO3	2	2	3	2	-	-	-	-	-	-	-	-	-	-	-
CO4	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-

22ETHS105	**தமிழர் மரபு** **HERITAGE OF TAMILS**	L	T	P	C
		1	0	0	1

அலகு I: **மொழி மற்றும் இலக்கியம்**: 3

இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் –சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் – தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் – பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II: **மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை**: 3

நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள்– பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளுவர் சிலை – இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III: **நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்**: 3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு IV: **தமிழர்களின் திணைக் கோட்பாடுகள்**: 3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்ககால நகரங்களும் துறை முகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V: **இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு**: 3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் – தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

TEXT-CUM-REFERENCE BOOKS

தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).

கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).

கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)

பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)

1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
3. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
5. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
8. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – ReferenceBook.

PAPER – 1

HERITAGE OF TAMILS

UNIT I

Language and Literature: Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars
- Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

UNIT II

Heritage - Rock art paintings to modern art - Sculpture: Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

UNIT III

Folk and Martial arts - Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT IV

Thinai concept of Tamils – Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT V

Contribution of Tamils to Indian National Movement and Indian Culture: Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of TamilStudies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay)(Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

22ETP106	COMMUNICATION SKILLS AND LANGUAGE LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

- To facilitate computer assisted multimedia instruction enabling individualized and independent language learning.
- 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 students pronunciation of English by providing an opportunity for practice in speaking.
- To improve the fluency of students in spoken English.
- To train students to use Language appropriately for public speaking, group discussion and interviews.

LIST OF TOPICS:

1. Listening Comprehension
2. Pronunciation, Intonation, Stress and Rhythm
3. Common Everyday Situations: Conversations and Dialogues
4. Communication at Workplace
5. Interviews
6. Formal Presentations

SUGGESTED SOFTWARE PACKAGE:

1. Globarena Package for communicative English The Globarena Package consists of the following exercises
2. Reading comprehension
3. Listening comprehension
4. Vocabulary exercises
5. Phonetics
6. Role Play in dialogues
7. Auto Speak

TEXT BOOKS:

1. Daniel Jones Current," English Pronouncing Dictionary", Edition with CD.
2. R. K. Bansal and J. B. Harrison, "Spoken English ",Orient Longman 2006 Edn.
3. J. Sethi, Kamlesh Sadanand& D.V. Jindal, "A Practical course in English Pronunciation, (with two Audio cassettes)", Prentice-Hall of India Pvt. Ltd., New Delhi.
4. T.Balasubramanian," A text book of English Phonetics for Indian Students", (Macmillan).
5. "English Skills for Technical Students", WBSCTE with British Council, OL.

COURSE OUTCOMES:

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

1. Student will heighten their awareness of correct usage of English Grammar in writing and speaking.
2. Acquire speaking ability in English both in terms of fluency and comprehensibility.

3. Enhance competence in the four modes of literacy; Writing, Speaking, Reading and Listening.
4. Ensure student to improve their accuracy and fluency in producing and understanding spoken and written English
5. Exposure of the grammatical forms of English and the use of these forms in specific communicative contexts.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	3	-	-	-	-	-	-	-	3	-	3	-	-	-
CO2	-	3	-	-	-	-	-	-	-	3	-	3	-	-	-
CO3	-	-	2	-	-	-	-	-	-	3	-	3	-	-	-
CO4	-	2	-	-	-	-	-	-	-	3	-	3	-	-	-
CO5	-	-	3	-	-	-	-	-	-	3	-	3	-	-	-

22ETSP107	ENGINEERING WORKSHOP PRACTICES	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

- To provide the students simple hands-on-experience in the basic aspects of production engineering in fitting, carpentry and sheet metal.
- To familiarize the students in the various hand forging operations

CARPENTRY: Use of hand tools - exercises in planning and making joints namely, Lap joint, Lenthhening joint, half lap joint, dovetail joint, mortising and tenoning etc.

FITTING: Use of bench tools, vice, hammers, chisels, files, hacksaw, centre punch, twist drill, taps and dies - Simple exercises in making T, V joint and dovetail joints.

SHEET METAL WORK: Use of hand tools - Simple exercises in making objects like cone, funnel, tray, cylinder.

SMITHY: Demonstration of hand forging and drop forging.

COURSE OUTCOMES:

Upon completion of this course, students will be able to

1. Use basic tools of fitting, carpentry and sheet metal fabrication.
2. Fabricate simple carpentry joints.
3. Develop skill to make simple fitting joints.
4. Create simple shapes of sheet material.
5. Distinguish hand forging and drop forging operation.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	2	-	-	-	-	-	-	2	-	-	-
CO2	3	-	2	-	-	-	-	-	-	-	-	1	-	-	-
CO3	3	-	2	-	-	-	-	-	2	-	-	-	-	-	-
CO4	3	-	1	-	-	-	-	-	2	-	-	1	-	-	-
CO5	3	-	2	-	-	-	-	-	1	-	-	2	-	-	-

22ETSP108	ELECTRICAL WIRING AND EARTHING PRACTICE LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

- To create an awareness on the electrical safety in industrial and commercial environment.
- To enable the understanding on the principles of different types of electrical wiring.
- To offer exposure on the need for earthing and earthing practices.
- To provide practical knowledge on the various types of lighting circuits.
- To introduce methods for measuring the variables in electric circuits.

a) Study of Basics of Safety Precautions
   1. Study of Wiring Materials

a) Study of types of Wiring
   1. Fan and Fluorescent Lamp Connections
   2. Residential Wiring
   3. Stair case Wiring
   4. Industrial Wiring
   5. Series and Parallel Lamp Circuits
   6. Measurement of Earth Resistance
   7. Measurement of Frequency and Phase of AC Circuits

COURSE OUTCOMES:

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

1. Familiarize with the electrical safety measures.
2. Identify the different types of electrical wiring.
3. know the necessity of Earthing.
4. gain knowledge on the different types of lighting circuits.
5. understand the methods for measuring electrical variables.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	1	-	-	-	-	-	-	-	2	-	-	-
CO2	3	-	-	2	-	-	-	-	2	-	-	2	-	-	-
CO3	3	-	-	2	-	-	-	-	2	-	-	2	-	-	-
CO4	3	-	-	2	-	-	-	-	2	-	-	2	-	-	-
CO5	3	-	-	2	-	-	-	-	2	-	-	2	-	-	-

S E M E S T E R - II

22ETHS201	ENGLISH	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To ensure the students with good vocabulary
- To make the students participate actively in writing activities
- To practice the unique qualities of professional writing style
- To develop the students the proficiency in communicative skills
- To ensure the students to face the demand of their profession

UNIT- I VOCABULARY BUILDING

1. The concept of Word Formation -
2. Root words from foreign languages and their use in English
3. Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives, Count and uncount nouns.
4. Synonyms, antonyms, and standard abbreviations.
5. Language development - Wh questions asking and answering yes or no questions.

UNIT –II BASIC WRITING SKILLS

1. Sentence Structures
2. Use of phrases and clauses in sentences
3. Importance of proper punctuation
4. Creating coherence and Techniques for writing precisely
5. Organizing principles of paragraphs in writing

UNIT – III NATURE AND STYLE OF SENSIBLE WRITING

1. Describing and Defining
2. Classifying and Providing examples or evidence
3. Writing introduction and conclusion
4. Comprehension
5. Precis Writing

UNIT – IV WRITING PRACTICES & ORAL COMMUNICATION

1. Listening to lectures and making notes
2. Mechanics of presentation, asking and giving instruction
3. Essay Writing – Writing analytical essays and issue based essays.
4. Dialogue writing and conversation
5. Letter writing – Formal and informal

UNIT – V GROUP DISCUSSION AND JOB APPLICATION

1. Characteristics and practices of group discussion
2. Job application
3. Resume preparation
4. Writing reports – minutes of a meeting, accident, survey
5. E-mail – etiquette

TEXT /REFERENCE BOOKS:

1. Michael Swan,“Practical English Usage”, OUP, 1995.

2. F.T. Wood,,"Remedial English Grammar",Macmillan,2007.
3. William Zinsser,"On Writing Well", Harper Resource Book, 2001,
4. Liz Hamp - Lyons and Ben Heasly,"Study Writing", Cambridge University Press, 2006.
5. Sanjay Kumar and PushpLata, "Communication Skills" Oxford University Press, 2011.
6. "Exercises in Spoken English. Parts. I-III", CIEFL, Hyderabad,. Oxford University Press.
7. Raman, Meenakshi and Shama, Sangeetha – "Technical Communication Principles and Practice", Oxford University Press, New Delhi,2014.

COURSE OUTCOMES:

At the end of this course, students will able to

1. Comprehension, writing and speaking skills. Get an exposure of vocabulary and gain a good glossary.
2. Get knowledge regarding use of Grammar in speech and writing.
3. Acquire a knowledge of remembering, understanding, applying, analyzing, evaluating & Creating.
4. Determine how to articulate their ideas effectively to a variety of listeners.
5. Acquire ability to speak and write effectively in English.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	2	-	2	-	-	-	-	-	3	-	3	-	-	-
CO2	-	2	-	2	-	-	-	-	-	3	-	3	-	-	-
CO3	-	-	3	-	-	-	-	-	-	3	-	3	-	-	-
CO4	-	-	2	3	-	-	-	-	-	3	-	3	-	-	-
CO5	-	-	3	2	-	-	-	-	-	3	-	3	-	-	-

22ETBS202	MATHEMATICS-II	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To familiarize multiple integrals and its application in finding area and volume.
- To make the student to learn line, surface and volume integrals.
- To solve Second order linear differential equations with constant coefficients.
- To acquaint the student with the techniques in the theory of analytic functions.
- To Introduce the fundamentals of complex integrations.

UNIT-I MULTIVARIABLE CALCULUS (INTEGRATION)

Double integrals (Cartesian) - change of order of integration in double integrals - Change of variables (Cartesian to polar) - Applications: Area as a double integral. Triple integrals (Cartesian) - Applications: Volume as a triple integral.

UNIT – II VECTOR CALCULUS (INTEGRATION)

Line, Surface and Volume integrals - Gauss divergence theorem (without proof) - Green's theorem in the plane (without proof) – Stokes theorem (without proof).Verification of the above theorems and evaluation of integrals using them.

UNIT – III ORDINARY DIFFERENTIAL EQUATIONS

First order ordinary differential equations (Linear and Bernoulli's differential equations, exact differential equations). Solution of Second order ordinary linear differential equations with constant co-efficient (method of variation of parameters only).Solution of Second order ordinary linear differential equations with variable co-efficient (Euler and Legendre's linear equations).

UNIT – IV COMPLEX VARIABLE (DIFFERENTIATION)

Analytic functions and their properties-Cauchy-Riemann equations- Harmonic functions – harmonic conjugate of elementary analytic functions– Construction of an analytic function. Mobius transformations.

UNIT – V COMPLEX VARIABLE (INTEGRATION)

Cauchy theorem (without proof) –Cauchy Integral formula (without proof) – Cauchy Integral formula for higher derivatives (without proof) – zeros and poles of an analytic functions – singularities. Residues - Cauchy Residue theorem (without proof) –Evaluation of definite integral using them. Taylor's series and Laurent's series.

TEXT BOOKS:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 36 Edition,2010.
2. Erwin kreyszig, "Advanced Engineering Mathematics", 9 Edition, John Wiley &Sons, 2006.

REFERENCE BOOKS:

1. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9 Edition, Pearson, Reprint,2002.
2. W. E. Boyce and R. C. DiPrima, "Elementary Differential Equations and Boundary Value Problems", 9thEdn., Wiley India, 2009.
3. S. L. Ross, "Differential Equations", 3rd Ed., Wiley India,1984.
4. J. W. Brown and R. V. Churchill, "Complex Variables and Applications", 7th Ed., Mc- Graw Hill, 2004.
5. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2008.

COURSE OUTCOMES:

At the end of this course, students will able to

1. Solve double and triple integrals in finding area and volumes.
2. Apply line, surface and volume integrals in Gauss, Greens and Stoke'stheorems.
3. Solve Second order linear differential equations with constant coefficients.
4. Construct analytic function and analyze conformal mappings.
5. Evaluate the complex integrals and contour integration.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	3	3	-	-	-	-	-	-	-	-	-	-
CO4	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	2	-	-	-	-	-	-	-	-	-	-	-

22ETES203	BASIC ENGINEERING*	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To understand the basics of Electrical circuit laws and fundamentals of AC circuits
- To understand the working of DC Machines, transformers and AC machines
- To learn the basics of electronic devices and Communication Systems
- To inculcate a knowledge on essentials of Civil Engineering
- To expose the students on the role, significance and contributions of Civil Engineering in satisfying societal needs
- To illustrate the concepts of various construction techniques

UNIT-I BASIC CIRCUITS

Definition of current and voltage - Electrical circuit elements (R, L and C)- Ohm's Law- Kirchhoff's laws - solution for currents and voltages - AC circuits - RMS-Average values- Introduction to 3 phase systems - Advantages

UNIT-II ELECTRICAL MACHINES

Laws of Electromagnetism - Construction of DC Machines- DC Generator - EMF Equation - DC Motor- Principle of operation - Types– Characteristics Single-phase Transformer: Construction and Working principle-EMF equation - Three-phase transformer-Working principle. Three-phase induction motor – Construction and working principle-Singlephase induction motor- Alternators- Working principle

UNIT-III BASIC ELECTRONICS

P-N junction - VI Characteristics of PN junction diode, Zener diode – Rectifier circuits- Voltage Regulator using Zener diode - Elements of Communication Systems - Microwave, Satellite and Optical Fibre (Block Diagram Approach only).

UNIT-IV

Introduction to Civil Engineering - Relevance of Civil Engineering in the overall infrastructural development of the country. Introduction to various building materials – Stone, Bricks, Steel, Cement, Concrete, Timber – its characteristics, types and uses. Various types of buildings as per NBC; Selection of suitable site for buildings, Components of a residential building – its functions, Orientation of a building, simple definitions – plinth area / built up area, floor area / carpet area – floor space index.

UNIT-V

Surveying - Principles and objectives of surveying; Types, Classifications of surveying, measurement of areas and distances – chain – compass: Introduction to Leveling, Total station, Remote sensing – fundamental principles and applications. Building construction – foundations; Bearing capacity of soil, functions of foundations, Types - Shallow and Deep. Brick masonry – Header, Stretcher, Flemish and English Bond. Columns, Lintels, Roofs – functions, types, roofing materials, Floors – functions, types, flooring materials. Decorative finishes – plastering, interior design.

UNIT-VI

Bridges – necessity - selection of site – components of a bridge: Dams – types – selection of site - forces acting on a dam – Roads – uses - classification of roads – components of a road; Railways – basic components of permanent way – water supply – per capita requirement – sources – need for conservation of water – rain water harvesting - basic water treatment – Sewage and its disposal – basic definitions – Septic tank - components and functions.

TEXT BOOKS :

1. Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", McGraw Hill Education, 2014.
2. A K Theraja&B L Theraja, A Textbook of Electrical Technology, Vol.2, S. ChandPublishing, 2014.
3. Ramesh babu. V, A text book of Basic Civil Engineering, Anuradha Agencies, Kumbakonam, 1995.
4. Palanichamy M.S., Basic Civil Engineering, Tata McGraw Hill Publishing Company ltd, 2000.

REFERENCE BOOKS:

1. Del Toro, "Electrical Engineering Fundamentals", Second edition, Pearson Education, New Delhi, 1989.
2. John Bird, "Electrical Circuit theory and technology", Routledge, 5th edition, 2013.
3. V.K. Mehta, Rohit Mehta, "Basic Electrical Engineering", S.Chand Publications, 2012.
4. Ramamrutham V, Basic Civil Engineering, DhanpatRai Publishing Co. (P) Ltd., 1999.
5. Natarajan K V, Basic Civil Engineering, Dhanalakshmi Publications, Chennai, 2005.
6. SatheeshGopi, Basic Civil Engineering, Pearson Publications, 2010.

COURSE OUTCOMES:

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

1. Apply the concepts related with electrical circuits and AC fundamentals.
2. Explore the concepts of DC machines, Transformers and AC machines
3. Explore the basic electronic devices and their applications. Gain insight on the various elements of Communication systems.
4. Develop the skill to satisfy the social needs
5. Describe the suitable method of construction technique

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	2	-	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-	2	-	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-	2	-	-	-
CO4	3	-	1	-	-	-	-	-	-	-	-	2	-	-	-
CO5	3	-	1	-	-	-	-	-	-	-	-	2	-	-	-

22ETHS204	தமிழரும் தொழில்நுட்பமும் TAMILS AND TECHNOLOGY	L	T	P	C
		1	0	0	1

அலகு I: **நெசவு மற்றும் பானைத் தொழில்நுட்பம்:** 3

சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் – கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு II: **வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்:** 3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு– சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் – மாமல்லபுரச் சிற்பங்களும், கோவில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் – மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ–சாரோசெனிக் கட்டிடக் கலை.

அலகு III: **உற்பத்தித் தொழில் நுட்பம்:** 3

கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத்துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு IV: **வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்:** 3

அணை, ஏரி, குளங்கள், மதகு – சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.

அலகு V: **அறிவியல் தமிழ் மற்றும் கணித்தமிழ்:** 3

அறிவியல் தமிழின் வளர்ச்சி –கணித்தமிழ் வளர்ச்சி – தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).

கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).

கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)

பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)

1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
3. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
5. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
8. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

PAPER – 2
TAMILS AND TECHNOLOGY

1. **Weaving and Ceramic Technology**: Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

2. **Design and Construction Technology:** Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period

   - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

3. **Manufacturing Technology**: Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting,steel -Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads - Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

4. **Agriculture and Irrigation Technology:** Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

5. **Scientific Tamil & Tamil Computing**: Development of Scientific Tamil - Tamil

computing –Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
   கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
   கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
   பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)

1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
3. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
5. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Service Corporation, Tamil Nadu)
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) Publishedby: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
8. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

22ETBP205	PHYSICS LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

- To access the Rigidity modulus of wire.
- To assess the various properties of light.
- To asses the characterization of Metals.
- To analyses the thickness of microsized objects.

LIST OF EXPERIMENTS:

1. Air Wedge
2. Newtons's Rings
3. Simple Pendulum
4. Dispersive power of the Prism
5. Diffraction Grating
6. Acoustic diffraction Grating
7. Compound Pendulum
8. Kunt's tube experiment

9. Young's double slit experiment
10. Laser Grating
11. Torsional Pendulum
12. Young's Modulus – Non-uniform Bending
13. Young's Modulus – Uniform Bending.

COURSE OUTCOMES:

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

1. Acquired the knowledge of torsional properties of metals wire.
2. Generalized the dispersion of light through the prism.
3. Calculate the wavelength of monochromatic and polychromatic source of light.
4. Analyze diffraction patterns can be formed by light passing through a series of fine lines.
5. Estimate the size and shape of given unknown fine powder using laser gratings.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	-	3	2	1	-	-	-	-	-	-	-	-
CO2	3	3	-	-	3	1	1	-	-	-	-	-	-	-	-
CO3	3	2	2	-	3	1	1	-	-	1	-	-	-	-	-
CO4	3	2	2	-	3	1	1	-	-	1	-	-	-	-	-
CO5	3	2	2	-	3	1	1	-	-	1	-	-	-	-	-

22ETBP206	**CHEMISTRY LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

COURSE OBJECTIVES:

- To list the water quality standards.
- To assess the composition of an alloy.
- To appreciate the practical significance of acidimetry, alkalimetry, permananganometry, conductometry and potentiometry.
- To analyse quantitatively the amount of a substance present in a given sample.

LIST OF EXPERIMENTS:

1. Determination of surface tension and viscosity
2. Thin layer chromatography
3. Ion exchange column for removal of hardness of water
4. Determination of chloride content of water
5. Determination of the rate constant of a reaction
6. Determination of cell constant and conductance of solutions
7. Potentiometry - determination of redox potentials and emfs
8. Saponification/acid value of an oil
9. Determination of the partition coefficient of a substance between two immiscible liquids
10. Adsorption of acetic acid by charcoal
11. Volumetric analysis

COURSE OUTCOMES:

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

1. Determine the physical properties like surface tension and viscosity.
2. Determine rate of reactions and soapnification of oil.
3. Calculate the quantity of adsorbate adsorbed by charcoal.
4. Determine the impurity from Pharmacheutical products and hardness of water.
5. Determine exact concentration of acid and bases present in the industrial wastes.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	1	-	-	1	-	-	-	-	-	-	-	-
CO2	2	1	-	-	-	1	-	-	-	-	-	-	-	-	-
CO3	3	2	-	1	-	-	2	-	-	-	-	-	-	-	-
CO4	3	-	1	-	-	-	-	-	-	-	-	-	-	-	-
CO5	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-

22ETSP207	COMPUTER PROGRAMMING LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

- To enable students to code, compile and test C programs.
- To enable students to design algorithms using appropriate programming constructs for problem solving.
- Identify tasks in which the numerical techniques learned are applicable and apply them to write programs.
- To enable students to segregate large problems into functions using modular programming concepts.
- To enable students to apply pointer and structures in programs effectively.

[The laboratory should be preceded or followed by a tutorial to explain the approach or algorithm to be implemented for the problem given]

Tutorial 1: Problem solving using computers:
Lab1: Familiarization with programming environment
Tutorial 2: Variable types and type conversions:
Lab 2: Simple computational problems using arithmetic expressions

Tutorial 3: Branching and logical expressions:
Lab 3: Problems involving if-then-else structures

Tutorial 4: Loops, while and for loops:
Lab 4: Iterative problems e.g., sum of series

Tutorial 5: 1D Arrays: searching, sorting:
Lab 5: 1D Array manipulation

Tutorial 6: 2D arrays and Strings
Lab 6: Matrix problems, String operations

Tutorial 7: Functions, call by value:
Lab 7: Simple functions

Tutorial 8 & 9: Numerical methods (Root finding, numerical differentiation, numerical integration):
Lab 8 and 9: Programming for solving Numerical methods problems

Tutorial 10: Recursion, structure of recursive calls
Lab 10: Recursive functions

Tutorial 11: Pointers, structures and dynamic memory allocation
Lab 11: Pointers and structures

Tutorial 12: File handling:
Lab 12: File operations

COURSE OUTCOMES:

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

1. Analyze program requirements and develop programs using conditional and looping statements.
2. Write programs for handling arrays and strings.
3. Create C programs with user defined functions and recursive function calls.
4. Utilize pointers and structures for dynamic memory allocation in C programming.
5. Develop C programs for handling files.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	1	-	2	-	-	-	-	-	-	-	-	-	-
CO2	2	1	1	-	2	-	-	-	-	-	-	-	-	-	-
CO3	2	1	1	-	2	-	-	-	-	-	-	-	-	-	-
CO4	1	1	1	-	2	-	-	-	-	-	-	-	-	-	-
CO5	1	1	1	-	2	-	-	-	-	-	-	-	-	-	-

22ETSP208	**ENGINEERING GRAPHICS**	**L**	**T**	**P**	**C**
		2	**0**	**3**	**3**

TRADITIONAL ENGINEERING GRAPHICS:

PrinciplesofEngineeringGraphics;OrthographicProjection;DescriptiveGeometry;

Drawing Principles; Isometric Projection; Surface Development; Reading a Drawing; Sectional Views; Dimensioning, True Length, Angle.

COMPUTER GRAPHICS:

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modeling; Solid Modeling; Introduction to Building Information Modeling (BIM)

(Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory)

COURSE OBJECTIVES:

- To develop the ability to produce simple engineering drawing and sketches based on current practice
- To develop the means for communication of ideas, thoughts and design of objects, related to engineering applications, to others though drawing
- To develop the skills to read manufacturing and construction drawings used in industry
- To develop a working knowledge of the layout of plant and equipment
- To develop skills in abstracting information from calculation sheets and schematic diagrams to produce working drawings for manufacturers, installers and fabricators

UNIT- I INTRODUCTION TO ENGINEERING DRAWING,

Introduction to Engineering Drawing: Lettering, Dimensioning and use of drawing instruments. Conic sections: Eccentricity method of/for drawing ellipse, parabola and hyperbola- Tangent and Normal from a point on the curve.

UNIT- II ORTHOGRAPHIC PROJECTIONS,

Orthographic projections: Introduction – Projections of pointsProjections of Straight lines: Determination of true length and true angle of inclinations using half cone and trapezoidal methods – drawing the projections of straight lines using half cone method from true length and true angle of inclinations.

UNIT -III PROJECTIONS OF REGULAR SOLIDS,

Projections of solids in simple position: Projections of cube, Tetrahedron, prisms, Pyramids, cone and cylinder. Projections of solids: Auxiliary projections – projections of prisms, pyramids, cylinder and cone when the axis is inclined to only one plane.

UNIT- IV SECTIONS AND SECTIONAL VIEWS OF RIGHT ANGULAR SOLIDS,

Sections of solids: Sections of prisms, pyramids, cylinder and cones – true shape of section. Developments of solids: Developments of lateral surfaces of solids using parallel and radial line methods.

UNIT -V ISOMETRIC PROJECTIONS

Isometric projections: Projections of simple solids.Conversion of pictorial view of simple objects into orthographic projections (only elevation and plan)

Overview of Computer Graphics Covering:

Introduction to CAD software: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars). The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.

Customization & CAD Drawing

Consistingofsetupofthedrawingpageandtheprinter,includingscalesettings, Settingupof units and drawing limits;

Orthographicconstraints,Snaptoobjectsmanuallyandautomatically; Producing

drawings by using various coordinate input entry methods to draw straight lines and other basic geometric entities.

Annotations, layering & other functions

applying dimensions to objects and annotations to drawings; Setting up and use of Layers, Printing document stop a per using the print command; orthographic projection techniques ;Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation;

TEXT/REFERENCE BOOKS:

1. BhattN.D.,Panchal V.M.& Ingle P.R.,(2014), Engineering Drawing, Charotar Publishing House.
2. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education.
3. Agrawal B. &Agrawal C. M. (2012), Engineering Graphics, TMH Publication.
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.
5. (Corresponding set of) CAD Software Theory and User Manuals.

COURSE OUTCOMES:

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

1. Utilize drawing instruments effectively and able to present engineering drawings and sketches.
2. Describe the concept of orthographic, isometric projections of points, lines and regular solids.
3. Visualize the images and drawings in engineering perspective.
4. Practice sectioning of bodies like machines and equipment's.
5. Develop their technical communication skills and promote life-long learning.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	-	2	-	-	-	-	2	-	2	-	-	-
CO2	3	3	3	2	2	-	-	-	2	2	-	2	-	-	-
CO3	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	3	-	3	-	-	-

DEPARTMENT OF MANUFACTURING ENGINEERING
(DST-FIST-Level-2 & UGC-SAP-DRS-Phase-2 Department)

VISION

Provide high quality education to create technically competent Mechanical and Manufacturing Engineers to strive hard for the sustainable development of industry and society and to serve for the nation building.

MISSION

- Develop the student community with wider knowledge in the emerging fields of Mechanical Engineering with more emphasis on Manufacturing Engineering.

- Inculcate innovative skills, research aptitude, team work, ethical practices among students so as to meet the expectations of the industry as well as the society.

- Motivate the students to pursue higher education and take competitive examinations and various career enhancing program.

- Create a conducive and supportive environment for all round growth of the students, faculty & staff with emphasis on life-long learning.

- Provide quality education by periodically updating curriculum, effective teaching-learning process, best laboratory facilities and collaborative ventures with the industries.

B.E. MECHANICAL AND MANUFACTURING ENGINEERING

PROGRAM OUTCOMES (POs)

After the successful completion of the B.E. Mechanical and Manufacturing Engineering degree programme, the students will be able to:

PO1: INTEGRATION OF KNOWLEDGE

Demonstrate strong basics in mathematics, science, engineering and technology which serve as the foundation for the Programme.

PO2: PROBLEM ANALYSIS

Demonstrate the ability to design and conduct experiments, as well as to analyze and interpret data in the spheres of fundamental engineering.

PO3: DESIGN AND DEVELOPMENT OF SOLUTIONS

Demonstrate the ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability.

PO5: USE OF MODERN TOOLS AND TECHNIQUES

Become familiar with modern engineering tools and analyse the problems within the domains of Manufacturing Technology as the members of multidisciplinary teams

PO5: COLLABORATIVE AND MULTIDISCIPLINARY APPROACH

Acquire the capability to identify, formulate and solve engineering problems related to manufacturing engineering in interdisciplinary and multidisciplinary sciences

PO6: ETHICAL PRACTICES AND SOCIAL RESPONSIBILITIES

Demonstrate an understanding of professional and ethical responsibility with reference to their career in the field of manufacturing engineering.

PO7: COMMUNICATION SKILLS

Interact with engineering community and with society at large, regarding intricate engineering activities on technical perspectives and emerge as an efficient motivator. He will be able to communicate effectively both in verbal and non verbal forms.

PO8: PROJECT MANAGEMENT

Design and develop innovative / manufacturable / marketable/ environmental friendly products useful to the society and nation at large. Graduate will be able to manage any organization well and will be able to emerge as a successful entrepreneur

PO9: LIFE LONG LEARNING

Understand the value for life long-long learning, in the context of technological challenges.

PO10: ENVIRONMENT AND SUSTAINABLITY

Acquire ample knowledge essential for sustainable development in consideration of environmental impacts and contemporary issues.

PO11: SOCIAL RESPONSIBILITY

Understand the nature of profession and be vigilant in order to maximize the chances of a positive contribution to society.

PO12: INVESTIGATION OF COMPLEX PROBLEM

Perform investigations, design and conduct experiments, analyze and interpret the results to provide valid conclusion.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO-1: The graduates acquire ability to create model, design, synthesize and analyze essential production operational skills, mechanism and automation system.

PEO-2: The graduates use their talent, self-confidence, knowledge and engineering practice which facilitate them to presume position of scientific and/or managerial leadership in their career paths.

PEO-3: The graduates will adopt ethical attitude and exhibit effective skills in communication management team work and leader qualities.

PEO-4: The graduates apply their consciousness of moral, professional responsibilities and motivation to practice life-long learning in a team work environment.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO-1: Ability to apply the concepts of manufacturing engineering to develop and implement new ideas on product design and development with the help of modern engineering tools, while ensuring best manufacturing practices;

PSO-2: Capability to analyse, interpret and provide solutions to the Real Time Manufacturing Engineering and related problems;

PSO-3: The ability to work as a professional and/or as an entrepreneur by applying the manufacturing engineering principles and management practices.

Mapping PO with PEO												
POs/ PEOs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
PEO1	3	3	1	2	2							1
PEO2			3	2	1		1	2			1	2
PEO3						3	3	3		1		
PEO4			1	1		1	1	3	3		3	

S E M E S T E R - III

22ETBS301	MATHEMATICS – III	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To understand the basic concepts of partial differential equations which is helpful in solving Real world problems.
- Introduce Fourier series which is very useful in the study of electrostatics, acoustics and computing.
- Introduce Boundary value problems which is helpful in investigation of the important features of electromagnetic theory.
- The study of Fourier transform is useful in solving problems in frequency response of a filter and signal analysis.
- Provide a study of Z-transform which can played important role in the development of communication engineering.

UNIT – I: PARTIAL DIFFERENTIAL EQUATIONS

Formation of partial differential equations by eliminating arbitrary constants and arbitrary functions - Solution of standard type of first order partial differential equations - Lagrange's linear equation - Linear partial differential equations of second order with constant coefficients.

UNIT – II: FOURIER SERIES

Dirichlet's conditions - General Fourier series - Odd and Even functions - Half range sine series - Half range cosine series - Complex form of Fourier series – Parseval's identity.

UNIT – III: BOUNDARY VALUE PROBLEMS

Solutions of one-dimensional wave equation – One dimensional heat equation (without derivation) – Fourier series solutions in Cartesian co-ordinates.

UNIT – IV: FOURIER TRANSFORM

Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem - Parseval's identity

UNIT – V: Z – TRANSFORM AND DIFFERENCE EQUATIONS

Z – transform – Elementary properties – Inverse Z – transform - Convolution theorem – Solution of difference equations using Z – transform.

TEXT BOOKS:

1. Kandasamy,P., Thilagavathy,K. and Gunavathy,K., Engineering Mathematics,6th ed., (Vol-I & II) S.Chand& Co Ltd. 2006, New Delhi.
2. Ventakataraman,M.K., 2003. Engineering Mathematics-The National Publishing Co., Chennai.

REFERENCES BOOKS:

1. Ramana B V., Higher Engineering Mathematics.,2007, Tata McGraw Hill Pub.
2. Veerarajan, T., Engineering Mathematics, 3rd edition, 2005, Tata McGraw Hill Pub.

3. Vairamanickam.k., Nirmala.p., Tamilselvan.S., Transforms and Partial Differential Equations., 2014,Scitech Publications(India) Pvt.Ltd
4. Singaravelu, A., Engineering Mathematics, Meenakshi Publications, Chennai,2004.

COURSE OUTCOMES:

At the end of this course, students will able to

1. Acquire basic understanding of the most common partial differential equations.
2. Understand the concepts of Fourier series.
3. Ability to solve boundary value problems.
4. Able to investigate signals problems using Fourier transform
5. Familiarize Z-transform that play important roles in many discreate engineering problems.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	2	-	-	-	-	-	-	-	-	2	-	-
CO2	3	3	3	2	-	-	-	-	-	-	-	-	2	-	-
CO3	3	3	3	2	-	-	-	-	-	-	-	-	2	-	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-	2	-	-
CO5	3	3	3	2	-	-	-	-	-	-	-	-	2	-	-

22ETES302	**ENVIRONMENTAL STUDIES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To study the nature and the facts about environment.
- To find and implement scientific, technological, economic and political solutions to environmental problems.
- To Study the dynamic processes and understand the features of the earth interior and surface.

UNIT I

Introduction - Multidisciplinary nature of environmental studies - Definition, scope and importance - Need for public awareness. Natural resources - Forest resources: use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Land resources: Land as a resource, land degradation, 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

Concept of an ecosystem - Structure and function of an ecosystem - Producers, consumers and decomposers - Energy flow in the ecosystem - Ecological succession - Food chains, food webs and ecological - pyramids - Introduction, types, characteristic features,

structure and function of the following ecosystem - Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

UNIT III

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

UNIT IV

Definition - Cause, effects and control measures of Air pollution – Water pollution - Soil pollution - Marine pollution- Noise pollution - Thermal pollution - Nuclear hazards- Solid waste Management: Causes, effects and control measures of 53 urban and industrial wastes - Role of an individual in prevention of pollution – Disaster management: floods, earthquake, cyclone and landslides. Sustainable development - Urban problems related to energy - Water conservation, rain water harvesting, and watershed management - Resettlement and rehabilitation of people; its problems and concerns. - Environmental ethics: Issues and possible solutions - Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation - Consumerism and waste products - Environment Protection Act - Air (Prevention and Control of Pollution) Act - Water (Prevention and control of Pollution) Act - Wildlife Protection Act - Forest Conservation Act - Issues involved in enforcement of environmental legislation.

UNIT V

Population growth, variation among nations - Population explosion – Family Welfare Programme - Environment and human health - Human Rights – Value Education - HIV/AIDS - Women and Child Welfare - Role of Information Technology in Environment and human health -Case Studies.

FIELD WORK

Visit to a local area to document environmental assets-river / forest / grassland / hill / mountain - Visit to a local polluted site-Urban/Rural/ Industrial/ Agricultural – Study of common plants, insects, birds - Study of simple ecosystems-pond, river, hill slopes, etc. **(Field work Equal to 5 lecture hours)**

TEXT BOOKS:

1. Agarwal, K.C. 2008 Environmental Biology, Nidi Publ. Ltd. Bikaner.
2. Bharucha Erach, 2002 The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad.

REFERENCE BOOKS:

1. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc.
2. Clark R.S., Marine Pollution, Clanderson Press Oxford (TB), 2018
3. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 200.
4. Environmental Encyclopedia, Jaico Publ. House, Mumbai.
5. De A.K., Environmental Chemistry, Wiley Eastern Ltd, 2018

COURSE OUTCOMES:

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

1. Analyze the multidisciplinary nature of environmental awareness.
2. Evaluate the significance of ecosystem.
3. Demonstrate the importance of biodiversity and its threats
4. Compare the effects of air, land and water pollution.
5. Analyzethe impact of population growth and importance of Human rights

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	-	-	-	3	-	-	-	-	-	-	-	-	1
CO2	-	-	-	3	-	-	-	-	-	-	-	-	3	-	-
CO3	-	-	-	-	3	-	3	-	-	-	-	2	3	-	-
CO4	3	-	2		2	-	-	-	-	-	-	2	3	-	1
CO5	3	-	-	-	-	-	-	-	2	-	-	2	-	-	1

22ETES303	ENGINEERING MECHANICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the fundamentals of forces and their effects with their governing laws.
- To understand the definitions of particle, body forces and their equilibrium conditions.
- To understand and predict the forces and its related motions.

UNIT I

Introduction to Engineering Mechanics covering, Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminancy

UNIT II

Basic Structural Analysis covering, Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines

Centroid and Centre of Gravity covering, Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.

UNIT III

Friction covering, Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack

Virtual Work and Energy Method- Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems

with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium.

UNIT IV

Review of particle dynamics- Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy.Impulse-momentum (linear, angular); Impact (Direct and oblique).

UNIT V

Introduction to Kinetics of Rigid Bodies covering, Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation

Mechanical Vibrations covering, Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums;

TEXT BOOKS:

1. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall
2. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill
3. R. C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.

REFERENCE BOOKS:

1. Andy Ruina and Rudra Pratap (2011), Introduction to Statics and Dynamics, Oxford University Press
2. Shanes and Rao, Engineering Mechanics, (2006)Pearson Education,
3. Hibler and Gupta,Engineering Mechanics (Statics, Dynamics) (2010)by Pearson Education
4. Reddy Vijaykumar K. and K. Suresh Kumar, Singer's Engineering Mechanics, (2010)
5. Bansal R.K., A Text Book of Engineering Mechanics, .(2010), Laxmi Publications
6. Tayal A.K., Engineering Mechanics, (2010), Umesh Publications

COURSE OUTCOMES:

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

1. apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems
2. use scalar and vector analytical techniques for analysing forces in statically determinate structures
3. realize the basic dynamics concepts of force, momentum, work and energy
4. apply their basic kinematics concepts to solve problems in displacement, velocity and acceleration (and their angular counterparts)
5. use their basic knowledge of mathematics and physics to solve real-world problems in the application areas like mechanical vibration

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	1	1	2	-	-	-	1	-	-	1	2	1	1
CO2	1	2	2	-	-	-	-	-	2	-	-	2	2	-	1
CO3	3	1	2	1	2	-	-	-	-	-	-	1	-	1	1
CO4	2	2	1	-	-	-	-	-	1	-	-	2	1	-	-
CO5	3	2	2	-	-	-	-	-	-	-	-	2	-	-	-

22MMPC304	**MECHATRONICS AND FLUID POWER SYSTEM**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

The main objectives of the course for the students is

1. To acquire knowledge about elements of mechatronics system and apply the mechanical and electrical actuators and its drives for interfacing.
2. To have a clear view on the fluid power system, the pneumatic and hydraulic actuation systems.
3. To familiarize the performance of different types of sensors and transducers and its interfacing, the principle of signal conditioning.
4. To study the system representation and performance and different controllers used in mechatronics design.
5. To illustrate the concepts of real time interfacing and advanced application and data acquisition and control systems of mechatronics in manufacturing.

UNIT I

Introduction & Actuation systems: Introduction to Mechatronics System - Elements of measurement system - control systems - open and closed loop systems. Electrical actuation systems - electrical system - mechanical switches: solid state switches - solenoids - A.C. - D.C Motors - stepper motors. Mechanical actuation systems - Types of motion - Kinematic chains - cams gear trains - ratchet and pawl - belt and chain drives - bearing - mechanical aspects of motor selection.

UNIT II

Introduction to fluid power – advantages and applications – Fluid power systems – Types of fluids - Properties of fluids and selection. Sources of Hydraulic power: Pumping theory-– Pump Classification – Construction, Working and Selection criteria of pumps – Fixed and Variable displacement pumps. Pneumatic and hydraulic actuation systems - directional control valves - pressure control valves - cylinders – cylinder sequencing- process control valves - rotary actuators.

UNIT III

Sensors and Transducers- Performance terminology - static and dynamic characteristics - types - displacement, position and proximity sensors - velocity and motion - fluid pressure - temperature sensors - light sensors - Micro sensors in mechatronics; Signal conditioning- operational amplifier - protection - filtering - wheat stone bridge; digital signals - multiplexers - data acquisitions - data signal processing - pulse modulation.

UNIT IV

Systems and control: Introduction - system representation - Transfer function form - block diagram form - time delays - measurement of system performance - stability - accuracy - transient response - sensitivity. Elementary ideas on control modes, PID controller, digital controller, velocity control, adaptive control – Programmable logic controller, velocity control, adaptive control - Programmable logic controller - basic structure - ladder diagram.

UNIT V

Real time interfacing and advanced application: Real time interfacing with computer - elements of data acquisition and control system - overview of I/O process. Application - Sensors for conditioning monitoring – mechatronics control in automated manufacturing - online quality monitoring - monitoring of manufacturing processes - supervisory control in manufacturing - inspection - integration of heterogeneous system - artificial intelligence in mechatronics.

TEXT BOOKS:

1. Bolton W., "Mechatronics", Pearson Education, 6th Edition, 2015.
2. J.E. Shigley and L.D. Mitchell, *Mechatronics*, *Tata McGraw-Hill*, *1998*

REFERENCE BOOKS:

1. Bradley D.A., Dawson D., Buru N.C. and Loader A.J., "Mechatronics", Chapman and Hall, 1993.
2. Nitaigour Premchand Mahalik, "Mechatronics Principles, Concepts and Applications", McGraw Hill Education, 2015.
3. Devadas Shetty and Richard A. Kolk, "Mechatronics Systems Design", Cengage Learning, 2010.
4. Anthony Esposito, "Fluid Power with Applications", Prentice Hall, 2009.
5. Majumdar, S.R., "Oil Hydraulics Systems - Principles and Maintenance", Tata McGraw-Hill, 2001.

COURSE OUTCOMES:

Upon completing this course, students should be able to:

1. Understand the elements of mechatronic system and select the appropriate actuators.
2. Identify suitable fluid power system to design mechatronics systems.
3. Select sensors and signal condition elements to develop mechatronics systems.
4. Develop the mathematical model of mechanical system and identify suitable controllers.
5. Design and develop new mechatronics control system for different manufacturing processes.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	-	1	1	-	-	-	1	-	-	-	3	1	-
CO2	1	-	3	-		-	-	-	1	-	-	-	2	-	1
CO3	2	1	-	-	3	-	-	-	-	-	-	-	2	-	-
CO4	1	-	3	2	-	-	-	1	3	2	1	-	3	2	1
CO5	3	2	2		-	-	-	2	2	2	1	-	3	2	2

22MMPC305	THERMODYNAMICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn about work and heat interactions, and balance of energy between system and its surroundings
- To learn about application of I law to various energy conversion devices
- To evaluate the changes in properties of substances in various processes
- To understand the difference between high grade and low grade energies and II law limitations on energy conversion

Unit-I: Fundamentals - System & Control volume; Property, State & Process; Exact & Inexact differentials; Work-Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work. Temperature, Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers- Definition of heat; examples of heat/work interaction in systems- First Law for Cyclic & Non-cyclic processes; Concept of total energy E ; Demonstration that E is a property; Various modes of energy, Internal energy and Enthalpy.

Unit-II: First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady I law applications for system and control volume.

Unit-III: Second law - Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale. Clausius inequality; Definition of entropy S ; Demonstration that entropy S is a property; Evaluation of S for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; Determination of s from steam tables- Principle of increase of entropy; Illustration of processes in Ts coordinates;

Unit-IV: Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Compressibility charts- Properties of two phase systems - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables and R134a tables; Saturation tables; Superheated tables; Identification of states & determination of properties, Mollier's chart

Unit-V: Thermodynamic cycles - Basic Rankine cycle; Basic Brayton cycle; Basic vapor compression cycle and comparison with Carnot cycle. Definition of Isentropic efficiency for compressors, turbines and nozzles-Irreversibility and Availability, Availability function for systems and Control volumes undergoing different processes, Lost work. Second law analysis for a control volume. Exergy balance equation and Exergy analysis.

TEXT BOOKS:

1. Engineering Thermodynamics, P.K. Nag, Tata McGraw Hill
2. Thermodynamics –An Engineering Approach –Yunus A Cengel & Michael A Boles

REFERENCE BOOKS:

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of a Thermodynamics, John Wiley and Sons.
2. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India
3. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.
4. Basic and Applied Thermodynamics, P.K. Nag, Tata McGraw Hill.

COURSE OUTCOMES:

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

1. Apply energy balance to systems and control volumes, in situations involving heat and work interactions
2. Evaluate changes in thermodynamic properties of substances
3. Evaluate the performance of energy conversion devices
4. Differentiate between high grade and low grade energies.
5. Learn various thermodynamic cycles

	Mapping with Programme Outcomes												Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	-	-	1	-	2	-	-	-	-	-	2	1	2
CO2	3	3	1	-	-	-	2	-	-	-	-	-	2	3	-
CO3	3	3	2	-	-	-	2	-	-	-	-	-	3	3	-
CO4	3	3	1	-	-	-	2	-	-	-	-	-	3	3	1
CO5	3	3	2	-	-	-	2	-	-	-	-	-	3	3	1

22MMPC306	**METAL CUTTING AND MACHINE TOOLS**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**3**

COURSE OBJECTIVES:

- To identify the necessity of "Manufacturing" define with examples the concepts of manufacturing , machine tool and machining
- To knows the basic concepts of temperature developed during machining
- To give an insight on conventional machining principles and operation
- To understand different types of machine tools and its vibration

Unit I Fundamentals of metal cutting process :

Mechanics of orthogonal and oblique cutting - mechanics of chip formation – types of chips – chip breakers - theories of formation of build up edge and their effect. Various cutting forces, power and specific energy in cutting –numerical problems-temperature in cutting – machinability –tool life –numerical problems -wear and failure –surface finish and integrity ,chip formation in drilling & milling – Cutting tool materials.

Unit-II Thermal aspects in Machining:

Sources of heat generation, Effects of temperature, determination of cutting temperature using analytical and experimental methods; Methods of controlling cutting

temperature. Temperature distribution in tool. Average shear plane temperature, chip – tool interface temperature. Cutting fluids, types, composition, selection

Unit-III Mechanics of multipoint machining processes

Drilling geometry & mechanics of drilling process; Geometry of milling cutters and mechanics of milling process –mechanics grinding (plunge grinding & surface grinding, grinding wheel wear. Cutting tool materials –properties and characteristics of cutting tool materials, indexable inserts, coated tools –geometry of cutting tools –significant of various angles of single point cutting tools –ASA system, ORS (Orthogonal rake system).

UNIT-IV

lathe and its types –constructional details including accessories and attachments , operations, types of lathe –constructional and operational details of shaping –slotting –planning –drilling –boring –reaming –tapping –broaching , Milling operations –indexing –cutters , gear hobbing, bevel gear generator.

UNIT-V Grinding machine;

Grinding operations and applications of surface, cylindrical and centre less grinding, dressing, turning and balancing of grinding wheels –micro finishing –honing , lapping, super finishing –vibration of machining –sources of vibration –semi automatic –automatic machine with a mechanic controls.

TEXT BOOKS:

1. Sharma P.C "A Text book of production Technology". Manufacturing process S. Chand & company Ltd, 7th Edition 2007.
2. P.N Rao, Manufacturing Technology, MC Graw Hill education, New Delhi 2013

REFERENCE BOOKS:

1. Sen G.C and Bhattacharya, A "Principles of machines tools" New central book agency, Calcutta, 2006.
2. R.K Rajput, A Textbook of manufacturing Technology , Laxmi publications, New Delhi, 2015.
3. Kalpakjians and schmid s, "Manufacturing Engineering and Technology", Prentice – Hall of India ; 50th Edition (2006)
4. Bhattacharya, A metal cutting : Theory and practice, New central book Agency, Kolkata 2007.

COURSE OUTCOMES:

At the end of this course, students will able to

1. Asses the mechanics of chip formation and the mechanism of tool wear
2. Appraise the source of heat generation and heat distribution during metal machining
3. Understand the tool geometry of various cutting tools
4. Outline the construction details and functions of metal cutting machine tools
5. Demonstrate need and applications of macro- and micro-finishing

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	2	-	2	1	-	-	-	-	1	1	-	2	1	-
CO2	-	2	-	2	1	-	-	-	-	1	1	-	2	1	-
CO3	-	2	-	2	1	-	-	-	-	-	-	-	2	1	-
CO4	-	2	-	2	1	-	-	-	-	-	-	-	2	1	-
CO5	-	2	-	2	1	-	-	-	-	-	-	-	2	1	-

22MMSP307	ELECTRICAL AND ELECTRONICS LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- To impart hands on experience in verification of circuit laws and measurement of circuit parameters
- To familiarize the students with the functioning of different types of DC, AC machines, their mountings and accessories apart from transformer.
- To study the behavior of AC and DC machines under loading conditions
- To learn the speed control of DC machines.
- To learn the characteristics of electronic devices and their applications

LIST OF EXPERIMENTS

ELECTRICAL ENGINEERING

1. Speed Control of DC Shunt Motor
2. Load Test on DC shunt Motor
3. Load Test on Single phase Transformer
4. Load Test on Three phase Transformer
5. Load Test on Single phase Induction Motor
6. Load Test on Three phase Induction Motor
7. Load Test on Three Phase Alternator

ELECTRONICS ENGINEERING

1. Verification of Ohm's and Kirchhoff's Laws
2. Characteristics of PN diode and Zener diode
3. Half wave and full wave Rectifiers
4. Application of Zener diode as Shunt Regulator
5. Characteristics of Bipolar Junction Transistor

COURSE OUTCOMES

Upon completion of this course, students will be able to

1 Understand the construction, working principles & operations of DC machines and transformers, Induction motors and Alternators.

2 Understand the performance ofelectrical machines under different loading conditions

3 Analyze the characteristics of basic electronic devices.
4 Analyze the circuits by applying basic laws.
5 Employ electronic devices for simple applications.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	2	1
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO3	-	3	-	2	-	-	-	-	-	-	-	-	-	2	-
CO4	-	2	-	-	-	-	-	-	-	-	-	-	-	2	-
CO5	-	2	-	1	-	-	-	-	-	-	-	-	-	2	1

22MMCP308	MANUFACTURING TECHNOLOGY LABORATORY- I	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

- To provide hands an experience on the working of lathes.
- To educate the students on the handling and use of foundry tools
- To provide hands on experience on preparing various types of moulds.

To prepare the part shown in the sketch from mild steel rod on a lathe.

1. Plain turning and step turning
2. Taper turning (Tail stock method & compound rest method)
3. Thread cutting (internal & External)
4. Boring
5. knurling
6. Eccentric turning
7. Groove cutting and angle cutting
8. Dovetail cutting

To prepare sand mould and Hands on experience of listed experiments.

1. Face plate (Solid pattern)
2. Hexagonal nut (Self core solid pattern)
3. Lathe saddle (loose piece pattern)
4. Oil cup (Self core solid pattern)
5. Ball handle (Split pattern)
6. Pipe flange (Split pattern)
7. Pulley (Split pattern)
8. Gear wheel (Solid pattern)

COURSE OUTCOMES:

At the end of this course, students will able to

1. Identify and use the various parts and mechanisms in lathe.
2. Perform various types of turning operations in lathe.
3. Perform operations such as knurling, grooving, boring etc.
4. Differentiate the various types of patterns for casting.
5. Prepare green sand moulding with different types of patterns.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2		-	-	1	-	-	2	-	-	2	3	2	3
CO3	3	2	1	-	-	-	-	-	2	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-		-	-	-	-	-	-
CO5	3	2	2	-	-	1	-	1	2	-	-	2	3	1	3

22MMCP309	MACHINE DRAWING	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

- Students have an ability to apply knowledge of modeling, science & engineering.
- Student can modeled this drawing even in CAD/CAM software by applying the basic knowledge of machine drawing.
- Students will able to demonstrate an ability to design and conduct experiments, analyze and interpret data, assembly and disassembly drawings knowledge will be provided.

Free Hand Sketches

Fasteners: Different form of rivet heads – Single, double riveted lap and butt joints - Foundation bolts - Locking arrangements for nuts - lock nut, split pin, locking plate and spring washer - Stud Set screws – Different forms of machine screws - pan, countersunk, slotted and philip headed screws - Keys - sunk taper key, gib headed taper key, feather key, woodruff key, saddle key.

Orthographic and Assembly Drawings

To draw orthographic views from the given isometric views of simple objects. Detailed assembly drawing and additional views from the given drawing.

(a) Shaft coupling - Protected type and Pin type flexible coupling
(b) Bearings and Supports - Bushed bearing, Foot step bearing and Plummer Block
(c) Eccentric
(d) Steam engine stuffing box
(e) Screw jack.

TEXT BOOKS:

1. Gopalakrishna, K.R., Machine Drawing, Subhas stores, Bangalore.
2. Bhatt, N.D., Machine Drawing, Charotar Publishing House.

REFERENCE BOOKS:

1. Parkinson, A.C. (Sinha), A First Year Engineering Drawing, Wheeler Publishers, New Delhi.
2. Parkinson, A.C., Intermediate Engineering Drawing.
3. Narayana, K.L., Kanniah, P. & Venkata Reddy, K., A Text Book on Production Drawing, Premier Publishing House, Hydrabad.

4. Narayana, K.L., Kanniah, P. & Venkata Reddy, K., Machine Drawing, New Age International (P) Limited, Publishers.
5. Lakshmi Narayanan, V. & Mathur, M.L., A Text Book of Machine Drawing, Jain Brothers Publishers.

COURSE OUTCOMES:

Upon completing this course, students should be able to:

1. apply the knowledge of machine drawing as a system of communication in which ideas are expressed clearly and all information fully conveyed
2. learn the importance of fasteners for various application
3. realize the importance of various views of a component and interpret it
4. gain the ability to understand the design of a system, component or process to meet desired needs within, realistic constraints such as manufacturability, economic, environmental, safety & sustainability etc. to represent a part drawing
5. create detailed assembly drawings

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	-	-	-	-	-	1	-	-	-	3	2	-
CO2	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	1	1	-	-	-	-	-	-	-	-	2	2	2	1
CO4	2	-	2	-	-	-	-	-	1	-	-	2	1	-	-
CO5	2	-	2	-	-	-	-	-	-	-	-	1	1	2	1

S E M E S T E R - IV

22ETBS401	PROBABILITY, RANDOM PROCESSES AND NUMERICAL METHODS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Introduce Probability theory which is helpful in investigating the important features of the random experiment.
- To understand the basic concepts of random processes which are widely used in Electrical fields.
- The aim of theory of sampling is to get as much information as possible of the population to the process of making scientific judgments in the face of uncertainty and variation.
- To develop the skills of the students in finding numerical solution of Interpolation, differentiation and integration problems.
- Provide the study of numerical solution of algebraic and transcendental equations, the numerical solution of ordinary and partial differential equations.

UNIT–I: Probability and Random Variables

Definition – Types of random variables - probability distribution function - probability density function – expectation and moments – moment generating functions –joint probability distribution -marginal probability distribution function – joint probability density function – marginal probability density function – conditional probability density function.

UNIT–II: Random Processes

Classification of random processes – methods of description of a random process – special classes of random processes – Average values of random process - stationary – Autocorrelation function and its properties - cross correlation function and its properties.

UNIT–III: Test of Significance

Hypothesis, testing – Large sampling tests – small sampling test based on t, F and chi-square distributions – interval estimates of mean, standard deviation and proportion.

UNIT–IV: Interpolation, Numerical Differentiation and Integration

Interpolation: Gregory Newton forward and backward interpolation formula; Stirling's central difference formula; Lagrange's interpolation formula for unequal interval. Numerical differentiation: Using Newton's forward and backward interpolation formula. Numerical integration: Trapezoidal rule, Simpson's one-third and three-eight rules.

UNIT–V: Solution of Algebraic, Transcendental and Ordinary Differential Equations

Solution of algebraic and transcendental equations: Bolzano's bisection method, Regula-falsi method, Newton – Raphson method.

Solution of simultaneous algebraic equation: Gauss elimination method, Crout's method, Gauss – Seidel iteration method.

Solution of ordinary differential equations: Taylor series method, Runge–Kutta fourth order method, Milne's - Predictor corrector method.

TEXT BOOKS:

1. Kandasamy, P., Thilagavathy, K., and Gunavathy, K., Probability and Random Processes, S.Chand& Co. Ltd. 2006, New Delhi.
2. Venkataraman, M.K., Numerical methods in Science and Engineering, National Publishing Co., Chennai - 2003.

REFERENCE BOOKS:

1. Lipschutz, S., and Schiller, J., Schaums‟s Outlines – Introduction to Probability and Statistics, McGraw Hill, New Delhi, 1998.
2. Veerarajan, T., Probability theory and Random Process, Tata McGraw Hill Co., Ltd., New Delhi, 2005
3. Kandasamy, P., Thilagavathy, K. and Gunavathy, K., Numerical Methods, S.Chand& Co. Ltd., New Delhi, 2004.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

1. Acquire skills in handling situations involving random experiments.
2. Familiarize the concept of random processes.
3. Understand the basic concepts of theory of sampling to any collection of individuals of their attributes can be numerically specified.
4. Ability to solve problems algebraic transcendental equations and numerical integration.
5. Able to obtain numerical solution of ordinary and partial differential equations.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	-	-	-	-	-	-	-	2	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	-	2	-	-
CO3	3	3	2	2	-	-	-	-	-	-	-	-	2	-	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-	2	-	-
CO5	3	3	3	2	-	-	-	-	-	-	-	-	2	-	-

22MMPC402	INDUSTRIAL MANAGEMENT AND ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce students various Industrial Engineering and Management concepts.
- To provide an understanding of the systematic approaches of various management functions.
- To enhance the management skills through the application of appropriate techniques.

UNIT I

Engineering Economics - nature and scope of managerial economics – basic economic tools in managerial economics - decision and efficiency analysis. Consumer behaviour - law of demand and supply - elasticity - determinants - uses. Pricing under different market conditions: Monopoly - monopolistic competition - oligopoly, pricing policies - Porter's five forces - model of competition. Financial markets: Primary and secondary markets - money market instruments - capital. market instruments. National income - concepts. Trade and development: Free trade versus protection - balance of payments - globalisation - W.T.O.

UNIT II

Organizational Components to be Managed - Individual Behaviour: Governing factors -Determinants of personality . Motivation – Importance – Theories: Maslow's Theory of Need Hierarchy - Theory X and Theory Y - techniques of motivation. Job satisfaction – Governing factors – Effects.Group Dynamics - Development of Inter- personal Relationship.Group Behaviour -Group cohesiveness.Conflict - Functional and Dysfunctional Conflict - Conflict resolution model.Stress – Sources – Management of Stress. Leadership – Types – Theories:Hersey and Blanchard's situational leadership model - Path-Goal theory

UNIT III

Principles of Management - Functions of management - Scientific management: Contributions of Taylor, Gilberth, Gantt- Forms of business organisation - line, functional, line and staff organisations - Industrial ownership: single, partnership, joint stock company, co- operative organisations, state and central government owned. Costing: Objectives - Elements of costs - estimation of selling price – simple problems, Allocation of overheads.

UNIT IV

Break-even analysis - concept and applications - Depreciation - straight line and declining balance method.

Plant Location: Influencing factors. Location models – Breakeven analysis – Qualitative factor rating Method.

Plan Layout: Layout Objectivess – Types of Layout – Load distance analysis – Muthur grid technique. Concept of Line balance – Largest candidate rule.

UNIT V

Method Study: Objectives and procedure for methods analysis, Recording techniques, Operations Process Chart, Flow Process Chart, Man-Machine chart , Multiple Activity Chart, and Two Handed process chart, String Diagram, Therbligs, Micro motion and macro-motion study: Principles of motion economy.

Work Measurement: Objectives, Work measurement techniques – time study, work sampling -Determination of time standards- Observed time, basic time, normal time, rating factors, allowances, and standard time.

TEXT BOOKS:

1. Kumar. B., "Industrial Engineering", Khanna Publications, 1995.
2. M. Govindarajan and S.Natarajan, Principles of Management, Prentice Hall of India Pvt. Ltd. New Delhi, 2007.
3. Jain, S.K., "Applied Economics for Managers and Engineers", Vikas Publishers, 1997.

REFERENCE BOOKS:

1. Herald Koontz and Heinz Weihrich, "Essentials of Management", McGraw Hill Publishing Company, Singapore International Edition, 1980.
2. "Mechanical Estimating and Costing", TTTI Madras, Tata McGraw Hill,2003.
3. Mehta P.L., "Managerial Economics", Sultan Chand & Sons, 1995.
4. Vaish M.C., "Money, Banking, Trade and Public Finance", New Age International (P) Ltd., 1996.
5. Ties, AF, Stoner and R. Edward Freeman, "Management", Prentice Hall of India Pvt. Ltd. New Delhi, 1992.
6. Chandran, S., "Organizational Behaviors", Vikas Publishing House Pvt. Ltd, 1994.
7. Jain. S.K., Applied Economics for Managers and Engineers, Vikas Publishers, 1997.

COURSE OUTCOMES:

Upon completing this course, students should be able to:

1. Recognize the factors such as demand and production for pricing criteria
2. Employ the effective interpersonal, team building and leadership skills
3. Improve the organizational performance through the effective management of human resources
4. Gain Knowledge on the applications of various Industrial Engineering Techniques
5. Apply the concepts of Method Study and Time study.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	1	2	1	-	-	2	1	-	-	-	-	-	1
CO2	2	1	-	-	-	1	3	2	-	-	1	-	2	-	-
CO3	3	2	-	-	1		1		1	-	1	1		2	2
CO4	2	2	2	2	-	-	-	1	-	-	-	1	2	-	-
CO5	3		1	2	-	-	-	2	1	-	-	-	2	-	-

22MMPC403	**MECHANICS OF MACHINES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the kinematics and rigid- body dynamics of kinematically driven machine
- components
- To understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link
- To be able to design some linkage mechanisms and cam systems to generate specified output motion

UNIT-I

Classification of mechanisms-Basic kinematic concepts and definitions-Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider crank chains-Limit positions-Mechanical advantage-Transmission angle-Description of some common mechanisms-Quick return mechanism, straight line generators-Universal Joint-Rocker mechanisms

UNIT-II

Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations kinematic analysis of simple mechanisms- slider crank mechanism dynamics-Coincident points-Coriolis component of acceleration- introduction to linkage synthesis- three position graphical synthesis for motion and path generation

UNIT-III

Classification of cams and followers-Terminology and definitions-Displacement diagrams- Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers Surface contacts- sliding and rolling friction- friction drives- bearings and lubrication- friction clutches- belt and rope drives- friction in brakes

UNIT-IV

Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm,

rack & pinion gears, epicyclic and regular gear train kinematics. Governors – Watt, Porter, Hartnell and Proell

UNIT-V

Elementary insights of vibrations – Free , forced and damped (Theory Only) Balancing of rotating masses – single rotating mass by single mass in same and different planes (Simple problems only) Balancing of reciprocating masses – Primary and secondary forces – swaying couples and hammer blow (Theory Only)

TEXT BOOKS:

1. Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers & Distributors, 2005.
2. Cleghorn W.L. , Mechanisms of Machines, Oxford University Press, 2005.

REFERENCE BOOKS:

1. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw Hill, 2009.
2. Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, Affiliated East-West Pvt. Ltd, New Delhi, 1988.

COURSE OUTCOMES:

Upon completion of the course, students can ale to

1. Design various types of linkage mechanisms
2. Determine specific motion and analyze them for optimal functioning
3. Learn the significance of cam and followers
4. Learn the basics of governers
5. Understand the need for balancing

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	-	-	-	-	-	-	-	3	-	2	-	-	1	-
CO2	3	3	-	-	1	1	-	-	1	-	-	1	2	-	-
CO3	2	-	-	1	-	1	2		1	-	-	1	-	2	-
CO4	3	-	-	2	-	-	-	-	-	-	2	-	3	-	-
CO5	2	1	-	-	2	-	-	-	-	-	1	-	-	-	1

22MMPC404	**METROLOGY AND MEASUREMENTS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To impart knowledge on importance of Measuring instruments in Manufacturing Industry.
- To give depth education on Linear and Angular Measuring instruments
- To teach information on measurement of screw threads and surface finish equipment the various methods of measuring mechanical parameters
- To instruct about the measurement of Power, Flow and temperature.
- To impart realization of Laser based Precision instruments and Machine Vision system.

UNIT I

General concept - Generalized measurement system - Units and standards - Measuring instruments: sensitivity, stability, range, accuracy and precision - static and dynamic response - repeatability - systematic and random errors - correction, calibration - Introduction to Dimensional and Geometric Tolerancing - interchangeability.

UNIT II

Definition of metrology - Linear measuring instruments: Vernier, micrometer, Slip gauges and classification, -Tool Maker's Microscope-interferometer, optical flats,- Comparators: limit gauges Mechanical, pneumatic, electrical and differential comparators - applications. Angular measurements: Sine bar, Sine center, bevel protractor, Auto Collimators and Angle Decker.

UNIT III

Measurement of screw threads: Thread gauges, floating carriage micrometer- Measurement of gear tooth thickness: constant chord and base tangent method - Gleason gear testing machine - Radius measurements - surface finish: equipments and parameters, straightness, flatness and roundness measurements.

UNIT IV

Measurement of force, torque, power: - mechanical, pneumatic, hydraulic, electrical types and Strain gauges - Pressure measurement – Flow measurement: Venturi, orifice, rotameter, pitot tube – Temperature measurement: bimetallic strip, thermocouples, pyrometer, electrical resistance thermistor and Alignment tests for machine tools.

UNIT V

Precision instruments based on laser - Principles-laser interferometer - application in measurements and machine tool metrology - Coordinate Measuring Machine (CMM): Need, construction, types, applications. In process control with computer aided inspection - Machine vision system - fundamentals and applications.

TEXT BOOKS:

1. Jain, R.K., "Engineering Metrology", Khanna Publishers, 2005.
2. Alan, S., Morris, "The Essence of Measurement", Prentice Hall of India, 1997.

REFERENCE BOOKS:

1. Gupta, S.C., "Engineering Metrology", Dhanpatrai Publications, 2005.
2. Jayal, A.K., "Instrumentation and Mechanical Measurements", Galgotia Publications, 2000.
3. Beckwith, Marangoni, and Lienhard, "Mechanical Measurements", Pearson Education, 2006.
4. Donald Deckman, "Industrial Instrumentation", Wiley Eastern, 1985.

COURSE OUTCOMES:

Upon completing this course, students should be able to:

1. Understand the basics of measurements and know various linear, angular, form measuring equipments- their principle of operation and applications.
2. Select appropriate measuring instrument by differentiating Linear and Angular measurements.

3. Know about measurement of gear tooth thickness and .working principle of Gleason gear testing machine.
4. To acquire education on Measurement of force, torque, power along with alignment test of machine tools
5. To expertise on principles of Laser Interferometer and its applications in application in measurements and machine tool metrology.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-		-	2	-	-
CO2	3	-	-	-	-	-	-	-	-	-	1	-	2	-	1
CO3	1	-	-		-	-	-	-	1	-	-	-	-	2	
CO4	3	-	-	2	-	-	-	-	1	-	-	2	2	-	2
CO5	2	-	-	2	-	-	-	-	-	-	-	-	2	-	-

22MMPC405	METAL JOINING AND NON-DESTRUCTIVE TESTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the different types of welding
- Analyze the parameters that influences welding
- Understand the application of various welding processes
- The mechanism involved in their NDT techniques
- Applications of NDT and recent trends in NDT

UNIT-I

Basics of arc welding processes - Classification of welding and allied Processes - Welding arc: physics involved in arc, structure and characteristics, arc efficiency calculation, methods of arc initiation and maintenance, arc stability, arc blow - V-I characteristics, constant current and constant voltage characteristics, duty cycle.
Arc Welding Power Sources: welding transformers, generators, rectifiers, inverters; Classification of electrodes - Metal Transfer: forces affecting metals transfer - modes of metal transfer.

UNIT-II

Arc welding processes-Basic principles, Process variables, Chief characteristics and applications of the following processes: Shielded(Manual) Metal Arc Welding (SMAW/MMAW) - Submerged Arc Welding (SAW), Gas Tungsten Arc Welding (GTAW), Gas Metal Arc Welding (GMAW), CO2 welding, Flux cored Arc Welding (FCAW), Electro Slag and Electro Gas Welding - Atomic Hydrogen Welding.

UNIT-III

Resistance welding processes Basic principle, Process variables, Welding Sequence, Process characteristics and applications of the following processes: Spot welding, simple problems - Seam welding - Projection welding - Percussion welding - Resistance Butt welding - Flash Butt welding - High Frequency Resistance Welding (HFRW) and High Frequency Induction Welding (HFIW).

UNIT-IV

Liquid penetrant systems – processing cycles – inspection of surface defects – Generation of Magnetic fields – Magnetic particle inspection equipments – Demagnetization – Applications and limitations. Production of x-rays – Characteristic rays and white ray – Tube current and Voltage – Sources of rays – Half life period – Penetrating power – Absorption of x and y rays – Radiation contrast and film contrast – exposure charts – pentameters and sensitivity – Safety.

UNIT – V

Production of ultrasonic waves – Different types of waves – normal beam inspection – Angle beam inspection – thickness measurements – Applications. Non destructive inspection– Instrumentation for non destructive testing – Principles of holography-Principle of acoustic emission – Applications of holographic techniques– advantages and limitations – Other techniques.

TEXT BOOK:

1. Parmar, R.S., "Welding Processes and Technology", Khanna Publishers, New Delhi, 2007.
2. Prasad, J., and Nair, C.G.K., "Non-Destructive Test and Evaluation of Materials", Tata McGraw-Hill Publishers, New Delhi, 2011.
3. Barry Hull and Vernon John, "Non Destructive Testing", MacMillan, 1988.

REFERENCE BOOKS:

1. Nadkarni, S.V., "Modern Arc Welding Technology", Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi, 1996.
2. Khanna, O.P., "Welding Technology" Dhanpat Rai & Sons Publishers, New Delhi, 1993.
3. Little, R.L., "Welding and Welding Technology", Tata McGraw Hill Publishing Company Limited, New Delhi, 1990.
4. Proceedings of the 10th International Acoustic Emission Symposium, Japanese Society for Non Destructive Inspection, Sendai, 1990
5. Holler, P., "New Procedures in Non Destructive Testing" Springer Verlag, 1983

COURSE OUTCOMES:

Upon completing this course, students should be able to:

1. Understand the physics behind welding arc and heat flow equations.
2. Distinguish between fusion welding processes.
3. Select appropriate welding process for joining specific materials.
4. Inspect welding defects using Non-destructive testing methods.
5. Understand the environmental issues and safety requirements for each processes.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	1	-	-	-	-	-	-	-	-	-	3	2	-
CO2	3	-	2	-	1	-	-	-	-	-	-	-	3	1	2
CO3	-	-	2	-	3	-	-	2	-	-	-	-	3	2	-
CO4	2	-	-	3	-	-	-	-	-	-	-	1	2	1	-
CO5	2	-	-	-	1	-	-	-	-	3	-	-	-	2	3

22MMPC406	METAL CASTING TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge about basic principles and foundry operations in metal casting
- To give introduction to various types of casting process, principles and application
- To provide knowledge on design of gating system and risers for manufacturing of defect free sand casting

UNIT I

Metals cast in the foundry- Ingot casting; Continuous casting and Shape casting- Factors determine the selection of a casting alloy--Patterns: Definition, classification, materials used for pattern, various pattern allowances and their importance-

Types of base sand, requirement of base sand. Binder, Additives definition, need and types; preparation of sand moulds- Green sand, core sand, dry sand. Moulding machines- Jolt type, squeeze type and Sand slinger.

Core definition, need, types. Method of making cores. Defects in casting: Causes and remedies

UNIT II

Purpose of the gating system. Components of the gating System and its functions. Design of the gating System. Different types of gates. Gating ratio and its functions. Definition and functions of the riser. Types of risers and their application. Design of the riser - its shape. Size and location. Use of insulating material and exothermic compounds in risers.

UNIT III

Melting furnaces for ferrous and non-ferrous metals Electric and fuel fired furnaces. Induction Furnaces; constructional features & working principle of cupola furnace

Melting practices; Fluxing, inoculation, degassing and grain refinement treatments. Control of pouring temperature

Foundry Mechanisation: Moulding- Core Making Sand Conditioning- Removal of Moulds- Pouring Methods- Shake out- Core Cleaning, Fettling, and Handling

UNIT IV

Concept of solidification of metals. Homogenous and heterogeneous nucleation. Growth mechanism. Solidification of pure metals and alloys. Mechanism of columnar and dendritic growth. Solidification time and Chvorinov's rule. Concept of progressive and directional solidifications

Testing: Sand Testing, Moulding Testing- Testing of Casting- Instrument Sand Equipments used for Testing and Inspection

UNIT V

Shell moulding, Plaster Mould casting, Carbon dioxide moulding Squeeze casting, Investment Casting, Die-casting, Pressure die casting Centrifugal casting, Stir casting slush casting, Thixocasting, and continuous casting processes.- Fundamental principles, production techniques, characteristics and its applications.

TEXT BOOKS:

1. Jain .P.L., "Principle of Foundry Technology", Tata McGraw Hill ,4th edition, 2004.

2. John K.C, Metal casting and Joining, PHI publications, 2015.

REFERENCE BOOKS:

1. P.N. Rao, Manufacturing Technology: Foundry, Forming and Welding, Volume I, 4th Edition, McGraw Hill, 2013.
2. Heine, R.W.,CarlLoper, and Rosenthal, P.C., Principles of Metal Casting, Tata McGraw Hill Pub. Co. Ltd., 2nd Edition,2008
3. Raghavan, V., "Materials Science & Engineering", Prentice Hall of India Pvt.Ltd, 2015
4. Ramana Rao, T. V., Metal Casting – Principles and Practice, New Age International Pvt. Ltd. (2003).
5. Srinivasan, N.K., Foundry Technology, Khanna Pub., 3rd Edition, 2009.

COURSE OUTCOME:

1. Understand the process of Pattern making, Moulding and core making
2. Design gating and riser system needed for defect free casting
3. Select suitable melting techniques and practices for ferrous and non ferrous castings
4. Analyze the thermal, metallurgical aspects during solidification in casting and their role on quality of cast objects
5. Understand the various metal casting processes and their applications

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	-	1	-	-	-	2	3	1	-	1	1	2	-
CO2	1	3	3	2	-	-	2		3	1	-	3	1	3	-
CO3	3	2		3	2	-	2	2	3	2	-	3	1	3	-
CO4	3	3	2	1	-	-	-	2	3	1	-	2	1	-	2
CO5	1	-	2	3	2	-	2	3	3	1	-	2	1	-	2

22MMHS407	**UNIVERSAL HUMAN VALUES**	**L**	**T**	**P**	**C**
		2	**1**	**0**	**3**

COURSE OBJECTIVES:

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence.
- Strengthening of self-reflection.
- Development of commitment and courage to act.

UNIT-I Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

Purpose and motivation for the course, recapitulation from Universal Human Values-I. - Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration - Continuous Happiness and Prosperity- A look at basic Human Aspirations - Right understanding, Relationship and Physical Facility- the basic requirements for fulfillment of aspirations of every human being with their correct priority - Understanding Happiness and Prosperity correctly- A critical

appraisal of the current scenario - Method to fulfill the above human aspirations: understanding and living in harmony at various levels - Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking

UNIT-II Understanding Harmony in the Human Being - Harmony in Myself!

Understanding human being as a co-existence of the sentient 'I' and the material 'Body' - Understanding the needs of Self ('I') and 'Body' - happiness and physical facility - Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer) - Understanding the characteristics and activities of 'I' and harmony in 'I' - Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of - Physical needs, meaning of Prosperity in detail - Programs to ensure Sanyam and Health - Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs. dealing with disease

UNIT-III Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship - Understanding the meaning of Trust; Difference between intention and competence - Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship- Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals - Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family - Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives

UNIT-IV Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

Understanding the harmony in the Nature - Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self- regulation in nature- Understanding Existence as Co-existence of mutually interacting units in all-pervasive space - Holistic perception of harmony at all levels of existence - Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

UNIT-V Implications of the above Holistic Understanding of Harmony on Professional Ethics

Natural acceptance of human values - Definitiveness of Ethical Human Conduct - Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order - Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people- friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems - Case studies of typical holistic technologies, management models and production systems -

Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations Sum up- Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. to discuss the conduct as an engineer or scientist etc.

TEXT BOOKS:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

REFERENCE BOOKS:

1 Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2 Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3 The Story of Stuff(Book).
4 The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5 Small is Beautiful - E. F Schumacher.
6 Slow is Beautiful - Cecile Andrews
7 Economy of Permanence - J CKumarappa
8 Bharat Mein Angreji Raj - PanditSunderlal
9 Rediscovering India - by Dharampal
10 Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11 India Wins Freedom - Maulana Abdul Kalam Azad
12 Vivekananda - Romain Rolland (English)
13 Gandhi - Romain Rolland (English)

COURSE OUTCOMES:

At the end of this course, students will able to

1 Analyze the essentials of human values and skills, self-exploration, happiness and prosperity.
2 Evaluate coexistence of the "I" with the body.
3 Identify and evaluate the role of harmony in family, society and universal order.
4 Find the holistic perception of harmony at all levels of existence.
5 Develop appropriate technologies and management patterns to create harmony in professional and personal lives

	Mapping with Programme Outcomes												Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	-	-	-	3	-	-	-	1	-	-	1
CO2	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1
CO3	-	-	-	-	-	2	1	-	-	-	-	-	-	-	1
CO4	-	-	-	-	-	2	2	-	-	-	-	1	-	-	1
CO5	-	-	-	-	-	2	2	3	-	-	-	1	-	-	1

22MMCP408	MANUFACTURING TECHNOLOGY LABORATORY-II	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

- To impart practical skills on the operation of milling, grinding machines.
- To provide hands an experience in the generation of gears and various shapes using milling and slotting machines.
- To make the students to understand the procedure of cutting force measurements in milling and grinding.

Special Machine laboratory

1. Machining a straight tools clutch milling (3and 4 dog)
2. Machining of T-slot using milling machine.
3. Machining a polygon, hexagonal head showing sketch on the specimen
4. Machining a keyway, convex, concave by using slotter machine
5. Various gear cutting using milling and gear hobbing machine.
6. Grinding of single point cutting'
7. Surface grinding &estimate surface roughness.
8. Estimation of cutting force during milling
9. Estimation of cutting force during grinding

Metal joining

1. Study of welding symbols and fabrication of various joints (Butt , Lap, Corner &fillet)
2. Effect of metal transfer modes of MIG welding
3. Effect of electrode polarity on bead Geometry
4. Analysis of temperature distribution during welding process
5. Performance evaluation of various welding power sources
6. Effect of pulsing current on bead geometry.
7. Evaluation of tensile properties of welded joints (flat specimen)

COURSE OUTCOMES:

At the end of this course, students will able to

1. Operate machines such as shaping, milling grinding, slotting etc.
2. Calculate the parameters for gear manufacturing and generate gears.
3. Estimate the cutting forces in drilling and grinding.
4. Fabricate different types of joints.
5. Evaluate the effects of various welding permanents bond power sources.

	Mapping with Programme Outcomes												Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	-	-	-	1	-	1	-	-	-	3	-	3
CO2	3	1	1	-	-	-	1		1	-	-	1	3	-	3
CO3	3	2	1	1	-	-	1		1	-	-	-	2	-	3
CO4	3	2	1	-	-	-	1		1	-	-	-	2	1	2
CO5	3	2	2	-	-	-	1		1	-	-	1	3	1	2

22MMCP409	THERMODYNAMICS LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

The main learning objective of this course is to provide hands on training to the students in:

- Predicting the thermal conductivity of solids and liquids.
- Estimating the heat transfer coefficient values of various fluids.
- Testing the performance of tubes in tube heat exchangers.

LIST OF EXPERIMENTS:

1. To study low pressure boilers and their accessories and mountings.
2. To study high pressure boilers and their accessories and mountings.
3. To find the condenser efficiencies.
4. To study cooling tower and find its efficiency.
5. To find calorific value of a sample of fuel using Bomb calorimeter.
6. Calibration of Thermometers and pressure gauges.
7. To study and find volumetric efficiency of a reciprocating air compressor.
8. To find dryness fraction of steam by separating and throttling calorimeter.
9. To find power out put & efficiency of a steam turbine.
10. To study the working of impulse and reaction steam turbines

LIST OF EQUIPEMENTS:

1. Model of Cochran and Lancashire Boiler
2. Model of Babcock & Wilcox Boiler
3. Model of Impulse and Reaction steam turbines
4. Cooling Tower set up
5. Two Stage Air Compressor with test rigs

COURSE OUTCOMES:

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

1. Identify and suggest boilers for application environment.
2. Predict the efficiency of the condensers and cooling towers.
3. Analytically predict the efficiency of compressor..
4. Suggest a better turbine with its working efficiencies.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	-	-	1	2	-	-	-	-	2	1	2
CO2	3	3	2	-	-	-	1	2	-	-	-	-	2	1	2
CO3	3	3	2	-	-	-	1	2	-	-	-	-	2	1	2
CO4	3	3	2	-	-	-	1	2	-	-	-	-	2	1	2
CO5	3	3	2	-	-	-	1	2	-	-	-	-	2	1	2

SEMESTER V

22MMPC501	ENGINEERING MATERIALS AND METALLURGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To impart fundamental knowledge on the structure, properties, heat treatment, testing and applications of metallic and non-metallic materials used in engineering applications.

UNIT I

Unit cell, Crystal systems, BCC, FCC & HCP structures, Crystallographic planes & direction, Miller indices, Crystal imperfections - point, line & area defects. Constitution of alloys, compounds & solid solutions, Gibbs phase rule, lever rule. Phase diagrams: eutectic, peritectic, eutectoid and peritectoid reactions - Metallography - metallurgical microscope - preparation of specimen, micro & macro examination. Grain size ASTM grain size number, grain size measurement methods.

UNIT II

Iron-Iron Carbon Diagram, Isothermal transformation diagram, Time Temperature Transformation Diagram, Continuous cooling transformation diagrams, Heat Treatment Methods: full annealing, stress relief annealing, spheroidzing, normalizing, Hardenability and Jominy end quench test, Case hardening: carburising, nitriding, cyaniding, and carbon nitriding, flame hardening, induction hardening, vacuum hardening and cryogenic treatment- Precipitation and Age hardening

UNIT III

Classification of steels - Plain carbon steels - effect of C, Mn, Si, P & S. Purpose of alloying, effect of important alloying elements. - Important low alloy steels, stainless steel, tool steels - types, compositions and applications; Cast iron - types, composition and applications. Non ferrous metals: Physical, Mechanical, Metallurgical properties of Aluminum alloys, Magnesium alloys, Copper alloys, Nickel alloys and Titanium alloys – Classification of these alloys and applications..

UNIT-IV

Polymers – types of polymers, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS,PAI, PPO, PPS, PEEK, PTFE, Thermo set polymers – Urea and Phenol formaldehydes; Engineering Ceramics – Properties and applications of Al_2O_3, SiC, Si_3N_4, PSZ and SIALON; Introduction to Composite Materials: MMC, PMC, CMC and Hybrid Composites- Applications of Composite Materials.

UNIT V

Mechanical behaviour of materials: Tensile behaviour: engineering stress, engineering strain, true stress, true strain, Stress – strain curve, Yield point phenomenon, strain aging. Impact Toughness behaviour: Charpy and Izod impact testing, DBT curve. Hardness: Brinell hardness, Rockwell hardness, micro hardness testing; Fatigue behaviour: Stress cycles, S-N curves, fatigue crack initiation, fatigue crack propagation; Creep behaviour: creep curve, creep mechanisms, deformation mechanism maps.

TEXT BOOKS:

1. Sydney, H., Avner, S.H., "Introduction to Physical Metallurgy", McGraw Hill Book Co., 2008.
2. Higgins, R.A., "Engineering Metallurgy - Part I, Applied Physical Metallurgy", ELBS., 1993.
3. William D Callister, "Material Science and Engineering", Wiley India Pvt. Ltd, Revised Indian edition, 2007.

REFERENCE BOOKS:

1. Raghavan, V., "Introduction to Physical Metallurgy", Prentice Hall of India Pvt.Ltd, 2015.
2. George E. Dieter., "Mechanical Metallurgy", McGraw Hill Book Company, New York, 1988.
3. Rollason, E.C., "Metallurgy for Engineers", Butterworth-Heinemann Ltd, 4 th Revised edition, 1987.
4. Kenneth G.Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint 2002.

COURSE OUTCOMES:

Upon completing this course, students should be able to:

1. Understand the configuration of materials structure and characteristics;
2. Design heat treatment methods for specific applications;
3. Develop knowledge on metals and alloys;
4. Select the appropriate materials for specific applications;
5. Evaluate the mechanical properties of materials by modern tools and equipments.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	-	-	-	-	-	-	1	-	-	2	1	2	-
CO2	-	2	3	-	1	-	-	-	-	-	-	-	2	3	-
CO3	2	3	1	-		-	-	-	-	3	-	-	1	2	-
CO4	-	-	2	-	3	-	-	-	-	1	-	-		2	1
CO5	2	-	-	3	3	-	-	-	1	-	-	-	3	-	-

22MMPC502	**STRENGTH OF MATERIALS**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

COURSE OBJECTIVES:

- To gain knowledge of simple stresses, strains and deformation in components due to external loads.
- To assess stresses and deformations through mathematical models of beams, twisting bars or combinations of both.
- To study the effect of component dimensions and shape on stresses and deformations are to be understood.
- The study would provide knowledge for use in the design courses

UNIT I

Define of stress – types of stresses: Direct stress (Tensile and compressive), Bending stress, Shear stress, temperature stress, composite stress – Strains: Linear strain, lateral strain, volumetric strain, temperature strains- Hook‟s Law- modulus of elasticity- Axial rigidity Flexural rigidity – Torsional rigidity- Poison's ratio, stress versus strain diagrams for concrete, timber, mild steel sections, HYSD (High Yield Strength Deformed) bars. Elastic constants relationship- simple problem-Bending stress and strain variations for rectangular sections-Shear stress variations for rectangular sections.

UNIT II

Stain Energy-stain Energy stored in an elastic body due to axial force- Strain Energy stored in an elastic body due to bending – Strain Energy stored in an elastic body due to shear – Strain Energy stored in an elastic body due to torsion- Strain Energy stored in an elastic body due to gradually applied loads - Strain Energy stored in an elastic body due to suddenly applied loads or impact load-Stress at a point – stress tensor- Equations of Equilibrium-Uniaxial state of stress-Stresses on a plane-Transformation of plane stress- Principle stresses and maximum shear stress-Mohr's Circle for plane stress.

UNIT III

Loads: Gravity and lateral loads, concentrated loads, uniformly distributed loads, Beams: Cantilever beams, simply supported beams, single and double over hanging beams support Conditions: removed hinged support, Roller support and load and reactions –Bending moments and shear force diagrams-points of contra flexure-Variation of bending stress for rectangular and circular sections-section modulus-neutral axis- Moment resistance. Simple bending Theory (Euler Bernoulli Theory) – Deflection of determinative beams-Strain Energy methods-Double Integration Methods-Macaulay‟s Methods.

UNIT IV

Torsion-Theory of pure torsion in circular shafts-Variation of shear stress distribution across the solid (Circular), Hollow (Circular), and thin walled sections-saint venant's torsion warping torsion- Torque transmitted in circular and hollows shaft Spring-stiffness-linear stiffness and rotary stiffness-types: Helical (Open coiled, close coiled) and leaf spring uses – spring in series and – spring in parallel – load versus deformation, Stiffness and shear stress. – Automobile springs.

UNIT V

Simple machines-inclined plane- Law machine-Effort and load lifted- Mechanical advantages and Efficiency- Ideal machine-Levers – Wedges-screw jack-Gears- Belts pulleys-wheel and Axle-Differential pulleys-Worm and wheel-Handle winch.

TEXT BOOKS:

1. Bansal. R.K., "A Text Book on Engineering Mechanics", Lakshmi Publications, New Delhi, 2005.
2. Sadhu Singh. P., "Strength of Materials", Khanna Publishers. 1990.

REFERENCE BOOKS:

1. Timoshenko, S., and Young, D.H., "Strength of Materials", East west Press New Delhi, 1968.
2. Rajput, R.K., "Strength of Materials", S. Chand Company, New Delhi, 1999.

3. Nash, W.A., “Strength of Materials”, Schaums series - McGraw-Hill Publishing company, 1989.
4. Ramamrutham, S., “Strength of Materials”, Dhanpat Rai and sons, New Delhi, 1986.

COURSE OUTCOMES:

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

1. Develop knowledge on identifying stress, strain and their effects
2. Understand the theory of various types of loading systems
3. Critically analyses components like beams and twisting bars
4. Understand theories on columns and springs
5. Employ all the knowledge gained in designing of machine components.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	-	-	2	-	-	-	-	-	-	1	2	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-	2	3	-
CO3	-	3	2	-	-	-	-	-	-	-	-	1	1	3	-
CO4	3	1	-	-	2	-	-	-	-	-	-	-	-	2	-
CO5	-	-	1	-	3	-	-	-	-	-	-	2	3	-	1

22MMPC503	**FLUID MECHANICS AND HYDRAULICS MACHINERY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

To provide fundamental knowledge of fluids, its properties and behaviour under various conditions and to apply hydrostatic law, principle of mass and momentum in fluid flows, concepts in Euler’s and Bernoulli equations.

- To determine the losses in a flow system, flow through pipes, boundary layer concepts and to understand the importance of dimensional analysis.
- To understand the basic principles of hydraulic machineries and the importance of various types of flow in pumps and turbines

UNIT I - Properties of Fluid

Introduction to fluid mechanics - Real and ideal fluids – Properties of fluid – Pressure in a fluid – Pressure measurements – Manometers – Hydrostatic forces on surfaces - Total pressure and Centre of pressure on different surfaces – Buoyancy and floatation – Metacentre.

UNIT II - Flow Characteristics and Flow Through Pipes

Types of fluid flows and flow patterns - General Continuity Equation – Euler's equation - Bernoulli's equation and its applications. (Orifice meter, Venturimeter and Pitot tube). Flow through pipes – Major Energy losses - Darcy Weisbach equation and chezy’s formula – Minor Energy losses due to sudden Expansion and Contraction of pipe

UNIT III - Boundary Layer Flow and Dimensional Analysis

Boundary layer – laminar and turbulent boundary layer – Boundary layer thickness – Types. Dimensional Analysis – Rayleigh’s and Buckingham’s π -theorem – Dimensionless

Parameters – Reynold's number, Froude's number, Weber's number, Euler's number and Mach's number.

UNIT IV - Turbines

Impact of jet on a Stationary, Moving and Curved blades. Classification of Turbines - Impulse and Reaction turbines – Pelton wheel – Velocity diagram for Impulse Turbine – Hydraulic, Mechanical and Overall efficiency – Reaction Turbines – Francis and Kaplan turbine – Velocity diagrams – Draft Tubes – Specific Speed – Cavitation.

UNIT V - Pumps

Centrifugal Pump – Casing types – Velocity diagrams - Work done by the Impeller – Heads and Efficiencies – Minimum speed for starting a pump – Specific Speed. Reciprocating Pump – Slip and Co-efficient of Discharge – Indicator Diagram – Work saved by fitting Air Vessels.

TEXT BOOKS:

1. Bansal, R.K., "A Text Book of Fluid Mechanics and Hydraulic Machinery", Lakshmi Publications, Chennai, 2017.
2. Modi, P.N., Seth S.M, "Hydraulics and Fluid Mechanics", Standard Book House, NewDelhi, 2017.

REFERENCE BOOKS:

1. Khurmi, R.S., "Fluid Mechanics and Hydraulics Machinery", S. Chand and Co. New Delhi, 2000.
2. Jagdish Lal, "Fluid Mechanics and Hydraulics Machines", Metropolitan Book Co. Pvt. Ltd., New Delhi, 1994.
3. Kumar, K.L., "Engineering Fluid Mechanics", Eurasia Publishing House (p) Ltd. New Delhi (2004).

COURSE OUTCOMES:

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

1. Understand the properties and characteristics of fluids and Measurements of Pressure.
2. Understand the flow characteristics and able to identify the energy loses when fluids flow through Pipes.
3. Able to understand the boundary layer and their thickness. Understand the concept of Dimensional Analysis.
4. Students can able to develop the velocity diagram for various turbines and able to design a Turbine by considering all the design aspects.
5. Students can able to develop the velocity diagram for Centrifugal and Reciprocating pumps and able to design the pumps.

	Mapping with Programme Outcomes												Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	-	-	2	-	-	-	1	-	1	1	-	2	-
CO2	3	2	-	-	2	-	1	-	-	-	1	-	-	2	1
CO3	3	2	-	-	2	1	-	-	-	-	-	2	1	2	-
CO4	3	3	3	1	-	-	-	2	-	1	-	-	3	-	2
CO5	3	3	3	-	-	-	-	2	-	1	-	-	3	-	2

22MMPC504	OPERATIONS MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Recognize and appreciate the concept of Production and Operations Management in creating and enhancing a firm's competitive advantages.
- Describe the concept and contribution of various constituents of Production and Operations Management (both manufacturing and service) .
- Teach analytical skills and problem-solving tools to the analysis of the operations problems .
- Apply scheduling and Lean Concepts for improving System Performance.

UNIT I INTRODUCTION

Objectives of Operations Management, Scope of Operations Management, Relationship of Operations with other Functional areas, Manufacturing Vs Service sector, Operations Decision making, Phases in Product Design and Development, Product Life Cycle, Process Selection.

UNIT II FORECASTING

Need, Determinants of Demand, Demand Patterns, Qualitative Forecasting Methods-Delphi techniques. Market Research, Quantitative Forecasting methods – Moving Average Methods, Exponential Smoothing Methods, Regression methods, Monitoring and Control of Forecasts, Requirements and Selection of Good forecasting methods.

UNIT III AGGREGATE PLANNING AND MATERIAL REQUIREMENT PLANNING

Role of aggregate Product planning, Managerial inputs to Aggregate planning, Pure and Mixed strategies, Mathematical Models for Aggregate planning – Transportation Method, Linear programming Formulation, Linear Decision Rues, Master Production Schedule(MPS), Procedure for developing MPS, MRP - Lot sizing methods: Lot-for-lot technique, EOQ approach, Periodic order quantity approach – Implementation issues, MRP – II, Introduction to ERP.

UNIT IV CAPACITY MANAGEMENT

Measures of capacity, Factors affecting capacity, Capacity Planning, Systematic approach to capacity planning, Long-term and short-term capacity decisions, Tools for capacity planning, Capacity Requirement Planning- Business Process Outsourcing

UNIT V PRODUCTION ACTIVITY CONTROL AND LEAN MANUFACTURING

Objectives and Activities of Production Activity Control - JIT- Kanban- Introduction to Scheduling in different types of Production Systems. Lean Manufacturing - Principles – Activities - Tools and techniques - Case studies.

TEXT BOOKS:

1. Panneerselvam. R, Production and operations Management, PHI, 3rd Edition, 2012.

REFERENCE BOOKS:

1. Lee J. Krajewski, Manoj K. Malhotra, Larry P. Ritzman,Operations Management: Processes and Supply Chains Pearson Education,11th Edition,2015

2. Norman Gaither, Greg Frazier, Operations Management, Thomson Learning, 9th Edition, 2002.
3. William J Stevenson, Operations Management, McGraw Hill,13th Edition,2018.

COURSE OUTCOMES:

1. The students will appreciate the role of Production and Operations management in enabling and enhancing a firm's competitive advantages in the dynamic business environment.
2. The students will obtain sufficient knowledge and skills to forecast demand for Production and Service Systems.
3. The students will able to Formulate and Assess Aggregate Planning strategies and Material Requirement Plan.
4. The students will be able to develop analytical skills to calculate capacity requirements and developing capacity alternatives.
5. The students will be able to apply scheduling and Lean Concepts for improving System Performance.

22MMCP508	MACHINE THEORY LAB	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

- To supplement the principles learnt in kinematics and Dynamics of Machinery.
- To make the students understand the working principle of various types of governors, balancing systems, Cam analyzer, Torsional vibration of single rotor system, whirling speed concept, action of forces in gyroscope.

LIST OF EXPERIMENTS:

1. Experimental verifi cation of natural frequency in undamped vibration of single rotor system.
2. Determine the characteristic curves of watt/ Hartnell governors.
3. Determination of mass moment of inertia of connecting rod and fly wheel.
4. Studies on cam analyser.
5. Study of gyroscopic couple.
6. Whirling of speed – determination of critical speed.
7. Study and experiments on static and dynamic balancing of rotating masses.

COURSE OUTCOMES:

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

1. Observe the data of mechanical system in the rigid body dynamics.
2. Evaluate the parameter of mechanical system in the rigid body dynamics.
3. Analyze the rigid body dynamics of mechanical system.
4. Infer and interpret the rigid body dynamics of mechanical systems.
5. Demonstrate the rigid body dynamics.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	3	-	-	-	-	-	2	-	-	1	3	3	-
CO2	3	-	3	-	-	-	-	-	2	-	-	1	3	3	-
CO3	3	-	3	-	-	-	-	-	2	-	-	1	3	3	-
CO4	3	-	3	-	-	-	-	-	2	-	-	1	3	3	-
CO5	3	-	3	-	-	-	-	-	2	-	-	1	3	3	-

22MMCP509	MECHATRONICS AND METROLOGY LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

The main objectives of the course for the students is

- To Measuring of physical quantity such as displacement, force and temperature, and also the operation of signal conditioning circuits.
- To get basic working for sensor and its application in image processing technique for Mechatronics Systems.
- To design appropriate circuits to automate and control the Hydraulic, Pneumatic, and Electric actuators.
- To familiarize the importance of measurement and inspection in manufacturing industries.
- To train the students with advanced metrological devices.

EXPERIMENTS:

1. Study of various pneumatic and electro-pneumatic components, symbols and circuits.
2. Study of PLC, Ladder Diagram and its applications.
3. Modeling and analysis of pneumatic and electrical circuits using FluidSim/P Software.
4. Modeling and Analysis of basic Hydraulic, Pneumatic, Electro-Pneumatic, Electrical and Electronic Circuits by using simulation software.
5. Actuation of double acting cylinder by using Hydraulic, Pneumatic and Electro-Pneumatic circuits.
6. Automating the cylinder sequence, A+B+B-A- by using Microcontroller.
7. Measurement of external taper (Sine Bar and Roller)
8. Calibration of plain plug gauge
9. Measurement of external radius and internal radius
10. Inspection of screw thread
11. Study Exercises in Video measuring system and CMMs.

COURSE OUTCOMES:

Upon completing this course, students should be able to:

1. Understand the basics of hydraulics, pneumatics, and electro-pneumatic and their working
2. Design and model the hydraulic, pneumatic and electro-pneumatic circuits using the software
3. Analyze the model constructed using PLC software
4. Follow the right procedure for measurement of various components depending upon the applications.
5. Identify the right instrument and method of measurement for a particular application.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	1	1	-	-	-	1	-	-	-	3	1	-
CO2	2	2	3	-	-	-	-	-	-	1	-	-	2	-	1
CO3	2	3	2	1	1	-	-	-	-	2	-	-	2	-	-
CO4	1	-	3	2	-	-	-	1	2	-	1	-	3	2	1
CO5	2	1	2	1	1	-	1	2	2	-	1	-	3	2	2

SEMESTER – VI

22MMPC601	METAL FORMING TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To import knowledge on stress-strain relations and stress tensor approach applied in metal forming
- To provide basic knowledge of secondary processes and condition for manufacturing
- defect free end-product.
- To illustrate the concepts of various advanced metal forming processes.

UNIT I

State of stress – Components of stress, symmetry of stress tensor, principle stresses – Stress deviator – Von-Mises, Tresca yield criteria . Comparison of yield criteria
Fundamentals of Metal working: Flow curve, Relationship between true stress and true strain, Mechanics of metal working – **slab method** Temperature in metal forming, hot cold and warm working Friction and lubrication. Workability, Residual stresses.

UNIT II

Classification of forming processes Forging- Forging classification - open die forging, closed die forging, Forging Operations such as Heading, Piercing, coining, forging equipment, **forging in plane strain** calculation of forging loads in closed die forging, forging operations forging defects and remedies Rolling: Classification of rolling processes, types of rolling mills, hot and cold rolling, rolling of bars and shapes, forces and geometrical relationship in rolling, **analysis of rolling load,** torque and power, , rolling defects- causes and remedies

UNIT III

Extrusion – classification – hot and cold extrusion – deformation, lubrication - simple analysis of extrusion process - hydrostatic extrusion - tube extrusion, production of seamless pipes and tubes - extrusion defects causes and remedies

Drawing of rods, wires & tubes : Simple analysis of wire and tube drawing . residual stress in rod, wire & tubes .

UNIT IV

Sheet Metal Forming: Forming methods – shearing and blanking – Shearing operations- Blanking, Piercing, fine Blanking, Slitting, trimming, lancing, cut off, coining, flanging. bending – types of bending – spring back – Deep drawing – Mechanism of Deep drawing – Limiting draw ratio – Concept of Forming Limit Diagram. Description only: Stretch forming – Rubber pad forming – Tube hydro forming – defects in sheet metal forming.

UNIT V

High velocity forming, Comparison with conventional forming, Dynapark and petro forge forming Explosive forming, Electro hydraulic, Electro Magnetic forming, water hammer forming – principles characteristics, process variables and applications

TEXT BOOKS:

1. Dieter.G.E., "Mechanical Metallurgy", McGraw – Hill Co., SI Edition, 2012.
2. Nagpal G.R. ,"Metal forming processes", Khanna Publishers, New Delhi, 2nd edition 2009.

REFERENCE BOOKS:

1. Juneja B.L., "Fundamentals of Metal forming Processes", New Age International Publishers Ltd., Chennai, India, 2018.
2. William F. Hosford and Robert M. Caddell, Metal Forming: Mechanics and Metallurgy, 4th edition, Cambridge University Press, 2011
3. Kumar Surender, "Technology of Metal Forming Processes", PHI learning Pvt. Ltd., New Delhi, India, 2008.
4. Kalpakjian S. and Schmid S.R., "Manufacturing Processes for Engineering Materials", Pearson., New Delhi, India, 2012.
5. Surender Kumar, "Technology of Metal Forming Processes", PHI, New Delhi, 2008.

COURSE OUTCOMES:

On Completion of the course the student will be able to

1. Evaluate the state of stress during yielding of ductile when forming a component
2. Determine the forging and rolling forces for various metal forming processes.
3. Ability to calculate the forming loads for extrusion and drawing processes
4. Elaborate different sheet metal forming processes and their applications
5. Understand and grasp the significance of various high energy rate forming techniques

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	-	-	-	-	3	-	-	3	2	3	-
CO2	3	3	3	2	1	-	-	-	3	-	-	3	2	3	-
CO3	3	3	3	2	1	-	-	-	3	-	-	3	2	3	-
CO4	2	1	1	1	-	-	-	2	3	-	-	1	2	-	2
CO5	2	1	1	1	-	-	-	2	3	-	-	1	2	-	2

22MMPC602	DESIGN OF MACHINE ELEMENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To familiarize the various steps involved in the Design Process
- To understand the principals involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
- To learn to use standard practices and standard data
- To learn to use catalogues and standard machine components

UNIT I

Introduction: Types of Design factors. Factor of safety , Theories of failure - Curved beam, crane hook and C frames.

Design for fatigue strength: S-N diagram - Endurance limit modifying factors - Stress concentration - Fluctuation stress – Soderberg & Good Man equations

UNIT II

Thin cylinders – Stresses in thin cylindrical shell due to internal pressure – circumferential and longitudinal stresses and deformation in thin cylinders Design of mechanical elements: Shafts – Design for static load – bending and torsion – Equivalent twisting moment**.** Coupling - Types - Design and selection of coupling - Flange coupling, Bushed pin type, flexible coupling design and selection

UNIT III

Theory of columns: Design of push rod, piston rod and I.C. Engine connecting rods sections.

Wire ropes - Stresses - selection Design procedure–leaf springs - construction equalized stresses in leaves - material and design. Open and closed coiled helical springs stress - Wahl's factor

UNIT IV

Power screws - Thread forms Design consideration and materials - wear and shear - design procedure. Threaded fasteners – Bolted joints – simple and eccentrically loaded bolted joints

UNIT V

Design of Joints: Riveted Joints: Introduction - Types of riveted joints - failures of a riveted joint - strength and efficiency - Design of boiler joints.

Welded joints: Introduction - Strength of transverse and parallel fillet welded joints - Axially loaded unsymmetrical welded sections - Eccentrically loaded welded joints

TEXT BOOKS:

1. Khurmi, R.S., "Machine Design" , S. Chand and Company Ltd., New Delhi, 14th edition, 2005.
2. Pandya, and Sha., "Machine Design", Charotar Publisher, house, Anand, India

REFERENCE BOOKS:

1. Richard Budynnas, J.E.Shigley's, "Mechanical Engineering Design", McGraw-Hill Book Company, 8th ed.,2008
2. Prabhu, T.J., "Fundamentals of Machine Design", Scitect Publisher 4th edition, 2000.
3. Sundararajamoorthy, T.V., and N. Shanmugam, "Machine Design", Anuradha Agencies, 2000.

COURSE OUTCOMES:

Upon completing this course, students should be able to

1. Apply the basics of engineering design of machine elements
2. Demonstrate the functions of various machine elements and assemblies
3. Select and design various machine components according to the requirement as per the prescribed standards
4. Choose materials and evaluate the design consideration for power screws
5. Design riveted as well as welded joints

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	1	1	-	-	-	1	-	-	-	2	-	-
CO2	3	-	2	-	-	-	-	-	1	-	-	-	2	1	-
CO3	3	2	3	1	-	-	-	-	-	-	-	-	-	3	-
CO4	2	2	3	-	-	-	-	-	-	-	-	1	2	2	2
CO5	2	2	3	-	-	-	-	-	2	-	-	1	-	1	2

22MMES607	**INTRODUCTION TO PYTHON PROGRAMMING**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**2**

COURSE OBJECTIVES:

- To familiarize with data types, variable, Operators, conditionals and looping.
- To provide in-depth Knowledge and understanding about the Functions.
- To make the students to understand the fundamentals of Classes and Objects.
- To impart the knowledge about File handling and networking.
- To educate the student in Database Management and GUI Programming in Python.

UNIT I

Introduction to Python: Getting Started with Python – Programming Style – Writing a Simple Program, Python Comments, Python variables, Python Data Types, Python Numbers, Python Casting, Python String, Python Boolean, Python basic Operators, Understanding python blocks. Python Program Flow Control Conditional blocks: if, else and else if, Simple for loops in python, For loop using ranges, string, list and dictionaries. Use of while loops in

python, Loop manipulation using pass, continue, break and else. Programming using Python conditional and loop blocks.

UNIT II

Python Function: Defining a Function, Calling a Function, Pass by reference and value, Function Arguments, Anonymous Functions, return Statement, pass Statement, Scope of Variables, Recursion function, Mathematical Functions, Strings and User Defined Functions ,Python lambda, Python Array and Array Methods.

UNIT III

Object-Oriented Programming, Classes and Objects, Creating Classes in Python, Creating Objects in Python, The Constructor Method, Classes with Multiple Objects, Class Attributes versus Data Attributes, Encapsulation, Inheritance, The Polymorphism.

UNIT IV

Python File Operations: Reading files, Writing files in python, Understanding read functions, read (), readline(), readlines(). Understanding write functions, write () and writelines() Manipulating file pointer using seek Programming, using file operations. Database Programming: Connecting to a database, Creating Tables, INSERT, UPDATE, DELETE and READ operations, Transaction Control, Disconnecting from a database, and Exception Handling in Databases.

UNIT V

Python packages: Simple programs using the built-in functions of packages matplotlib, numpy, pandas etc. GUI Programming: Tkinter introduction, Tkinter and PythonProgramming, Tk Widgets, Tkinter examples. Python programming with IDE.

TEXT BOOKS:

1. Wesley J. Chun, "Core Python Applications Programming", 3rd Edition, Pearson Education, 2016.
2. Charles Dierbach, "Introduction to Computer Science using Python", Wiley, 2015.
3. Gowrishankar S, Veena A, "Introduction to Python Programming", 1st Edition, CRC Press/Taylor & Francis, 2018. ISBN-13: 978-0815394372

REFERENCE BOOKS:

1. Jennifer Campbell, Paul Gries, Jason montajo, Greg Wilson, "Practical Programming An Introduction To Computer Science Using Python" The Pragmatic Bookshelf , 2018.
2. Wesley J Chun "Core Python Applications Programming", Prentice Hall, 2015.
3. Jeeva Jose, "Taming Python by Programming", Khanna Publishing House,1st edition,2018.
4. J.Jose, "Introduction to Computing and Problem Solving with Python", Khanna Publications,1st edition,2019.
5. Reema Thareja, "Python Programming", Pearson,1st edition,2017.

COURSE OUTCOMES:

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

1. Explore the basic concepts of Conditional and Looping Statements in python.
2. Learn the various functions in Python
3. Apply the concepts of Object Oriented programming including encapsulation,

inheritance and polymorphism as used in Python.

4. Simulate the commonly used operations in file system and able to develop application program to communicate from one end system to another end.
5. Develop menu driven program using GUI interface and to gain knowledge about how to store and retrieve data.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	1	-	-	-	-	-	1	-	-	-	1	1	-
CO2	3	-	-	-	1	-	-	-	1	-	-	-	1	1	-
CO3	3	1	1	-	-	-	-	-	-	-	-	-	2	1	-
CO4	3	-	3	1	1	-	-	-	-	-	-	-	1	1	1
CO5	3	-	3	1	1	-	-	-	-	-	-	-	1	1	1

22MMCP608	**MANUFACTURING TECHNOLOGY LAB-III**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

COURSE OBJECTIVES:

- To study effect of section size and quenching media on hardness/
- To study the Microstructure of ferrous non-ferrous and heat treated specimens etc
- To educate the importance of various process parameters during metal forming processing methods such as rolling water hammer forming

LIST OF EXPERIMENTS:

METAL FORMING:

1. Formability of sheet metals by water hammer technique
2. Rolling of metal strips
3. Disc compression test
4. Estimation of creep rate of a given specimen
5. Uniaxial tensile test
6. Charpy impact test
7. Izod impact test

METALLURGY:

1. Effect of section size on hardness
2. Effect of quenching media on hardness
3. Jominy hardenability test
4. Microscopic examination of a metallic specimen and determination of grain size
5. Micro-structural study of ferrous material
6. Micro-structural study of non-ferrous material
7. Micro-structural changes of a heat treated specimen
8. Micro-structural changes at the heat effected zone of a welded specimen
9. Identification of materials by spark test
10. Phase diagram
11. Characteristics of moulding sand
12. Corrosion test

COURSE OUTCOME:

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

1. Determine formability of sheet metals by water hammer technique
2. Ability to understand the parameters that influencing various material processing methods
3. Annalyse the effect of section size and quenching media on hardness
4. Differentiate the Microstructure of ferrous non-ferrous and heat treated specimens
5. Identify the material by spark test

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2		-	-	1	-	-	2	-	-	2	3	2	3
CO3	3	2	1	-	-	-	-	-	2	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-		-	-	-	-	-	-
CO5	3	2	2	-	-	1	-	1	2	-	-	2	3	1	3

22MMCP609	HYDRAULICS AND STRENGTH OF MATERIALS LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- To understand the properties of fluids and fluid statics, methods for determination of co-efficient of discharge.
- To study of the characteristic features of pumps and turbines.
- To understand the significance and role of such utilities in their further course of study.
- To understand the theoretical and practical aspects of elasticity and plasticity of the materials through a variety of experiments

LIST OF EXPERIMENTS:

Hydraulics:

1. Determination of Co-efficient of discharge of Mouth Piece
2. Determination of Co-efficient of discharge of Venturimeter
3. Determination of Co-efficient of Head loss due to Sudden Change in Section
4. Determination of Co-efficient of Head loss due to Friction in Pipe
5. Determination of Co-efficient of discharge of Rectangular Notch
6. Study of Performance characteristics of Elmo Pump (Centrifugal Pump)
7. Study of Performance characteristics of Sump Pump (Centrifugal Pump)
8. Study of Performance characteristics of Submersible Pump (Centrifugal Pump)
9. Study of Performance characteristics of Gould's Pump (Reciprocating Pump)
10. Study of Performance characteristics of Pelton Turbine (Constant Speed method)
11. Study of Performance characteristics of Francis Turbine (Constant Head method)
12. Determination of Metacentric Height of a floating vessel (Demo Only).

Strength of Materials:

1. Tensile properties evaluation of Round Rods
2. Tensile properties evaluation of Flat Plates
3. Impact toughness properties evaluation of Materials

4. Hardness Measurement using Brinnel Hardness Machine
5. Hardness Measurement using Rockwell Hardness Machine
6. Compression Properties Evaluation of Materials
7. Ductility Measurement through Bend Test
8. Torsion Test on Rods and Springs
9. Bending and Deflection Test on RCC Beams
10. Fatigue Test on Rods

COURSE OUTCOMES:

Upon completion of the course the students will be able to

1. study the construction and working of simple machines
2. analyze and design structural members subjected to tension, compression, torsion, bending and combined stresses using the fundamental concepts of stress, strain and elastic behavior of materials
3. utilize appropriate materials in design considering engineering properties, sustainability, cost and weight
4. perform engineering work in accordance with ethical and economic constraints related to the design of structures and machine parts
5. study the behavior of various machine elements under torsion and fatigue

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

SEMESTER – VII

22ETHS701	ENGINEERING ETHICS	L	T	P	C
		3	0	0	2

COURSE OBJECTIVES:

- To understand the moral and ethical dimensions in engineering.
- To take balanced decisions.

UNIT I

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories.

UNIT II

Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study.

UNIT III

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator's Approach to Risk - Chernobyl Case Studies and Bhopal.

UNIT IV

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V

Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct

TEXT BOOKS:

1. Govindarajan M, Natarajan S and Senthilkuma, V S, "Professional Ethics And Human Values", PHI Learning, New Delhi, 2013.
2. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York, 2005.

REFERENCE BOOKS:

1. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Thompson Learning, 2000.
2. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, 1999. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, 2003.
3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, 2001.
4. David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press, (2003).

COURSE OUTCOMES:

Upon successful completion of the course, the students are able to

1. realize the ethical values of an engineer
2. Understand the relationship between the engineer and the society.
3. Learn the importance of codes in engineering practice.
4. Acquire knowledge on the legal aspects in engineering.
5. Acquire knowledge on the moral and ethical aspects in engineering.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	1	-	-	3	-	1	1	1	-	1	1	-	-
CO2	2	2	-	-	-	2	1	-	-	-	-	-	2	-	-
CO3	2	-	2	-	-	2	-	-	-	-	-	-	2	1	-
CO4	-	2	1	-	-	1	-		1	-	-	-	-	1	1
CO5	1	1	-	-	-	1	1	-	-	-	1	-	1	-	1

22MMPC702	COMPUTER INTEGRATED MANUFACTURING SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To familiarize the basic concepts of CAD / CAM / CIM
- To introduce the various aspects of automated manufacturing
- To introduce the fundamentals of materials handling and storage system and robotics
- To introduce the concepts of automated assembly and control system

UNIT I: INTRODUCTION

Introduction to CAD and CAM – Manufacturing Planning and Manufacturing control – Concurrent Engineering – CIM concepts – Computerised elements of CIM system – Types of production – Manufacturing models and Metrics – Mathematical models of Production Performance – Simple problems – Manufacturing Control

Basic Elements of an automated system – Reason for Automation and Automation Strategies – Levels of Automation – Lean Production and Just-In-Time Production

UNIT II: PROCESS PLANNING AND CONTROL

Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and the Master Production Schedule – Material Requirement planning – Capacity Planning – Control Systems – Shop Floor Control – Inventory Control – Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP)

UNIT III: INDUSTRIAL ROBOTS

Industrial Robots: Definition – Robot Anatomy – Types and Classifications – Work Envelope – Co-ordinate Systems – Notations – End Effectors: Grippers and Tools – Robot Sensors and Machine Vision System – Robot Work cell – Robot programming – Robot Applications – Recent developments

UNIT IV: GT AND FMS

Group Technology: Definition – Part Families – Part family formation: Visual inspection, Parts Classification and Coding – Case Studies in Coding & Production Flow Analysis – Composite Part Concept – Benefits of GT – Application of GT – Cellular Manufacturing

Flexible Manufacturing System (FMS): Definition – Types of FMS – FMS Components – Workstations – FMS Layout – FMS Application and Benefits

Material Handling and storage system: Overview of Materials Handling Equipment – Conveyors – Automated Guided Vehicle (AGV) System: Types, Guidance Technology, Vehicle Management – Automated Storage and Retrieval Systems (AS/RS): Types and applications

UNIT V: AUTOMATED ASSEMBLY SYSTEMS

Automated Assembly: Fundamentals – System Configuration, Part Delivery at Work Station – Design For Automated Assembly – Computer Process Monitoring, Direct Digital Control, Supervisory Control – Distributed Control System

Shop Floor Control: Three Phases – Factory Data Collection – Manual Method – Automated and Semi-Automated Data Collection (ADC) – Bar Code Technologies and Other ADC Technologies.

TEXT BOOKS:

1. Mikell P. Groover, "Automation, Production Systems and Computer-integrated Manufacturing", Prentice Hall of India Private Limited, New Delhi
2. Mikell P. Groover, Weiss, M., Nagel, R.N., and Odrey, N.G., "Industrial Robotics: Technology, Programming and Applications", McGraw-Hill Book Company, New Delhi

REFERENCE BOOKS:

1. Yorem Koren, "Computer Integrated Manufacturing", McGraw-Hill.
2. Rao, P.N, "CAD/CAM - Principles and Applications", Tata McGraw-Hill Publications
3. Kant Vajpayee S, "Principles of Computer Integrated Manufacturing", Prentice Hall India

COURSE OUTCOMES:

Upon completing this course, students should be able to:

1. Provide engineering knowledge on the importance of CAD / CAM / CIM
2. Understand the various aspects of process planning and control
3. Understand the basics of Industrial robots & its applications in modern manufacturing
4. Provide knowledge on the concepts of group technology, flexible manufacturing and the materials handling systems
5. Understand the usage of automated assembly and the automatic data capture technologies

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	-	-	-	1	-	-	-	-	-	-	-	-	1	2
CO2	-	-	-	-	3	2	-	-	-	-	-	-	1	-	-
CO3	-	-	2	1	2	-	-	-	-	-	-	-	2	2	-
CO4	-	1	1	2	-	-	-	2	-	-	-	-	1	-	1
CO5	-	-	1	1	-	-	-	-	-	-	-	-	1	1	-

22MMPC703	**OPERATIONS RESEARCH**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To introduce students the use of quantitative methods and techniques for effective decision–making and to provide an understanding of the systematic approach to solve decision making problems.
- To introduce the operations research models and to apply them for modelling and solving Engineering problems in general and manufacturing situations in particular.
- To apply these techniques constructively to make effective business decisions and for real life problems.

UNIT I

Linear programming – formulation, graphical method, Simplex method, Big M method - Applications – Problems.

UNIT II

Transportation problems – Balanced and unbalanced transportation problems – various methods of finding initial basic feasible solution – finding optimal solutions.
Assignment problems – various types of assignment problems - Hungarian algorithm - Traveling salesman problem.

UNIT III

Waiting line Problems: characteristics of queuing problems – terminologies - kendall and Lee notation - cost of waiting and cost of providing service - single channel - single stage type of problems with poisson arrivals and exponential service times.

Monte Carlo simulation: need for simulation – advantages and disadvantages – Application problems in maintenance, queue and inventory.

UNIT IV

Network models: Minimal spanning tree problem - shortest route problem - Maximum flow problems.

PERT and CPM: Difference between PERT and CPM - critical path method (CPM) - Determination of critical path – Project evaluation review technique (PERT) calculations - probability of meeting the time schedule - crashing of project network.

UNIT V

Decision Theory - Decision making under risk condition - expected value criteria - Decision trees. Decision making under uncertain conditions – Laplace criterion, Minimax criterion, maximin criterion, savage regret criterion, Hurwitz criterion.

TEXT BOOKS:

1. Prem Kumar Gupta and Hira D.S., "Operations Research", S. Chand & Co. Pvt. Ltd., 7th edition, 2014.
2. Vohra, N.D., "Quantitative Techniques in Management", Tata McGraw-Hill, 3rd edition, 2007.

REFERENCE BOOKS:

1. Anderson, D.R., Sweeney, D.J., Williams, T.A, Martin, K, An Introduction to Management Science: Quantitative Approach to Decision Making, South Western, 13th Edition, 2012.
2. Barry Render, Ralph M. Stair Jr., "Quantitative analysis for Management", Pearson, 13th edition, 2018.
3. Sharma J.K., Operations Research: Theory and Applications, Trinity Press, 6th edition, 2016.
4. Srinivasan G., Operations Research: Principles and Applications, PHI, 3rd edition, 2017.
5. Taha, "Operations Research: An introduction", Tata McGraw-Hill, 10th edition, 2017.

COURSE OUTCOMES:

1. Mathematically formulate a given engineering and business problems as a linear programming problem, and apply Graphical, Simplex or Big-M methods to obtain the optimal solution.

2. Justify the determined feasible solution in transportation and assignment method and finding an optimal solution using MODI method and Hungarian method.
3. Categorize various Queuing models and find the optimal solution using queuing model and simulate different real life probabilistic situations and to solve them using Monte-Carlo simulation technique.
4. Determine the optimal project duration and cost using CPM and PERT technique, also construct complex project network and control the complex project.
5. Develop models that can be used to improve decision making under risk and uncertainty within an organization and Sharpen their ability to structure problems and to perform logical analyses.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	-	3	-	-	3	2	-	2	3	2	3	3
CO2	2	3	2	-	2	-	-	3	2	-	2	2	2	3	3
CO3	2	3	2	-	2	-	-	2	1	-	1	1	1	3	2
CO4	2	3	3	-	3	-	-	3	3	-	2	3	2	3	3
CO5	2	3	2	-	2	-	-	3	3	-	2	2	1	3	2

22MMCP707	**DESIGN AND AUTOMATION LABORATORY (CREO, CNC AND FEA)**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

COURSE OBJECTIVES:

- To illustrate the steps involved in various stages of Geometric Modeling
- To impart hands on experience to students in Assembly and Engineering Drafting.
- To introduce the concepts of CNC programming and simulation on CNC turning, CNC Milling machines

LIST OF EXPERIMENTS:

Creo:

1. Sketcher
2. Solid modeling
3. Surface modeling
4. Feature manipulation
5. Assembly
6. Drafting

CNC:

- Study of different control systems and CNC codes
- Programming and simulation for turning, taper turning, thread, Cutting and facing operation
- Programming and simulation using Do-Loop and Sub-routine
- Programming and simulation of profile milling operation, circular interpolation circular and rectangular pocket milling
- Programming using canned cycles.
- CNC code generation using CAM software packages – Turning, Milling

COURSE OUTCOMES:

Upon successful completion of the course, the students are able to

1. Gain practical experience in 2D drafting using modeling software
2. Gain practical experience in 3D modeling using modeling software
3. Provide knowledge in assembly of parts using modelling software
4. Understand and apply the concepts G and M codes and manual part programming of turning and milling processes
5. Understand the CNC code generation and simulation of turning and milling parts using CAM software

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	1	-	1	-	-	-	-	-	-	-	1	-	-
CO2	-	-	1	-	1	-	-	-	-	-	-	-	1	-	-
CO3	-	-	1	-	1	-	-	-	-	-	-	-	1	-	-
CO4	-	-	1	-	1	-	-	-	-	-	-	-	1	-	-
CO5	-	-	1	-	1	-	-	-	-	-	-	-	1	-	-

SEMESTER – VIII

22MMPV803	PROJECT WORK AND VIVA-VOCE	L	T	P	C
		0	10	2	6

COURSE OBJECTIVES:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports and to face reviews and viva voce examination.

This course is aimed to provide more weightage for project work. The project work could be done in the form of a summer project or internship in the industry or even a minor practical project in the college. Participation in any technical event/competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.

COURSE OUTCOMES:

Upon completing this course, students should be able to:

1. Take up any challenging practical problems and find solution by formulating proper methodology.
2. Students will acquire the ability to make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
3. Students will acquire collaborative skills through working in a team to achieve common goals.
4. Students will be able to learn on their own, reflect on their learning and take appropriate actions to improve it.

5. Students will acquire the skills to communicate effectively and to present ideas clearly and coherently to specific audience in both the written and oral forms.

V SEMESTER: PROFESSIONAL ELECTIVES

22MMPEXXX	COMPOSITE MATERIALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To impart an in-depth knowledge on composite materials
- To provide the knowledge the processing methods and properties of various type of composite materials
- Gain in fundamental knowledge in Nano composites.

UNIT-I

Introduction to Composites – Definition – Classification – Advantages – Disadvantages. Elastic behavior of Fiber reinforce composites under longitudinal and transverse loading – Elastic modules of particulate composites. Fiber reinforcement - Properties of synthetic fibers: Glass fiber – Carbon fiber – organic fiber – Ceramic fiber. Properties of natural fibers: Blast fiber – Leaf fiber – Seed fiber – Surface treatment of natural fibers. Particulate materials – Nano reinforcement: Nano fiber – nano tubes – nano clay – nano particles.

UNIT-II

Matrix materials: Functions - Polymer matrix – properties of thermoset polymers – thermo plastics – Elastomers. Metallic matrix materials: Aluminium alloy – titanium alloy – magnesium alloy. Ceramic matrix materials: crystalline oxide - Alumina – Zirconia – Silicon carbide – Silicon Nitride – Boron Carbide – Aluminium Nitride. Glasses and Glass–ceramics.

UNIT-III

Polymer Matrix Composite (PMC): Processing of PMC – Hand lay-up process – Spray-up process – Resin transfer moulding – Filament winding process – Putrusion – Compression moulding. Structure and Mechanical properties of PMCS – Applications.

UNIT-IV

Metal Matrix Composites (MMC): Selection of reinforcement – Processing of MMCs: Liquid State processing – Solid state processing – Gaseous State processing – Deposition techniques - Properties of MMCs. – Applications. Carbon-Carbon composites: High pressure processing – properties – applications.

UNIT-V

Ceramic Matrix Composites (CMC): Processing of CMCs: - Cold pressing and sintering – Hot pressing – Sol-Gel technique – Reaction bonding – Mechanical properties of CMCs. – Applications. Nano composites: Polymer nano composites – Properties of clay – Properties and applications of Polymer Nano composites – Clay-polymer – Graphite-polymer – Nano fiber reinforced composites. Properties and applications of metal matrix nano composites and ceramic nano composites.

TEXT BOOKS:

1. Composite Materials - Science and Engineering, Krishan K. Chawla, Springer, Third Edition, 2013
2. Composite materials and processing, M. Balasubramanian, CRC Press, 2014.

REFERENCE BOOKS:

1. Modern Composite Materials, Broutman.L.J and Krock.R.H, Addison Wesley, 1967.
2. An Introduction to Metal Matrix Composites, Clyne.T.W. And Wihers.P.T., Cambridge University Press, 1993.
3. Fundamentals of Composite Manufacturing, B. Strong, SME, 1989
4. Composite materials, Engineering and Science, Mathews .F.L. and Rawings .R.D., Chapman.
5. Composite materials, Chawla K.K., Springer¬Verlag, 1987.
6. Engineering Materials, Kenneth G.Budinski, Prentice Pvt. Ltd., 41th Indian Reprint, 2002

COURSE OUTCOMES:

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

1. Classify the composite material, different types of fibers of its properties.
2. Summarize the various types of matrix material used in the composite materials.
3. Select the appropriate processing method of polymer composites.
4. Understand in selection of the reinforcement in metal matrix composites and various types of fabrication methods adopted in Metal matrix composites
5. Choose the suitable processing methods in ceramic composites of also have knowledge in properties of application of nano composites.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	1	2	-	-	-	2	2	-	-	-	2	-	2
CO2	3	-	1	2	-	-	-	2	2	1	-	-	2	-	2
CO3	3	-	2	2	-	-	-	2	2	1	-	-	2	-	2
CO4	3	-	2	2	-	-	-	2	2	2	-	-	2	-	2
CO5	3	-	2	2	-	-	-	2	2	2	-	-	2	-	2

22MMPEXXX	**PROCESS PLANNING AND COST ESTIMATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

1. Creating a process plan for a given Product.
2. Preparing cost elements for a given product.
3. Allocating overhead to different departments.
4. Estimating cost for the casting and forging products.
5. Analyzing the costs for machining a product.

UNIT I PROCESS PLANNING

Defining process planning –Drawing interpretation –Material selection process and methods – Selection of Production Processes from Tables – Selection of Process Parameters

from Tables– Factors to be considered in selecting: Processes; Process Sequencing; Operation Sequencing; Equipment & Tool Selection; Tool Holding Devices; Measuring Instruments –Computer Aided Process Planning – Retrieval / Variance CAPP and Generative CAPP - Case Study in Process Planning.

UNIT II FUNDAMENTAL OF ESTIMATING AND ELEMENTS OF COST

Concept and Purpose of Estimating, Functions of Estimating Department, Concept of Costing, Costing versus Estimating, Types of Estimates, Importance of Estimates, Estimating Procedure, Cost Estimators and their Qualifications, Principal Constituents in a Cost Estimate – Elements of Cost – Introduction, Material Cost, Labour Cost, Expenses and Cost of Product (Ladder Cost).

UNIT III OVERHEADS AND DEPRECIATION

Overheads , Allocation or Distribution of Overhead Cost , Depreciation and Methods to Calculate it, Interest on Capital, Idleness Costs, Repair and Maintenance Cost

UNIT IV ESTIMATION OF CASTING, FORGING & WELDING COSTS

Estimation of cost for Casting processes, Welding processes and Forging processes.

UNIT V ESTIMATION OF MACHINING TIME AND COST

Estimation of Machining Time and Cost – Lathe operations, Drilling, Milling, Shaping Planing, and Grinding operations.

TEXT BOOKS:

1. Adithan, M, Process Planning and Cost Estimation, New Age International Publishers, 2007.
2. Peter Scallan, Process planning, The Design/Manufacture Interface, Butterworth-Heinemann, 2003.

REFERENCE BOOKS:

1. Chitale A. K., and Gupta R. C., “Product Design and manufacturing”, Prentice Hall of India, New Delhi, 1997.
2. Gideon Halevi, “Process and operation planning”, Kluwer academic publishers (Printed ebook), 2003.
3. Narang G.B.S. & Kumar .V, “Production and Costing”, Khanna Publishers, 2000.
4. Phillip F. Ostwald & Jairo Munoz, “Manufacturing Processes And Systems”, 9th Edition, Wiley student edition, 2002.
5. Robert Creese, Adithan M. &Pabla B. S., “Estimating and Costing for the Metal Manufacturing Industries”, Marcel Dekker, 1992.

COURSE OUTCOMES:

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

1. Create a Process Plan for a given Product.
2. Prepare Cost elements for a given Product.
3. Allocate Overhead to different departments.
4. Estimate cost for Casting and Forging products.
5. Analyze the cost of machining a product.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	2	-	1	-	2	3	2	2	-
CO2	3	2	2	1	-	-	-	2	-	1	-	1	-	2	-
CO3	3	2	2	-	-	1	-	2	2	-	-	1	3	2	2
CO4	3	2	3	-	1	-	-	2	-	-	1		3	-	-
CO5	3	3	3	-	-	-	1	2	-	-	-	2	2	2	3

22MMPEXXX	ENERGY CONSERVATION AND MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand and analyse the energy data of industries
- Carryout energy accounting and balancing
- Conduct energy audit and suggest methodologies for energy savings and
- Utilise the available resources in optimal ways

UNIT I: INTRODUCTION

Energy - Power – Past & Present scenario of World; National Energy Consumption Data – Environmental aspects associated with energy utilization –Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Instruments for energy auditing.

UNIT II: ELECTRICAL SYSTEMS

Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.

UNIT III: THERMAL SYSTEMS

Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and encon measures. Steam: Distribution & Usage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators & Refractories

UNIT IV: ENERGY CONSERVATION IN MAJOR UTILITIES

Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets

UNIT V: ECONOMICS

Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept

TEXT BOOKS:

1. Energy Manager Training Manual (4 Volumes) available at www.energymanager training.com, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.

2. Witte L.C., Schmidt P.S. and Brown D.R., Industrial Energy Management and Utilization, Hemisphere Publ., Washington, 1988..
3. Callaghn P.W., Design and Management for Energy Conservation, Pergamon Press, Oxford, 1981.

REFERENCE BOOKS:

1. Witte. L.C., P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilisation" Hemisphere Publ, Washington, 1988.
2. Callaghn, P.W. "Design and Management for Energy Conservation", Pergamon Press, Oxford, 1981.
3. Dryden. I.G.C., "The Efficient Use of Energy" Butterworths, London, 1982
4. Turner. W.C., "Energy Management Hand book", Wiley, New York, 1982.
5. Murphy. W.R. and G. Mc KAY, "Energy Management", Butterworths, London 1987.

COURSE OUTCOMES:

Upon completion of this course, the students

1. Will get basic knowledge on the energy consumption around the world.
2. Will get knowledge on various electrical systems.
3. Analyse the energy data of industries.
4. Carryout energy accounting and balancing
5. Suggest methodologies for energy savings

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	2	1	-	-	-	-	-	-	2	-	-	1	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO3	-	3	-	2	-	-	-	-	-	-	-	-	-	2	-
CO4	-	-	-	-	-	-	-	-	-	3	-	-	-	-	2
CO5	2	-	-	-	-	-	-	-	-	-	3	-	-	-	2

22MMPEXXX	**MEMS AND NEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To introduce the changes in properties of materials with dimension reduction and materials for MEMS.
- To provide overview of microfabrication processes applicable for MEMS.
- To introduce students on the working principle of typical micro-sensors, micro-actuators and MEMS devices and the role of packaging.
- To apply knowledge on strength of materials, thermal and design engineering in design of MEMS devices.
- To familiarize the properties and method of synthesis of nanomaterials and progress of MEMS to nano system.

UNIT I

Miniaturization of Systems Need for miniaturization, Microsystems versus MEMS, Need for micro fabrication, smart materials, Structure and Systems, Application of smart material and Micro system. Scaling of Physical Systems, Geometric Scaling, Mechanical

System Scaling, Thermal System Scaling, Computational Issues of Scale, Fabrication Issues of Scale, Material Issues

UNIT II

Microsystem fabrication processes: Structural and Sacrificial Materials, Thin film deposition: Evaporation, Sputtering, Chemical vapour deposition, Epitaxial growth of silicon, Thermal Oxidation - Lithography: Photolithography, Lift-off technique, X- ray and Electron beam lithography. Impurity doping: Diffusion based and Ion implantation based doping. Etching: Isotropic etching, Anisotropic etching, Etch stops – Dry etching: Plasma etching, Reactive Ion etching, Deep reactive iron etching - Surface Micromachining – Bulk versus surface micro machining. Wafer bonding techniques – Dissolved wafer processes - LIGA process. Packaging: Microsystems packaging – Objectives - Essential packaging technologies - Selection of packaging materials

Unit III

Principles of sensing and actuation – Mechanical sensors and actuators: Beam and cantilever – corrugated diaphragm – capacitive sensors – piezoelectric material as sensing and actuating elements – strain, pressure and flow measurement – MEMS gyroscope – Inch worm technology.

Thermal sensors and actuators: Thermistors – Thermodevices – Thermocouple – Thermal flow sensors – MEMS relay – shape memory alloys – Micro spring thermal actuators.

UNIT IV

Micro-Opto electromechanical systems – principle – light modulators – beam splitter -micro lens – optical switch.

Magnetic sensors and actuator: Magnetic materials for MEMS, magenetic sensing and detection – magneto resistive sensors – MAGMEMS actuators – bidirectional micro actuators. Radio frequency MEMS: Tuners – resonators – switch – phase shifter – application areas.

UNIT V

Nanofabrication Techniques: E-beam nanofabrication - Epitaxy and strain engineering – Scanning probe techniques – physical and chemical self-assembly and template manufacturing – Template manufacturing technique - Nanoimprint Lithography.

TEXT BOOKS

1. G.K. Ananthasuresh, K. J. Vinoy, S. Gopalakrishnan, K. N. Bhat, V. K. Aatre, Micro and Smart Systems Technology and Modeling, Wiley, 2012
2. Mahalik N P. Tata McGraw-Hill Education, 2007
3. Bharat Bhushan, Springer Handbook of Nanotechnology, Springer, 2017

REFERENCE BOOKS:

1. Tai Ran Hsu ,MEMS and Microsystems Design and Manufacture ,Tata Mcraw Hill, 2002.
2. Chang Liu, Foundations of MEMS, Pearson education India limited, 2006
3. Stephen D. Senturia,, Micro system Design, Kluwer Academic Publishers,2001
4. Marc Madou, Fundamentals of Micro fabrication, CRC press ,1997.

COURSE OUTCOMES:

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

1. Identify the changes in properties of materials with reduction of dimensions by Scaling laws and choice of materials for MEMS.
2. Define the principles of microfabrication techniques applicable for MEMS.
3. Enumerate the functioning of MEMS sensors, actuators and devices as well as packaging.
4. Apply knowledge on strength of materials, design and thermal engineering for development of MEMS.
5. Define the properties and method of synthesis of nanomaterials and recognize their role in nanosystems.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	2	-	1	-	-	-	-	-	-	1	3	1	-
CO2	3	1	1	-	-	-	-	-	-	-	-	1	3	1	-
CO3	3	2	-	1	-	-	-	-	-	-	-	-	3	1	-
CO4	3	2	1	2	-	-	-	-	-	-	-	1	2	1	1
CO5	3	-	1	1	-	-	-	-	-	-	-	1	2	1	-

22MMPEXXX	**DESIGN OF JIGS, FIXTURES AND PRESS TOOLS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the functions and design principles of Jigs, fixtures and press tools
- To gain proficiency in the development of required views of the final design.
- To develop capability to analyze and evaluation of design of Jigs and Fixtures.

UNIT – I LOCATING AND CLAMPING PRINCIPLES:

Work holding devices - Function of Jigs and fixtures – General rules for designing jigs or fixtures – Factors to be considered for design jigs and fixtures – Locating principles – Degrees of freedom – 3-2-1 principles - Locating methods and devices – Redundant Location – Clamping Principles – Types of Clamps - Mechanical actuation Clamps – pneumatic and hydraulic actuation Standard parts – Drill bushes and Jig buttons – Tolerances and materials used.

UNIT – II JIGS AND FIXTURES

Design and development of jigs – Elements of jigs - Types of Jigs – Post, Turnover, Channel, latch, box, pot, angular post jigs – Indexing jigs – Design principles of Fixtures – Types of fixtures - General principles of milling, Lathe, boring, broaching and grinding fixtures – Assembly, Inspection and Welding fixtures – Modular fixtures - Assembly fixtures.

UNIT – III PRESS WORKING

Operations – types of presses – principle accessories of press — Press working operations - Accessories Dies and Punches– Types of Dies - Press work Materials – Design of various elements of dies – Die Block – punch holder, Die set, guide plates – Stops – Strippers – Pilots – Selection of Standard parts – Design and preparation of four standard views of simple blanking, piercing - compound Die - progressive dies.

UNIT – IV BENDING AND DRAWING DIES

Difference between bending and drawing – Blank development for above operations – Types of Bending dies – Press capacity – Spring back – knockouts – direct and indirect – pressure pads -Ejectors – Variables affecting Metal flow in drawing operations – draw die inserts – draw beads- ironing – Design and development of bending, forming, drawing, reverse redrawing and combination dies – Blank development for axisymmetric, rectangular and elliptic parts – Single and double action dies.

UNIT – V FORMING TECHNIQUES AND EVALUATION

Solid form Dies – Pressure pad forming dies – Bulging - Swaging - Embossing – Coining - Curling, hole flanging, shaving and sizing, assembly, fine Blanking dies – recent trends in tool design- computer Aids for sheet metal forming Analysis – basic introduction – tooling for numerically controlled machines- setup reduction for work holding – Single minute exchange of dies

TEXT BOOKS:

1. C.Elanchezhian, T.Sunder Seiwyn and B.Vijay Ramnath, Design of Jigs, Fixtures and Press tools, 2017
2. Joshi, P.H. Jigs and Fixtures, Second Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2010
3. Joshi P.H Press tools – Design and Construction, wheels publishing, 1996

REFERENCES:

1. ASTME Fundamentals of Tool Design Prentice Hall of India.
2. Design Data Hand Book, PSG College of Technology, Coimbatore.
3. Venkataraman. K., Design of Jigs Fixtures and Press Tools, Tata McGraw Hill, New Delhi, 2005.
4. P.C.Sharma, A Text book of Production Engineering , 2002
5. P.C.Sharma, A Text book of Manufacturing Technology - 2

COURSE OUTCOMES:

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

1. Summarize the different methods of Locating Jigs and Fixtures and Clamping principles
2. Design and develop jigs and fixtures for given component
3. Discuss the press working terminologies and elements of cutting dies
4. Distinguish between Bending and Drawing dies.
5. Discuss the different types of forming techniques

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	1	-	-	-	-	-	-	-	-	-	1	-	-
CO2	3	2	3	-	-	-	-	-	-	-	-	-	-	2	3
CO3	2	1	2	-	-	-	-	-	-	-	-	-	1	2	-
CO4	3	1	2	-	-	-	-	-	-	-	-	-	-	2	-
CO5	2	3	2	-	-	-	-	-	-	-	-	-	1	2	-

22MMPEXXX	SURFACE ENGINEERING AND TRIBOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- Educate the importance of surface modifications Techniques.
- Illustrate the causes of surface damage and its effect on performance of Components
- To impart knowledge to students on controlling the wear by surface modification techniques.
- Educate the students for changing the surface metallurgy and its composition
- Illustrate advanced surface coating techniques and surface characterization studies.

UNIT- I

Surface Engineering: Introduction – Purpose and Need of Surface Engineering in Industries – Surface and Subsurface Regions - Properties for the Enhanced Life and Performance of Mechanical Components - Classification of Surface Modification Techniques - Scope of Surface Engineering - Role of Surface Properties Affecting Wear and Friction Behavior - Advantages, Limitations, and Applications.

UNIT- II

Surface Damage: Causes and Mechanisms - Material Properties and Its Effect on Performance of Components - Common Factors Leading to the Deterioration of Surfaces - Types of Wear and Mechanisms and Classical Governing Laws - Techniques to Evaluate Damage of Wear Surfaces.

UNIT- III

Materials for Controlling the Wear: Materials Properties and Wear - Materials Properties Required for Better Wear Resistance - Selection of Materials for Surface Engineering - Structure and Wear of Material - Common Materials for Surface Modifications for Specific Applications - Common Materials and Their Typical Applications.

UNIT- IV

Surface Engineering by Changing the Surface Metallurgy and Changing the Composition – Approach - Transformation Hardening Methods Re-melting of Base Metal or Modified Surfaces Using Laser and TIG - Plastic Deformation-Based Approaches. Approach - Carburizing - Nitriding - Plasma Carburizing and Plasma Nitriding - Surface Modification by Changing Chemical Composition - Surface Modification Using Diffusion-Based Processes - Ion Beam-Assisted Deposition – Boronizing.

UNIT- V

Surface Modification by Developing Coating and Cladding and Characterization of Engineered Surfaces: Approach - Technical Factor Affecting Performance - Metals for Developing, Coating, and Cladding - Weld Surfacing – Hardfacing -Laser Cladding - Thermal Spraying - Electroplating - Electroless Process. Characterization of Surface Properties - Thickness of Coatings and Films - Bond Strength of Coating–Substrate - Soundness of Modified Surfaces Using Non-destructive Testing (NDT) - Destructive Testing of Modified Surfaces - Adhesive Wear - X-Ray Diffraction (XRD) Analysis - Scanning Electron Microscopy (SEM) - Compositional Analysis - Energy Dispersive X-Ray (EDAX) Analysis - Macroscopic Observation - Metallographic Examination.

TEXT BOOK:

1. Dwivedi, Dheerendra Kumar, Surface Engineering: Enhancing Life of Tribological Components

REFERENCE BOOKS:

1. Metals Hand Book on Surface Engineering, 8th edition , ASM,1994.

COURSE OUTCOMES:

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

1. Develop the skills on surface modification techniques.
2. Describe the factors in the deterioration of interning the deteriorations of surfaces.
3. Understand the properties of materials and develop skills for selection of materials.
4. Experiment the procedure for changing the metallurgy of surface.
5. Explain different types of advanced surface modification techniques and characterization studies.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	3	-	2	-	-	-	-	-	3	3	3	2
CO2	3	2	2	3	-	2	-	-	-	-	-	2	2	2	1
CO3	2	2	3	3	-	2	-	-	-	-	-	2	3	3	2
CO4	3	3	2	2	-	2	-	-	-	-	-	2	3	1	1
CO5	3	3	2	3	-	2	-	-	-	-	-	2	2	2	2

22MMPEXXX	ARTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the fundamentals of artificial intelligence, knowledge representation and reasoning
- To familiarize the basic problem solving methods and its applications
- To introduce basic concepts of machine learning, Bayesian Decision Theory and Normal Distribution.

UNIT - I INTRODUCTION

Artificial Intelligence: Definition – Problems, Problem spaces and search – Heuristic Search Techniques. Intelligent Agents: Agents and Environments – Rationality – Nature of Environments – Structure of Agents – Examples

UNIT - II KNOWLEDGE REPRESENTATION AND REASONING

Issues in knowledge representation – Predicate logic – Symbolic reasoning under uncertainty statistical reasoning – weak, strong slot and filter structures

Ontological Engineering Categories and Objects – Actions, situations and Events – Applications

UNIT - III PROBLEM SOLVING METHODS

Problem solving by searching: Problem solving agents – uninformed search strategies. Informed search: A* search, Heuristic Search – Local search algorithms and optimization

problems. Constraint satisfaction problems. Adversarial search: Games, Alpha-beta Pruning – Examples

UNIT – IV BAYESIAN DECISION THEORY AND NORMAL DISTRIBUTION

Machine perception – feature extraction – classification, clustering, linear and logistic regression – Types of learning – Bayesian decision theory – classifiers, discriminant functions, and decision surfaces – univariate and multivariate normal densities – Bayesian belief networks

UNIT – V CLASSIFICATION OF ALGORITHMS

Perceptron and backpropagation neural network – k-nearest-neighbor rule Support vector machine: multi-category generalizations – Regression Decision trees: classification and regression tree – random forest – Applications

TEXT BOOKS:

1. Elaine Rich, Kevin Knight, Shivashankar B. Nair, Artificial Intelligence, Tata McGraw Hill
2. Ethem Alpaydin, Introduction to Machine Learning, MIT Press

REFERENCE BOOKS:

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach, Prentice Hall
2. R. O. Duda, E. Hart, and D.G. Stork, Pattern classification, Second edition, John Wiley & Sons, Singapore

COURSE OUTCOMES:

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

1. Build intelligent agents for solving real time problems in the environment
2. Apply the suitable knowledge representation method for solving problems using symbolic reasoning and uncertainty
3. Design problem solving approaches using search algorithms including uninformed search, informed search and heuristic search
4. Understand the basic concepts of Bayesian theory and normal densities
5. Implement different classification algorithms used in machine learning

	Mapping with Programme Outcomes												Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO3	-	1	1	1	1	-	-	-	-	-	-	-	1	-	-
CO4	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-

22MMPEXXX	**INTERNAL COMBUSTION ENGINES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To familiarize with the terminology associated with IC engines.
- To understand the basics of IC engines.

- To understand combustion, and various parameters and variables affecting it in various types of IC engines.
- To learn about various systems used in IC engines and the type of IC engine required for various applications

UNIT-I - SI and CI Engine Combustion

SI engine combustion - combustion phenomenon – normal and abnormal combustion - pre ignition and detonation – effects and factors affecting knocking – factor influencing combustion chamber design – types of combustion chambers – CI engine combustion - combustion phenomenon – delay period – diesel knock – criteria for combustion chamber design – types of combustion chambers – cold start of CI engine

UNIT-II – Ideal, Fuel – Air and Actual Cycles

Review of ideal cycles – fuel-air cycles – factors and assumptions - variable specific heats – effect on internal energy, enthalpy, entropy, expansion and heat transfer – effect on air standard efficiencies - effect of variation of specific heats – effect of common engine variables – actual cycles – factors affecting losses of actual cycle – comparison of ideal, fuel-air and actual cycles

UNIT-III - Fuel Supply Systems

Fuel supply system in SI engine – air fuel mixture formation – carburettors – mixture requirement at operating conditions – types of carburettors – design and operating principles – electronically controlled carburettors – gasoline injection systems – single point fuel injection – multi point fuel injection(MPFI) – gasoline direct injection(GDI) – fuel supply system in CI engine – fuel metering requirements – mechanical injection – common rail injection – fuel supply computations in SI and CI engine

UNIT-IV – Auxiliries and Testing of IC Engine

Ignition system of SI engine – requirements - battery ignition system – magneto ignition system – electronic ignition system – lubrication system – engine friction – types of lubrication - wet sump, dry sump and mist lubrication – engine cooling – necessity of engine cooling – types of cooling – air cooling – liquid cooling – testing of IC engine – performance parameters – performance of SI and CI engine – emission formation in SI and CI engine - strategies for emission control – in-cylinder and after burn control

UNIT-V - Advanced Engines

Advanced IC engine concept – gasoline direct injection (GDI) engine – homogeneous charge, stratified charge – spray, wall and air guided - ignition technology – plasma ignition – Lean burn concept – dual fuel engine - high pressure compression ignition engine - Homogeneous Charge Compression Ignition (HCCI) engine - hybrid electric vehicles – add on devices - variable valve timing (VVT) – VTEC - downsizing and turbo charging and their types.

TEXT BOOKS:

1. Obert E. F, “Internal Combustion Engines and Air Pollution”, Harper and Row Publication Inc. NY, 1973.
2. Heisler H, “Advanced Engine Technology”, Edward Arnold, 1995.

REFERENCE BOOKS:

1. Heywood J. B, "Internal Combustion Engine Fundamentals", McGraw Hill Book Co. NY, 1989
2. Heldt P. M, "High Speed Combustion Engines", Oxford & IBH publishing Co. India, 1985.
3. Stockel M W, Stockel T S and Johanson C, "Auto Fundamentals", The Goodheart, Wilcox Co. Inc., Illinois, 1996.
4. Bosch "Automotive Handbook", Fifth Edition, SEA Society of Automotive Engineers,400 Common wealth Drive, Warrendale, USA, 2000
5. Rajput R.K. "Internal Combustion Engines" Lakshmi Publications (P) Ltd., New Delhi, Second Edition reprint 2008.

COURSE OUTCOMES:

Upon completing this course, students should be able to:

1. Explore the working of advanced engines
2. Explore the various working cycles
3. Explore the combustion phenomenon
4. Analyze the different fuel supply system in a engine
5. Analyze the engine auxiliaries and performance of the engine

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	1	-	1	-	-	-	-	1	1	2	-
CO2	3	-	-	-	1	-	1	-	-	-	-	1	1	2	-
CO3	3	-	-	-	1	-	1	-	-	-	-	1	-	2	-
CO4	3	-	-	-	1	-	1	-	-	-	-	1	-	2	-
CO5	3	-	-	-	1	-	1	-	-	-	-	1	-	3	-

VI SEMESTER: PROFESSIONAL ELECTIVES

22MMPEXXX	TOTAL QUALITY MANAGEMENT AND RELIABILITY ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide an understanding and impart the knowledge and on the application of conventional and modern tools and techniques of TQM which are used in manufacturing and service industries.
- To understand the various principles, practices of TQM to achieve quality and for continuous process improvement.
- To understand the concepts and importance of reliability.

UNIT I

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality.

Basic concepts of TQM – Principles of TQM - TQM Framework - TQM implementation - Barriers to TQM - difference between traditional and TQM organization.

Contributions of Quality Gurus – Philosophies – Deming - Deming's chain reaction - 14 points – seven deadly diseases of management – Crosby - four absolutes - 14 steps - Juran - quality trilogy.

UNIT II

Customer focus- introduction - customer satisfaction - customer perception of quality - Customer complaints - service quality - translating needs to requirements - Kano model - Customer retention.

Supplier partnership – customer / supplier relations – partnering – sourcing - Supplier selection - relationship development - Supplier Rating.

Continuous process improvement – improvement strategies - PDCA cycle - 5s – Kaizen - Poka-yoke.

UNIT III

The seven traditional tools of quality – New management tools. Six-sigma – Concepts – methodology – DMAIC - implementation – Various formulae to measure different metrics related to Six Sigma defects - applications to manufacturing, service sector including IT.- Bench marking – Types – reasons - Bench marking process - pitfalls and criticisms.

UNIT IV

Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function - Goal post view of Quality vs. Taguchi's loss function approach.

Performance measures - Introduction - Balance score card - Quality costs - Quality awards - Malcolm Baldrige national quality award.

Quality System - ISO 9000 standards – ISO 9001:2015 – principles - requirements – Documentation – implementation – auditing – Advantages and disadvantages. QS 9000 – ISO 14000 – Concepts - requirements - Benefits.

UNIT V

Reliability: Introduction – Definition – factors affecting reliability – methods to improve reliability – failure data analysis - Failure Rate – hazard rate - Mean Time Between Failures (MTBF)-Mean Time To Failure (MTTF) – Types of failures - Bathtub curve- – Evaluation of reliability – Series, Parallel and series parallel systems - stand-by redundancy - Down time, Repair time, Availability. Failure Mode Effect Criticality Analysis (FMECA): Introduction – Types – FMECA worksheet - procedure - risk priority number (RPN).

TEXT BOOKS:

1. Besterfield Dale H., Carol Besterfield-Michna., Glen H Besterfield., and Mary Besterfield- Scare., "Total Quality Management", PHI, 3rd edition, 2007.
2. Gupta A.K., "Reliability Engineering and Terotechnology", Macmillan India Limited, 1996.
3. Poornima M. Charantimath., "Total Quality Management", Pearson, 3rd edition, 2017.

REFERENCE BOOKS:

1. James R Evans and William M Lindsay, "Managing for Quality and Performance Excellence", Cengage Learning, 10th edition, 2016.
2. Jayakumar V., and Raju R., "Total Quality Management", Lakshmi Publications, 2018.
3. Janakiraman B and Gopal R.K., Total Quality Management: Text and Cases, PHI, 2006.

4. Srinath L.S., Reliability Engineering, Affiliated East West Press, 2005.
5. Sunil Luthra., Dixit Garg., Ashish Agarwal and Sachin K Mangla., "Total Quality Management (TQM): Principles, Methods and Applications, CRC Press, 2021.

COURSE OUTCOMES:

Upon completing this course, students should be able to:

1. Understand the core features of the Total quality management in terms of various dimensions of quality in manufacturing and service processes and develop an understanding on quality management philosophies and frameworks.
2. Develop an understanding of customer perception of quality and to understand the methods of developing relationship with supplier.
3. Develop the ability to apply the tools of quality control and quality management for continuous process improvement and to understand proven methodologies to enhance management processes, such as six sigma and benchmarking.
4. Measure the cost of poor quality and process effectiveness and efficiency to track performance quality and to identify areas for improvement.
5. Able to understand the basic concepts of reliability and to identify and analyze the failures of the components and subcomponents of mechanical and electronic items, and also should be able to explain the purpose of redundancy in a system.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	1	2	2	1	3	2	1	1	2	1	2	3	2
CO2	2	1	2	2	2	2	3	2	1	-	2	1	2	3	2
CO3	2	1	3	3	3	1	3	3	2	-	2	2	2	3	3
CO4	2	1	3	2	2	1	2	2	1	2	2	2	2	3	2
CO5	2	1	3	3	3	2	3	3	1	-	2	2	3	3	3

22MMPEXXX	**SUSTAINABLE DEVELOPMENT AND MANUFACTURING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To introduce the concepts of sustainability and sustainable development
- To understand the theoretical and practical perspectives of sustainable manufacturing
- To impart knowledge on tools and techniques used for sustainable manufacturing
- To introduce the frameworks utilized for measuring sustainability

UNIT I

Concepts of sustainability and sustainable development – need for sustainable development – components of sustainability – Social, Economic, Environmental dimensions – linkages between technology and sustainability – sustainable manufacturing – scope, need and benefits.

UNIT II

Sustainable Manufacturing Tools – Environmental conscious Quality function deployment (ECQFD), Life cycle assessment (LCA) – methods – CML, Eco indicator 95 and Eco indicator 99 – Design for environment – R3 and R6 cycles – Design for disassembly – Factors affecting, types and design for active disassembly

UNIT III

Standards for Sustainable Manufacturing – ISO 14001 Environmental Management System (EMS) and PAS 2050 standard – Environmental impact parameters – Interactions between energy and technology and their implications for environment and sustainable development.

UNIT IV

Design for recycling – Recycling process – Types – Eco friendly product design methods – Review of eco design strategies and methodologies – product sustainability and risk-benefit assessment – Corporate social responsibility

UNIT V

Frameworks for measuring sustainability – sustainability indicators – Environmental, Economic and Social based — sustainability and energy aspects of manufacturing process – Sustainability of conventional/unconventional manufacturing processes – sustainability of additive manufacturing process

TEXTBOOKS:

1. G. Atkinson, S. Dietz, E. Neumayer, — Handbook of Sustainable Manufacturing. Edward Elgar Publishing Limited, UK, 2007.
2. S. Vinodh, Sustainable Manufacturing Concepts, Tools, Methods and Case Studies, first edition, CRC Press, 2020.

REFERENCE BOOKS:

1. P. Lawn, Sustainable Development Indicators in Ecological Economics, Edward Elgar Publishing Limited.
2. S. Asefa, The Economics of Sustainable Development, W.E. Upjohn Institute for Employment Research, 2005.
3. D. Rodick, Industrial Development for the 21st Century: Sustainable Development Perspectives, UN New York, 2007.
4. Rogers, P.P., Jalal, K.F. and Boyd, J. A., "An introduction to Sustainable Development", Earth scan, London, 2007.

COURSE OUTCOMES:

At the end of the course, the students would

1. Able to explain the concepts of sustainability and its components
2. Acquired skills in selecting the suitable sustainable manufacturing tools
3. Gained knowledge on the standards and environmental impact parameters of sustainable manufacturing
4. Able to design the recycling process and explain the role of corporate social responsibility
5. Actively employ the frameworks for measuring sustainability

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	1	3	1	3	1	-	-	-	2	3	-	1
CO2	3	2	2	2	3	2	2	-	-	-	-	1	3	2	1
CO3	3	2	1	-	2	2	3	-	1	1	1	1	3	2	2
CO4	3	2	2	-	1	-	2	-	-	-	1	1	3	1	1
CO5	3	2	2	-	2	-	2	1	-	-	1	1	2	1	2

22MMPEXXX	MODERN MANUFACTURING STRATEGIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To provide knowledge and understanding of the modern manufacturing strategies
- To understand the role of various management techniques used in manufacturing
- To actively employ just in time and lean production principles

UNIT I

Total Productive Maintenance (TPM) – Pillars of TPM - Six big losses – TPM implementation – TPM and TQC.

UNIT II

Supply Chain Management (SCM)-Basic concepts – Supplier selection – Analytic Hierarchy Process (AHP) – Customer-supplier relationship – JIT and SCM - ERP Vs SCM-Logistics management.

UNIT III

Just-in-time (JIT) and Lean production- JIT principles – Objectives – value added focus - Sources of waste – Waste reduction – Structure of lean production systems - push system-pull system – push vs pull system – kanban – Autonomation – Poka yoke (Error prevention) – JIT implementation

UNIT IV

Business Process Re-engineering (BPR)- Basic concepts – TQM and BPR – Traditional IE and BPR- Benchmarking-Types of benchmarking- Concurrent Engineering and design for manufacturing and assembly - Agile Manufacturing- Small lot Production – Setup time reduction – SMED methodology.

UNIT V

Other Management Techniques - Technology Management – Strategic Management - Decision Support Systems (DSS) – Manufacturing flexibility - Enterprise wide information system (EWIS) – Enterprise resource planning (ERP) – selection of ERP - Product development – SWOT analysis – Value stream mapping – Customer relationship management – Re-Manufacturing.

TEXT BOOKS:

1. Industrial Engineering and Management, Ravishankar, Galgotia Publications pvt. Ltd., New Delhi. 2002

2. Competitive Manufacturing Management, Nicholas J.M., TMH, New Delhi. 2001.

REFERENCE BOOKS:

1. Advanced Operations Management, Mohanty R.P., and Deshmukh S.G., Pearson Education (Singapore) Pvt. Ltd., New Delhi, India.2003.
2. Introduction to Total Productive Maintenance, Seiichi Nakeiima, Productivity Press (India) Pvt Ltd., Madras, 1988.
3. Mikell P Groover, Automation Production Systems and Computer Integrated Manufacturing, Pearson Education, New Delhi, 2001
4. Paul M. Swamidass, Innovations in competitive manufacturing, springer science business media, New york, 2000.

COURSE OUTCOMES:

Upon completing this course, students should be able to:

1. Recognize and apply the concept of Total Productive Maintenance
2. Understand the roles of supply chain among various business functions and their roles in the organizations strategic planning and gaining competitive advantage
3. Analyze in finding the source of waste and apply waste reduction techniques
4. Apply Business Process Re-engineering techniques
5. Gain knowledge on the applications of various Management techniques/concepts

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	2		3	1	-	-	-	-	2	2	3	2	1
CO2	3	2	2	2	2	-	-	-	-	-	-	1	3	2	1
CO3	3	-	2	-	3	-	1	-	1	1	1	1	3	2	2
CO4	3	-	-	-	3	-	-	-	-	-	2	1	3	1	1
CO5	3	-	-	-	3	-	-	-	-	2	-	-	2	3	1

22MMPEXXX	**PRODUCT DESIGN AND DEVELOPMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- Appraise the fundamentals of modern product and process development
- Understand the role of multiple functions in creating a new product (e.g. marketing, finance, industrial design, engineering, production)
- Understand the concept of Design for manufacture and assembly

UNIT I INTRODUCTION

Need for Integrated Product and Process Development (IPPD) – Strategic importance of Product development – integration of customer, designer, material supplier and process planner, Competitor and customer – Behaviour analysis. Understanding customer – prompting customer understanding – involve customer in development and managing requirements – Organization – process management and improvement – Plan and establish product specifications.

UNIT II CONCEPT GENERATION AND SELECTION

Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology –benefits.

UNIT III PRODUCT ARCHITECTURE

Implications – Product change – variety – component standardization – product performance– manufacturability – product development management – establishing the architecture –creation – clustering – geometric layout development – fundamental and incidentalinteractions – related system level design issues – secondary systems – architecture of thechunks – creating detailed interface specifications.

UNIT IV INDUSTRIAL DESIGN

Integrate process design – Managing costs – Robust design – Integrating CAE, CAD, CAMtools – Simulating product performance and manufacturing processes electronically – Needfor industrial design – impact – design process – investigation of for industrial design –impact – design process – investigation of customer needs – conceptualization – refinement –management of the industrial design process – technology driven products – user–driven products – assessing the quality of industrial design.

UNIT V DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT

Definition – Estimation of Manufacturing cost – reducing the component costs and assemblycosts – Minimize system complexity – Prototype basics – principles of prototyping –planning for prototypes – Economic Analysis – Understanding and representing tasks –baseline project planning – accelerating the project – project execution.

TEXT BOOKS:

1. Product Design and Development, Kari T.Ulrich and Steven D.Eppinger, McGraw-Hill International Edns. 1999.

REFERENCE BOOKS:

1. Concurrent Engg./Integrated Product Development, Kemnneth Crow, DRM Associates, 26/3,Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book.
2. Effective Product Design and Development, Stephen Rosenthal, Business One Orwin, Homewood, 1992.
3. Tool Design -Integrated Methods for Successful Product Engineering, Staurt Pugh Addison Wesley Publishing, New york, NY.

COURSE OUTCOMES:

At the end of this course, students will able to

1. Assess the customer requirements and establish specifications in product design
2. Demonstrate the set of tools and methods for product design and development
3. Apply structural approach to concept generation
4. Identify various aspects of industrial design
5. Outline the various principles and technologies used for prototyping

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	3	3	2	3	-	1	2	-	3	1	2	3	2	-
CO2	-	1	3	2	1	-	1	2	-	2	1	-	3	2	-
CO3	-	2	3	2	1	-	1	2	-	2	1	-	3	2	-
CO4	-	-	3	2	1	-	1	2	-	2	1	-	3	2	-
CO5	-	-	3	2	1	-	1	2	-	2	1	-	3	2	-

22MMPEXXX	NON-TRADITIONAL MANUFACTURING PROCESSES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the contribution of non-traditional machining process in micro and precision manufacturing field.
- Select suitable machining process for suitable materials
- Summarizes the merits and demerits of the non-traditional manufacturing process

UNIT-1

Introduction - Classification - process economy - Mechanical machining - Types - Ultrasonic machining (USM) - Abrasive Jet Machining (AJM) - Abrasive Flow Machining (AFM) - Water Jet Machining (WJM) - Operating principle - Process parameters - Applications - Limitations.

UNIT-II

Electro chemical machining - Chemical material removal - Types - Electro chemical machining (ECM) - Electro chemical drilling (ECD) - Electro chemical grinding (ECG) - Electro chemical honing (ECH) - Shaped tube electrolytic machining - Operating principle - Process parameters - Applications - Limitations.

UNIT-III

Thermo electrical machining - Types – Electrical discharge machining (EDM) - Electrical discharge wire cutting (EDWC) - Electron beam machining (EBM) - Ion Beam Machining (IBM) - Plasma Arc Machining (PAM) - Operating principle - Process parameters - Applications - Limitations

UNIT-IV

Laser materials processing - Laser types - Processes - Laser beam machining (LBM) – Laser cutting (LC) – Laser drilling (LD) - Laser marking and engraving (LM) - Laser micromachining (LMM) - Laser engineered net shaping (LENS) - Applications - Limitations.

UNIT-V

Special processing technologies - Rapid Prototyping - Methods - Fused Deposition Modeling (FDM) - Laminated Object Manufacturing (LOM) - Selective laser sintering (SLA) - Solid Ground curing (SGC) - 3D printing (3DP) - Processing of integrated circuits - Micro and nano fabrication technologies.

TEXT BOOKS:

1. Abdel, H. and El-Hofy, G. “Advanced Machining Processes”, McGraw-Hill, USA, 2005.
2. Wellar, E.J. "Non-Traditional Machining Processes", Society of Manufacturing Engineers Publications, 2nd Edition, Michigan, 1984.

REFERENCE BOOKS:

1. Steen, W.M. and Watkins, K. “Laser Materials Processing”, Springer London Ltd, 2003.
2. Groover, M.P. “Fundamentals of modern manufacturing processes - Materials, Processes and Systems”, 3rd Edition, John Wiley and Sons Inc., 2007.

COURSE OUTCOMES:

At the end of this course, students will able to

1. Appraise the concepts of micro level mechanical metal removal processes
2. Asses the principles of chemical and electro-chemical metal removal processes
3. Demonstrate the principles of thermo-electric metal removal processes
4. Outline the importance of laser processing of materials
5. Understand the concepts of micro- and nano- fabrications techniques

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	2	2	-	-	-	-	2	-	-	2	2	-
CO2	2	1	1	2	2	-	-	-	-	2	-	-	2	2	-
CO3	2	1	1	2	2	-	-	-	-	2	-	-	2	2	-
CO4	2	1	1	2	2	-	-	-	-	2	-	-	2	2	-
CO5	2	1	1	2	2	-	-	-	-	2	-	-	2	2	-

22MMPEXXX	MICRO AND NANO MACHINING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To teach the basic concepts and applications of micro and nano machining processes.
- To impart Knowledge about the advanced Machining process
- To edify the operating principles of thermo-Electric machining process
- To educate High energy Machining process and their importance to the Current situation
- To demonstrate working principle of different advanced finishing processes prevailing in the market

UNIT I INTRODUCTION

Classification and types of machining process, Traditional micromachining- Theory of micromachining – Chip formation – Size effect in micromachining, Fundamentals of micro and Nano machining, micro turning, micro drilling, micro milling, micro grinding, Diamond turn machining, Applications and Limitations of micro machining.

UNIT II ADVACED MECHANICAL MICRO AND NANO MACHINING PROCESSES

Introduction – classification of advanced Mechanical Micro – Nano Machining processes, Abrasive Jet Micromachining (AJM), Water Jet Micromachining (WJM), Abrasive Water Jet Machining (WJM), Ultrasonic Micromachining (USM).

UNIT III ADVANCED THERMO-ELECTRIC MICRO – NANO MACHINING PROCESSES

Operating principles and processes parameters of Electric Discharge Micromachining, Electric Discharge Grinding and Electric Discharge Diamond Grinding, Wire Electric Discharge Micromachining.

UNIT IV HIGH ENERGY AND ADVANCED ELECTRO CHEMICAL MICRO NANO MACHINING PROCESSES

Operating principles and processes parameters of Laser Beam Micromachining (LBM), Electron Beam Micromachining (EBM), Focused Ion Beam Micromachining, Electrochemical Micromachining, Electrochemical Micro Grinding, Electro stream micro drilling, Electro-chemical Micro deburring.

UNIT V MODERN FINISHING PROCESSES

Advanced Finishing Processes (AFP), abrasive flow machining, (AFM), Magnetic abrasive finishing (MAF), magnetic float polishing (MFP), elastic emission machining (EEM), chemical mechanical polishing (CMP), Abrasive Flow Nano Finishing, Magnetic Abrasive Nano finishing.

TEXT BOOKS

1. Golam Kibria, B. Bhattacharyya, J. Paulo Davim, Non-traditional micro machining processes: Fundamentals and applications, Springer International publishing, 2017.
2. V.K. Jain, Micro manufacturing processes, CRC press Taylor & Francis group, 2013 (e-book)

REFERENCE BOOKS

1. H. EL-Hoof, Fundamentals of Machining Processes: Conventional and non - conventional, 2nd edition, CRC press, Taylor & Francis group, 2014.

COURSE OUTCOMES

On completion of this course the students will be able to

1. Acquire the knowledge on traditional micro and nano machining process and their process parameters.
2. Learn the working principles and process parameters of Advanced Machining Processes
3. Understand the concepts of Advanced thermo electric machining Processes and their process parameters.
4. Select suitable Advanced Electro-chemical, Micro-Nano Machining Processes relevant to the desired product.
5. Differentiate the advanced finishing process with conventional one

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	2	3	-	-	-	-	-	2	-	3	3	2	2
CO2	3	-	3	2	-	-	-	-	-	3	-	3	2	2	3
CO3	3	-	3	3	-	-	-	-	-	2	-	2	3	3	3
CO4	3	-	2	2	-	-	-	-	-	2	-	2	2	2	3
CO5	2	-	3	3	-	-	-	-	-	3	-	2	2	3	2

22MMPEXXX	MACHINE TOOL DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To acquaint students with the various drive systems used in machine tools.
- To understand the basic design aspects of various of machine tool components and structures.
- To understand the design aspects of Power Screw.

UNIT I

Machine tools – Machine tool drives – Hydraulic Transmission – Mechanical Transmission - Various driving systems for machine tools - Use of preferred numbers in machine tools - Stepped drives - Graphical representation of Speed - Structural and Ray Diagrams - Optimum Ray Diagram - Ruppert drive – Feed gear boxes - Norton's drive – Meander's drive.

UNIT II

Stepless Regulation systems - Types - Principles of Self aligning - methods of increasing the range of regulation in modern machine tools.

UNIT III

Machine Tool Guides - types - Design of guide ways - Wear adjustment - Anti Friction ways - Hydrodynamic and Hydro-Static Slide Ways.

UNIT IV

Machine tool Beds - types - Constructional and Design features - Design ofColumn of Drilling and Milling Machine - Stiffeners and Ribs arrangement.

UNIT V

Design of Power Screws - compensation for backlash - Re circulating Ball Screw - Spindles - Materials - Construction, Spindle supports - Preloading of BearingDesign of spindles - Air bearing and Hydrostatic bearings.

TEXT BOOKS:

1. Basu, S.K., and Pal, D.K., "Design of Machine Tools", Oxford and IBH, New Delhi, 2008.
2. Mehta, N.K., "Machine tool Design and Numerical Control", Tata McGraw-Hill, New Delhi, 2012.

REFERENCE BOOKS:

1. Sen and Bhattacharya, "Principles of Machine Tools", Volume- II, New CentralBook Agency, Calcutta, 2009.
2. Acherkan, "Machine Tool Design", Volume-I to IV, MIR Publishers, Moscow, 2000.

COURSE OUTCOMES:

Upon completing this course, students should be able to:

1. Develop an understanding of the various drive systems of machine tools and Construction of Structural diagram for speed box.
2. Acquire knowledge of various Stepless regulation of drive system used in various machine tools.
3. Get knowledge about the constructional and design features of various guide ways of machine tools.
4. Develop an understanding of the constructional and design features of machine beds and columns.
5. Acquire knowledge about develop and design of Power Screws.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	1	-	-	-	-	-	1	-	-	3	1	2
CO2	3	2	2	-	-	1	-	1	-	-	2	-	2	-	-
CO3	2	-	1	-	-	-	-	-	1	-	-	1		2	1
CO4	3	1	3	-	1	-	-	1		-	-	1	2	2	-
CO5	3	2	3	-	-	-	1	2	2	-	-	2	3	-	2

22MMPEXXX	**INTELLIGENT INDUSTRIAL ROBOTICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	3

COURSE OBJECTIVES:

- To outline the basic components and peripherals of an industrial robots
- To understand and design multiple robots cell and program it
- To enlighten the application of intelligent robots is multiple fields

UNIT I INTRODUCTION

Automation and Robotics – Brief history – State-of-the-art – Robot anatomy: Configurations, Joint motions – Joint notations – Work volume – Drives and control systems – Important definitions

UNIT II ROBOT AND ITS PERIPHERALS

Control system and its components: Robot controllers, Robot activation and feedback components, Sensors, actuators, power transmission system – Robot kinematics and Dynamics – Robot end-effectors – Grippers: Types and applications – Tools: Types and applications

UNIT III ROBOT CELL DESIGN AND CONTROL

Robot cell layouts: Robot-centered cell, In-line robot cell, Mobile robot cell – Multiple robots and machine interference – Workcell control – Interlocks – Error detection

and recovery – Workcell controller – Robot cycle time analysis – Robot programming – AI and expert systems

UNIT IV ROBOT SENSORS AND VISION SYSTEM

Robot sensors – Range sensing, proximity sensing, Touch sensing, Force and torque sensing – other robot sensors

Robot vision system: Low-level vision: Image acquisition – Illumination techniques – Imaging geometry – Pre-processing – High-level vision: Segmentation – Description – Recognition – Interpretation

UNIT V APPLICATIONS

Application of robots in various fields: Robot application in manufacturing: Materials transfer, Machine loading and unloading – Processing operations: Welding, Spray coating – Assembly and inspection – Non-conventional industrial robots: service industry, robots for agriculture, mining, exploration, underwater, civilian and military applications, nuclear applications, space applications – Humanoid robots

TEXT BOOKS:

1. Mikell P Groover, Mitchell Weiss, Roger N. Nagel, Nicholas G. Odrey, "Industrial Robots – Technology, Programming and Applications", McGraw Hill Book Company
2. Fu, K.S., Gonzalez, R.C., and Lee, C.S.G., Robotics – Control, Sensing, Vision and Intelligence, McGraw Hill Book Company

REFERENCE BOOKS:

1. Rajput, R.K., "Robotics and Industrial Automation", S. Chand & Company Ltd.
2. Deb, S.R., "Robotics Technology and Flexible automation", Tata McGraw Hill Pub., New Delhi
3. Jain, K.C, and Aggarwal, L.N., "Robotics Principles and Practice", Khanna Publishers
4. Klafter, R.D., Chmielewski, T.A., and Negin. M, "Robot Engineering - An Integrated Approach", Prentice Hall of India, New Delhi

COURSE OUTCOMES:

Upon completing this course, students should be able to:

1. Understand the importance of automation and the role of robots in modern manufacturing
2. Recognize the basic robot peripherals
3. Distinguish robotic cell layouts and programming
4. Appreciate the role of sensors and robotic vison system in modern robots
5. Select appropriate robots for industrial and non-industrial applications

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-
CO2	-	-		-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-		-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-
CO5	-	-	1	1	1	-	-	-	-	-	-	-	1	-	-

22MMPEXXX	AUTOMOBILE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the construction and working principle of various parts of an automobile
- To learn the present scenario of Indian Automotive industry.

UNIT -I

Types of automobiles, vehicle construction and layouts, chassis, frame and body, vehicle aerodynamics, IC engines -components, function and materials, variable valve timing (VVT).Present Scenario of Indian Autom otive industry.

UNIT -II

Engine auxiliary systems, electronic injection for SI and CI engines, Unit - injector system, rotary distributor type and common rail direct injection system, transistor based coil ignition & capacitive discharge ignition systems, turbo chargers (WGT, VGT), engine emission control by 3 -way catalytic converter system, Emission norms (Euro & BS).

UNIT -III

Transmission systems, clutch types & construction, gear boxes - manual and automatic gear shift mechanisms, Over drive, transfer box , flywheel, torque converter, propeller shaft, slip joints, universal joints, differential and rear axle, Hotchkiss drive and Torque tube drive.

UNIT -IV

Steering geometry and types of steering gear box, power steering, types of front axle, types of suspension systems, pneumatic and hydraulic braking systems, antilock braking system (ABS),electronic brake force distribution (EBD) and traction control.

UNIT -V

Alternative energy sources, natural gas, LPG, biodiesel, bio-ethanol, gasohol and hydrogen fuels in automobiles, modifications needed, Electric and Hybrid vehicles, application of Fuel Cells in automobiles.

TEXT BOOKS:

1. Kirpal Singh, Automobile Engineering, 7th ed., Standard Publishers, New Delhi, 2020.
2. Jain K.K. and Asthana R.B., Automobile Engineering,Tata McGraw Hill, New Delhi, 2017.

REFERENCE BOOKS:

1. Heitner J ., Automotive Mechanics, 2nd ed., East -West Press, 1999.
2. Heisler H., Advanced Engine Technology, SAE International Publ., USA, 1998.

COURSE OUTCOMES:

Upon completion of this course, students will be able to

1. Infer the fundamentals of automobile layouts and gain knowledge on components of IC engines.

2. Explain the working of fuel intake systems used in CI and SI engines. Gain facts about emission from IC engines and its treatment.
3. Outline the working of the components of transmission systems available in automobiles
4. Summarize requirement for steering geometry and working concepts of various steering and braking systems used in automobiles
5. Identify and Show the alternative energy sources for operating automobiles.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	1	-	-	-	-	-	1	1	2	-
CO2	3	-	-	-	-	1	3	-	-	-	-	1	-	2	-
CO3	3	-	-	-	-	1	-	-	-	-	-	1	1	2	-
CO4	3	-	-	-	-	1	-	-	-	-	-	1	-	2	-
CO5	3	-	-	-	-	1	-	-	-	-	-	1	1	-	1

22MMPEXXX	HEAT AND MASS TRANSFER	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- The aim of the course is to build a solid foundation in heat transfer exposing students to the three basic modes namely conduction, convection and radiation.
- Rigorous treatment of governing equations and solution procedures for the three modes will be provided, along with solution of practical problems using empirical correlations.
- The course will also briefly cover boiling and condensation heat transfer, and the analysis and design of heat exchangers.

UNIT-I

Introduction to three modes of heat transfer, Derivation of heat balance equation- Steady one dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry, concept of conduction and film resistances, Composite Medium, critical insulation thickness. Extended surfaces

UNIT-II

Lumped system approximation and Biot number, Two dimensional conduction solutions for both steady and unsteady heat transfer-approximate solution to unsteady conduction heat transfer by the use of Heissler charts.

UNIT-III

Heat convection, basic equations, boundary layers- Forced convection, external and internal flows-Natural convective heat transfer- Dimensionless parameters for forced and free convection heat transfer-Correlations for forced and free convection- Approximate solutions to laminar boundary layer equations (momentum and energy) for both internal and external flow- Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection.

UNIT-IV

Interaction of radiation with materials, definitions of radiative properties, Stefan Boltzmann's law, black and gray body radiation, Calculation of radiation heat transfer between surfaces using radiative properties, view factors and the radiosity method. Radiation Shields

UNIT-V

Types of heat exchangers, Analysis and design of heat exchangers using both LMTD and ε-NTU methods. Boiling and Condensation heat transfer, Pool boiling curve. Introduction mass transfer, Similarity between heat and mass transfer.

TEXT BOOKS:

1. Yunus A Cengel, Heat Transfer : A Practical Approach, McGraw Hill, 2002
2. J.P.Holman, Heat Transfer, Eighth Edition, McGraw Hill, 1997.

REFERENCE BOOKS:

1. F.P. Incropera, and D.P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley, Sixth Edition, 2007.
2. Massoud Kaviany, Principles of Heat Transfer, John Wiley, 2002
3. A. Bejan, Heat Transfer John Wiley, 1993

COURSE OUTCOMES:

After completing the course, the students will be able to

1. Formulate and analyze a heat transfer problem involving any of the three modes of heat transfer
2. Obtain exact solutions for the temperature variation using analytical methods
3. Design devices such as heat exchangers and also estimate the insulation needed
4. Learn the basics of radiation shields
5. Learn the basics of mass transfer.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	-	-	-	-	2	-	-	-	-	-	3	2	-
CO2	3	3	-	-	-	-	2	-	-	-	-	-	3	2	-
CO3	3	2	-	-	-	-	2	3	-	-	-	-	3	2	-
CO4	3	3	-	-	-	-	2	-	-	-	-	-	3	2	-
CO5	3	3	2	-	-	-	2	-	-	-	-	-	3	2	2

22MMPEXXX	**REFRIGERATION AND AIR CONDITIONING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	3

COURSE OBJECTIVES:

- To understand the underlying principles of operations in different Refrigeration and Air conditioning systems and components.
- To provide knowledge on design aspects of Refrigeration and Air conditioning systems

UNIT I: INTRODUCTION TO REFRIGERATION

Introduction to Refrigeration - Unit of Refrigeration and C.O.P.– Ideal cycles- Refrigerants Desirable properties – Classification - Nomenclature - ODP & GWP.

UNIT II: VAPOUR COMPRESSION REFRIGERATION SYSTEM

Vapor compression cycle : p-h and T-s diagrams – deviations from theoretical cycle – subcooling and super heating- effects of condenser and evaporator pressure on COP- multipressure system -low temperature refrigeration – Cascade systems – problems. Equipments: Type of Compressors, Condensers, Expansion devices, Evaporators.

UNIT III: OTHER REFRIGERATION SYSTEMS

Working principles of Vapour absorption systems and adsorption cooling systems – Steam jet refrigeration- Ejector refrigeration systems- Thermoelectric refrigeration- Air refrigeration – Magnetic – Vortex and Pulse tube refrigeration systems.

UNIT IV: PSYCHROMETRIC PROPERTIES AND PROCESSES

Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temperature Thermodynamic wet bulb temperature, Psychrometric chart; Psychrometric of air-conditioning processes, mixing of air streams.

UNIT V: AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION

Air conditioning loads: Outside and inside design conditions; Heat transfer through structure, Solar radiation, Electrical appliances, Infiltration and ventilation, internal heat load; Apparatus selection; fresh air load, human comfort and IAQ principles, effective temperature and chart, calculation of summer and winter air conditioning load; Classifications, Layout of plants; Air distribution system; Filters; Air Conditioning Systems with Controls: Temperature, Pressure and Humidity sensors, Actuators and Safety controls.

TEXT BOOKS:

1. Arora, C.P., "Refrigeration and Air Conditioning", 3rd edition, McGraw Hill, New Delhi, 2010.

REFERENCE BOOKS:

1. Roy J. Dossat, "Principles of Refrigeration", 4th edition, Pearson Education Asia, 2009.
2. Stoecker, W.F. and Jones J. W., "Refrigeration and Air Conditioning", McGraw Hill, New Delhi, 1986.
3. ASHRAE Hand book, Fundamentals, 2010
4. Jones W.P., "Air conditioning engineering", 5th edition,Elsevier Butterworth-Heinemann, 2001

COURSE OUTCOMES:

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

1. Explain the basic concepts of Refrigeration
2. Explain the Vapour Compression Refrigeration systems and to solve problems
3. Discuss the various types of Refrigeration systems
4. Calculate the Psychometric properties and its use in psychometric processes
5. Explain the concepts of Air conditioning and to solve problems

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	1	-	-	-	-	-	-	-	-	-	3
CO2	2	3	-	2	3	-	-	-	-	-	-	2	1	3	-
CO3	3	-	-	-	-	-	-	-	2	-	-	-	-	-	2
CO4	-	-	-	-	3	-	-	-	2	-	-	-	-	-	3
CO5	3	-	-	-	1	-	-	-	-	-	-	1	1	-	2

22MMPEXXX	POWER PLANT ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide an overview of power plants and the associated energy conversion issues
- To learn the basic components of power plants

UNIT-I

Coal based thermal power plants, basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers, steam and heating rates, subsystems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and cogeneration systems

UNIT-II

Gas turbine and combined cycle power plants, Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, Integrated Gasifier based Combined Cycle (IGCC) systems.

UNIT-III

Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.

UNIT-IV

Hydroelectric power plants, classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems

UNIT-V

Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

TEXT BOOKS:

1. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.
2. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.

REFERENCE BOOKS:

1. Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998.

COURSE OUTCOMES:

Upon completion of this course, students will be able to

1. Infer the fundamentals of automobile layouts and gain knowledge on components of IC engines.
2. Explain the working of fuel intake systems used in CI and SI engines. Gain facts about emission from IC engines and its treatment.
3. Outline the working of the components of transmission systems available in automobiles
4. Summarize requirement for steering geometry and working concepts of various steering and braking systems used in automobiles
5. Identify and Show the alternative energy sources for operating automobiles.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	1	-	-	-	-	-	1	1	2	-
CO2	3	-	-	-	-	1	3	-	-	-	-	1	-	2	-
CO3	3	-	-	-	-	1	-	-	-	-	-	1	1	2	-
CO4	3	-	-	-	-	1	-	-	-	-	-	1	-	2	-
CO5	3	-	-	-	-	1	-	-	-	-	-	1	1	-	1

22MMPEXXX	THERMAL CONCEPTS FOR MANUFACTURING ENGINEERS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To familiarize the students the various steady state heat conductions.
2. To Illustrate the concepts of transient conditions.
3. To make the students to solve multi-dimensional and transient heat conduction problems and discuss the concept of fluid dynamics.
4. To explore thermal concepts on extended surfaces and heat exchangers

UNIT I

Steady state heat conduction: Fourier's law of heat conduction, one-dimensional heat transfer, thermal contact resistance, composite wall and electrical analogy, heat flow through cylinder and sphere, critical thickness of insulation.

UNIT II

Transient heat conduction: Systems with negligible internal resistance (lumped systems), heat flow in an infinitely thick plate, heat balance integrals.

UNIT III

Numerical method (finite difference) for solving multi-dimensional and transient heat conduction problems.

UNIT IV

Fluid dynamics – Basic governing equations, boundary layer concept, dimensional analysis, turbulent flows.

UNIT V

Forced convection, free convection, radiation in non-participating media. Applications of thermal concepts: Heat transfer through extended surfaces, heat exchangers.

TEXT BOOKS:

1. T. L. Bergman, A. S. Lavine, F. P. Incropera and D. P. DeWitt, Engineering Thermodynamics, McGraw Hill Education (India) Private Limited, 2013.

REFERENCE BOOKS:

1. Y. A. Cengel, Introduction to Thermodynamics and Heat Transfer, Tata McGraw Hill Education, 2007.
2. C. Borgnakke and R. E. Sonntag, Fundamentals of Thermodynamics, Wiley, 2009.

COURSE OUTCOMES:

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

1. Describe the various steady state heat conductions.
2. Illustrate the concepts of transient conditions.
3. Solve multi-dimensional and transient heat conduction problems.
4. Discuss the concepts of fluid dynamics.
5. Apply thermal concepts on extended surfaces and heat exchangers

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	-	-	-	-	-	-	-	-	-	-	1	2	-	-
CO2	2	1	-	-	-	-	-	-	-	-	-	2	1	1	-
CO3	1	2	3	2	-	-	-	-	-	-	-	-	2	1	-
CO4	2	1	-	2	-	-	-	-	-	-	-	-	1	-	-
CO5	2	1	-	2	-	-	-	-	-	-	-	1	2	-	-

VII SEMESTER: PROFESSIONAL ELECTIVES

22MMPEXXX	ADDITIVE MANUFACTURING TECHNOLOGIES	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To exploit technology used in additive manufacturing.
- To understand importance of additive manufacturing in advance manufacturing process.
- To acquire knowledge, techniques and skills to select relevant additive manufacturing process.
- To explore the potential of additive manufacturing in different industrial sectors.
- To apply 3D printing technology for additive manufacturing.

UNIT-I

Introduction: Prototyping fundamentals, Historical development, Fundamentals of rapid prototyping, Advantages and limitations of rapid ptototyping, Commonly used terms, Classification of RP process. Process chain - 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.

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

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.

UNIT-IV

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.

UNIT-V

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. Softwares for Rapid protyping: Features Magics, Mimics, Solid View, View Expert, 3 D View. Applications examples: Aerospace, defense, automobile, bio-medical and general engineering Industries.

TEXT BOOKS:

1. Rapid prototyping: Principles and Applications by Chua C.K., Leong K.F. and LIM C.S, World Scientific publications, Third Edition, 2010.
2. Rapid Manufacturing, D.T. Pham and S.S. Dimov, Springer, 2001.

REFERENCE BOOKS:

1. Ian Gibson, David W Rosen, Brent Stucker, Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, 2nd Edition, Springer,2015
2. Additive Manufacturing, Andreas Gebhardt, Jan-Steffen Hötter, Hanser Publications, Cincinnati, 2016
3. Rapid Prototyping & Engineering Applications, Frank W.Liou, CRC Press, Taylor & Francis Group, 2007

COURSE OUTCOMES:

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

1. Define the various process used in Additive Manufacturing
2. Analyse and select suitable process and materials used in Additive Manufacturing.
3. Identify, analyse and solve problems related to Additive Manufacturing.

4. Apply knowledge of additive manufacturing for various real-life applications
5. Apply technique of CAD and reverse engineering for geometry transformation in AdditiveManufacturing.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	1	3	1	-
CO2	2	2	-	-	2	-	-	-	-	-	-	-	3	1	-
CO3	2	3	-	1	1	-	-	-	-	-	-	-	2	1	-
CO4	2	1	-	1	1	-	-	-	-	-	-	1	2	1	-
CO5	2	2	-	1	1	-	-	-	-	-	-	1	3	1	-

22MMPEXXX	SMART MANUFACTURING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To familiarize the road map of Industry 4.0
- To introduce the concepts of Internet of Things (IoT)
- To outline the importance of smart manufacturing with the help of case studies.

UNIT - I INTRODUCTION

Types of Manufacturing – Mechanization and Automation – Industry 4.0: Definition, evolution, capabilities – Smart manufacturing: Definition, elements, capabilities – smart factory

UNIT - II

Internet of Things (IoT) – Industrial Internet of Things (IIoT) and Internet of Services – Smart Devices and Products – Smart Logistics and Smart Cities

Concept, Advanced Analytics, Peer (M2M) Communication, IT Tools and Methodologies,

UNIT - III

Role of data, information, knowledge and collaboration in future organizations: Resource-based view of a firm – Data as a new resource for organizations – Harnessing and sharing knowledge in organizations – Cloud Computing Basics – Cloud Computing and Industry 4.0

UNIT – IV

Role of Identification – Sensing – Actuation & Control – Challenges – Smart sensors Cyber-Physical Systems: Concept – Features – Components – Impact on to Manufacturing; Fundamentals of Cloud Manufacturing

UNIT – V

Case Studies in Adaptive Machines – Smart Factories – Additive Manufacturing – Additive Manufacturing and Nanotechnology

Case studies: Smart manufacturing in food industries and Pharmaceutical industry

TEXT BOOKS:

1. Industry 4.0: Managing The Digital Transformation, Ustundag, Alp, Cevikcan, Emre, Springer
2. Industrial Internet of Things: Cyber manufacturing Systems by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat , Springer

REFERENCE BOOKS:

1. K. Schwab, The Fourth Industrial Revolution, Crown Business
2. Rajeev Alur, Principles of Cyber-physical Systems, MIT Press
3. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, A Press
4. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat, Industrial Internet of Things: Cyber manufacturing Systems, Springer

COURSE OUTCOMES:

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

1. Understand the state-of-art of smart manufacturing
2. Outline the need and importance of smartness in smart factories, smart cities, smart products and smart services
3. Appreciate the power of Cloud Computing in a networked economy
4. Understand the types of sensors and actuators & their need, and introduce the concepts of cyber-physical systems
5. Appreciate the role of smartness in various types of industries

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	2	-	-	-	-	-	-	-	1	1	-
CO2	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-
CO3	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-
CO4	-	-		-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	1	1	1	1	-	-	-	-	-	-	-	1	-	-

22MMPEXXX	**MATERIALS CHARACTERIZATION TECHNIQUES**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

COURSE OBJECTIVES:

- To provide a broad exposure to the aspects of optical characterization methods including Raman and infrared spectroscopy.
- To provide an extensive acquaintance to the theory and practice of x-ray and electron diffraction.
- To expose various other characterization features using electron microscopy
- To understand other characterization techniques involving thermal analysis.
- To familiarize with Advanced Characterization Techniques

UNIT I Diffraction and Imaging

Need for material Characterization – Methodology and Analysis. Phenomena of diffraction; Radiation – matter interactions and response signals; X-ray diffraction: powder diffraction, phase identification, Scherrer formula, strain and grain size determination; Fundamentals of Imaging: magnification, resolution, depth of field of focus, aberration and astigmastism; X-Ray reflectivity.

UNIT II Optical Microscopic techniques and Optical Spectroscopic techniques

Special microscopy techniques and applications: Bright field and dark field imaging; confocal microscopy; interference microscopy; polarized light microscopy; phase contrast micrscopy scanning near field laser microscopy; Image processing and quantification.
Principle, Working and Result Analysis of Fourier Transformation Infra-Red Sepectroscopy; Raman Spectroscopy; UV- Vis Absorption Spectroscopy; Photoluminescence Spectroscopy – Ellipsometer Spectroscopy.

UNIT III Electron Microscopic Techniques

Basics of Electron Microscopy – Introduction – Principle of SEM, Instrumentation, Contrast formation, Operational variables, Specimen preparation, imaging modes, Applications, Laminations – FE-SEM, FIB, EDAX. TEM – Introduction, Instrumentation, Specimen preparation; Mechanical thinning, electrochemical thinning, ion milling, sputter coating and carbon coating, replica methods. Image modes – mass density contrast, diffraction contrast, phase contrast, Applications, Limitations.

UNIT IV Thermal Analysis

Instrumentation, experimental parameters, Differential thermal analysis, Differential Scanning Calorimetry, Thermogravimetry, Dilatometry, Dynamic mechanical analysis – Basic principles, instrumentation, working principles, Applications, Limitations.

UNIT IV Advanced Characterization Techniques

Rutherford back scattering (RBS), Scanning Tunneling Microcopy (STM), Atom Force Microscopoy (AFM) and different operational modes, X-ray Photoelectron Spectroscopy (XPS): Characterization of Fluids – Viscosity, Relative density, thermal conductivity.

TEXT BOOK:

1. P.R. Khangaonkar, An introduction to Materials Characterization, Reprint 2013, Penram International Publishing (India) PVT Ltd., 2010.
2. Yang Leng, Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, 2nd edition, ISBN: 978-3-527-33463-6, Wiley Publications, 2013.

REFERENCE BOOKS:

1. E.J. Mittemeijer, Fundamentals of Materials Science – the Microstructure – property relationship using metals as model systems, Springer, 2010.
2. Cullity, Elements of X-Ray Diffraction, by.. Pearson Education India, 3rd Edition, 2014.

COURSE OUTCOMES:

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

1. Determine crystal structures using diffraction methods.

2. Characterize an unknown sample using spectroscopic techniques
3. Elucidate the modes of operation of SEM and TEM
4. Identify and justify the selection of at least three techniques to evaluate a particular sample
5. Evaluate the uncertainty of observations and results from the different methods
6. Evaluate an unknown sample and collect a targeted data set on it using available instrument.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	3	-	-	-	-	-	-	-	-	2	-	-	-
CO2	1	1	3	3	-	-	-	-	-	-	-	2	-	2	-
CO3	1	1	3	3	-	-	-	-	-	-	-	2	3	2	-
CO4	1	1	3	3	-	-	-	-	-	-	-	2	-	2	-
CO5	1	1	-	-	-	-	-	-	-	-	-	2	-	2	-

22MMPEXXX	ELECTRONICS MANUFACTURING TECHNOLOGY	L	T	P	C
		3	1	0	3

COURSE OBJECTIVES:

- To introduce the concepts of semiconductor process technology and various photo lithographic techniques.
- To familiarize the students the concepts and methods of film deposition methods.
- To make the students to understand the different IC manufacturing technology and to know about the current trends.

UNIT I

Introduction: Semiconductor Process Technology - Basic Fabrication Steps: Oxidation, Photolithography and Etching, Diffusion and Ion, Implantation, Metallization-Silicon Crystal Growth from the Melt-Silicon Float-Zone Process - GaAs Crystal Growth Techniques: Starting Materials-Crystal Growth Techniques - Material Characterization: Wafer Shaping-Crystal Characterization

Silicon Oxidation: Thermal Oxidation Process: Kinetics of Growth -Thin Oxide Growth-Masking Properties of Silicon Dioxide - Oxide Quality- Oxide Thickness Characterization

UNIT II

Photolithography: Optical Lithography - The Clean Room- Exposure Tools-Masks-Photoresist- Pattern Transfer Resolution Enhancement Techniques - Next –Generation Lithographic Methods: Electron Beam Lithography-Extreme Ultraviolet Lithography-X-Ray Lithography-Ion Beam Lithography-Comparison of Various Lithographic Methods

Etching: Wet Chemical Etching:Silicon Etching-Aluminum Etching-Gallium Arsenide Etching - Dry Etching:Plasma etching

Diffusion: Basic Diffusion Process - Extrinsic Diffusion - Lateral Diffusion

UNIT III

Film Deposition: Epitaxial Growth Techniques: Chemical Vapour Deposition - Molecular Beam Epitaxy-Structure and Defects in Epitaxial Layers - Lattice-Matched and Strained-Layer Epitaxy - Defects in Epitaxial Layers - Dielectric Deposition- Silicon Dioxide - Silicon Nitride - Polysilicon Deposition -Metallization: Physical Vapour Deposition - Chemical Vapour Deposition - Aluminum Metallization - Copper Metallization – Silicide.

UNIT IV

Ion Implantation: Range of Implanted Ions- Ion Distribution - Ion Stopping- Ion Channeling Implant Damage and Annealing- Implant Damage - Annealing

Process Integration: Passive Components: The Integrated Circuit Resistor - The Integrated Circuit Capacitor - The Integrated Circuit Inductor

Bipolar Technology: The Basic Fabrication Process - MOSFET Technology - The Basic Fabrication Process - CMOS Technology - MOSFET Technology

UNIT V

IC Manufacturing: Electrical Testing: Test Structures - Final Test – Packaging -Die Separation - Package Types - Attachment Methodologies

Future Trends and Challenges: Challenges for Integration - Ultrashallow Junction Formation

Ultrathin Oxide - Silicide Formation - New Materials for Interconnection- Power Limitations SOI Integration - System-on-a-Chip.

TEXT BOOKS:

1. Gary S May, Simon M Sze, Fundamentals of Semi-Conductor Fabrication, 2004
2. Prasad R., "Surface Mount Technology – Principles and practice", Chapman and Hall., New York, 1997

REFERENCE BOOKS:

1. Harper C.A., Electronic Packaging and Interconnection Handbook, McGraw Hill Inc., New York, 1997,
2. Ray Prasad, Surface Mount Technology: Principles and Practice, Second Edition , Chapman and Hall ,1997
3. Rao. R Tummala, Fundamentals of Microsystem Packaging, McGraw Hill, 2001

COURSE OUTCOMES:

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

1. To enumerate the concepts of semiconductor process technology
2. To recognize and explain various photo lithographic techniques.
3. To recognize the concepts and explain and methods of film deposition methods.
4. To explain Ion Implantation and describe the fabrication processes.
5. To consider the various IC manufacturing technology and to observe the current trends.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	-	-	1	-	-	-	-	-	-	1	2	1	-
CO2	2	1	1	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	1	-	-	1	-	-	-	-	-	-	1	2	1	-
CO4	2	-	1	-	2	-	-	-	-	-	-	-	3	1	-
CO5	2	-	-	-	-	-	-	-	-	-	-	2	2	-	-

22MMPEXXX	ADVANCED MANUFACTURING TECHNOLOGIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Illustrate the students about the different types of Manufacturing processes
- To make them understand the working principle of wire cut EDM, ECM, ECG BM EBM & PAM.
- Explain the latest manufacturing processes for micro fabrication and devices.

UNIT -I

(Non thermal energy) – Abrasive machining – water jet machining - ultrasonic machining – chemical machining – electro chemical machining – construction working principle – steps - types – process parameters – derivations – problems, merits, demerits and applications .

UNIT -II

Wire cut EDM - Electro chemical machining – ECG - Electric discharge machining – construction – principle – types – control - circuits – tool design – merits, demerits & applications.

UNIT -III

Laser beam machining – Electron beam machining – Plasma arc machining – Ion beam machining – construction working principle types – process parameter – derivations – problems, merits, demerits and applications.

UNIT -IV

Semiconductors – films and film depurification – Oxidation - diffusion – ion implantation – etching – metallization – bonding – surface and bulk machining – LIGA Process – Solid free form fabrication.

UNIT -V

Wafer preparation – monolithic processing – moulding – PCB board hybrid & MCM technology – programmable devices & ASIC – electronic material and processing.– steriolithography, SAW devices, Surface Mount Technology,

TEXT BOOKS:

1. Rao P.N., Manufacturing Technology, Metal cutting and Machine Tools, Tata McGraw Hill, 2013
2. Sharma .P.C., A text book of Production Technology- vol I &II , S.Chand and Company Ltd, New Delhi, 2014

REFERENCE BOOKS:

1. Serope kelpekijian & stevan r. schmid- manufacturing process engg material – 2003
2. Micro senors Mems & smart devices- Julian W.Hardner – 2002
3. Brahem T. Smith, Advanced machining I.F.S. UK 1989.
4. Jaeger R.C., Introduction to microelectronic fabrication Addison Wesley, 1988.
5. Nario Taniguchi – Nano technology – Oxford University Press 1996.
6. Pandey P.C. & Shan HS Modern Machining Processes, Standard Publishing Co., 1980
7. Madon, Fundamentals of Microfabrication, CRC Press, 1997.

COURSE OUTCOMES:

At the end of this course, students will able to

1. Understand the various manufacturing processes available.
2. Describe the working principles of EDM, ECM & ECG.
3. Differentiate the process parameters and working principles of LBM, EBM & PAM
4. Explain the different types of film depurification techniques available.
5. Understand the latest manufacturing processes for micro fabrication and devices.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	2	-	-	-	3	2	1
CO2	3	2	2	3	3	-	-	-	2	-	-	-	3	3	2
CO3	3	2	2	3	3	-	-	-	2	-	-	-	2	2	2
CO4	2	2	2		3	-	-	-	2	-	-	-	3	3	2
CO5	2	2		3	3	-	-	-	2	-	-	-	2	2	3

22MMPEXXX	DESIGN OF TRANSMISSION SYSTEMS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To gain knowledge on the principles and procedures for the design of power
- Transmission components.
- To understand the standard procedure available for Design of transmission systems
- To learn to use standard data and catalogues

UNIT–I

Bearings: - Hydrodynamic Journals Bearings - Design procedure - Minimum film thickness - Selection of Antifriction bearings - Life of bearings - Equivalent load, Cubic mean load – load rating - Design Procedure..

UNIT–II

Belt Drives of flat belts, V-Belts using manufacturer's table - Matched set of V-Belts, Chain drives for Power transmission design procedure.

UNIT–III

Gear drives: Toothed gear - types of failure - Design analysis - Gear Materials - Design of spur and Helical gears based on surface strength and bending strength - Forces acting on toothed gears.

UNIT–IV

Bevel and worm gears: Bevel gears classification - terminology - forces on bevel gear tooth - Design procedure - working gears - Design of worm gears - Terminology - centre distance - losses - design procedure.

UNIT–V

Gear Box: Standard Step ratio - Speed diagram - Kinematics layout - Design of six speed, twelve speed, eighteen speed gear box - calculation of actual speed.

TEXT BOOKS:

1. R.S. Khurmi, "Machine Design", S. Chand company Ltd., 14th ed. 2005.
2. T.J. Prabhu, "Design of Transmission Elements", 4th ed. 2000.

REFERENCE BOOKS:

1. Richard Bundya and Shigley, "Mechanical Engineering Design", McGraw Hill Book Company.
2. T.V. Sundarajamoorthy, N.Shanmugham, "Machine Design", Khanna Publishers.

COURSE OUTCOMES:

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

1. Design and select hydrodynamic and antifriction bearings
2. Design flat, V belts and chain drives for power transmission
3. Design Toothed, spur and helical gears for power transmission
4. Design bevel and worm gears.
5. Design multi speed gear box for machine tool and automotive applications

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	-	-	-	1	-	-	-	1	3	2	-
CO2	3	3	3	2	-	-	-	1	-	-	-	1	3	2	-
CO3	3	3	3	2	-	-	-	1	-	-	-	1	3	2	-
CO4	3	3	3	2	-	-	-	1	-	-	-	1	3	2	-
CO5	3	3	3	2	-	-	-	1	-	-	-	1	3	2	-

22MMPEXXX	FINITE ELEMENT ANALYSIS	L	T	P	C
		3	0	0	3

PRE-REQUISITES: Basic knowledge in Finite Element Methods.

COURSE OBJECTIVES:

- Impart basic concepts, applications and variational principles for solving various 1D FEM problems.
- Explain the stiffness matrix, load vector and shape functions of truss and beam element.
- Brief the concept of creating stiffness matrix and shape function for various 2D Iso-parametric and 3D elements.
- Edify the 1D and 2D heat conduction problem and dynamic analysis for bars and beams.
- Demonstrate the stiffness matrix, force vector and Galerkin's approach problems for axisymmetric elements.

UNIT I

Introduction to FEA, basic concepts, application of FEM, general steps involved in FEM, One Dimensional problems: Stiffness equations for a axial bar element in local co-ordinates using Potential Energy approach and Virtual energy principle – problems.

Variational Methods: Introduction, Variational Principles, Galerkin approximation, Coupled partial differential equation, Initial value Problems.

UNIT II

Analysis of Trusses and Beams: Stiffness equations for a truss bar element oriented in 2D plane- Finite Element Analysis of Trusses –Plane Truss elements–methods of assembly. Hermite shape functions – Element stiffness matrix – Load vector –Problems.

UNIT III

2-D Problems: CST - Stiffness matrix and load vector – Iso-parametric element representation –Shape functions –convergence requirements–Problems-Two dimensional four noded iso-parametric elements- Numerical integration 3-D Problems: Stiffness Matrix - Tetrahedron element – Hexahedron Element.

UNIT IV

Scalar field problems: 1-D Heat conduction – 1D fin elements – 2D heat conduction - analysis of thin plates – Composite slabs -problems. Dynamic Analysis: Dynamic equations – Lumped and consistent mass matrices – Eigen Values and Eigen Vectors – mode shapes – modal analysis for bars and beams.

UNIT V

Axis-symmetric Elements: Cylindrical co-ordinates, axis-symmetric elasticity, derivation of the stiffness matrix, body force vector, traction force vector, temperature load vector, Galerkin approach, problems.

TEXT BOOKS:

1. Rober Cook, Concepts and application of finite element analysis, Wiley, 4thEd., 2008.
2. Tirupathi K. Chandrupatla and Ashok D. Belagundu, Introduction to finite elements in engineering, 3rd Ed., 2009

REFERENCE BOOKS:

1. S.Md.Jalaludeen, Introduction of Finite Element Analysis, Anuradha, Publications, 1stEd.2012.
2. J. N. Reddy, An Introduction to Finite Element Methods McGrawhill 3rd Ed.2005.
3. The Finite element method in engineering science /O.C. Zienkowitz/ McGrawhill / 2ndEd.1971.
4. Finite Element Methods/Alavala/TMH
5. Finite Element Analysis by/ George R. Buchanan/McGrawhill/ 3rd series/1994.

COURSE OUTCOMES:

After Completion of this course students will be able to

1. Understand the basic concepts, applications and variationa l principles for solving various 1D FEM problem s.
2. Understand the stiffness m atrix, load vector and shape functions of truss bar elem ent.
3. Apply the concept of shape function for various 2D Isoparametric and 3D elem ents.
4. Interpret the 1D and 2D heat conducti on problem and dynam ic analysis for bars and beam s.
5. S olve the stiffness m atrix, force vector and Galerkin approach problem s for axisym m etric elem ents.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	-	-	-	-	-	-	-	-	3	2	2	-
CO2	2	3	3	-	-	-	-	-	-	-	-	3	3	3	-
CO3	2	3	3	-	-	-	-	-	-	-	-	3	3	2	-
CO4	2	3	3	-	-	-	-	-	-	-	-	3	3	2	-
CO5	2	3	2	-	-	-	-	-	-	-	-	3	2	2	-

22MMPEXXX	ENGINEERING FAILURE ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Educate the fundamentals of failure analysis and its importance
- Illustrate different analytical solutions for stationary crack and crack growth.
- Import knowledge on fatigue crack growth curve and elements of applied fracture mechanics.

UNIT I: FUNDAMENTALS OF FAILURE ANALYSIS

The geometry of stress and strain, elastic deformation, plastic and elasto-plastic deformation - limit analysis. Common causes of failure. Principles of failure analysis. Fracture mechanics approach to failure problems. Techniques of failure analysis. Service failure mechanisms - ductile and brittle fracture, fatigue fracture, wear failures, fretting failures, environment induced failures, high temp. failure. Faulty heat treatment and design failures, processing failures (forging, casting, machining etc.)

UNIT II: STATIONARY CRACK UNDER STATIC LOADING

Two dimensional elastic fields – Analytical solutions yielding near a crack front – Irwin's approximation - plastic zone size – Dugdaale model – J integral and its relation to crack opening displacement.

UNIT III: ENERGY BALANCE AND CRACK GROWTH

Griffith analysis – Linear Fracture Mechanics-Crack Opening displacement – Dynamic energy balance – crack arrest.

UNIT IV: FATIGUE CRACK GROWTH CURVE

Empirical Relation describing crack growth by fatigue – Life calculations for a given load amplitude – effects of changing the load spectrum – Effects of Environment.

UNIT V: ELEMENTS OF APPLIED FRACTURE MECHANICS

Examples of crack-growth Analysis for cyclic loading - leak before break – crack Initiation under large scale yielding – Thickness as a Design parameter – crack instability in Thermal or Residual – stress fields.

TEXT BOOKS:

1. Norman E. Dowling," Mechanical Behavior of Materials", 2nd Edition, Prentice-Hall 1999.
2. Prasanth Kumar – "Elements of fracture mechanics" – Wheeter publication, 1999.

3. Barrois W, Ripely, E.L., "Fatigue of aircraft structure", Pe/gamon press. Oxford, 1983.

REFERENCE BOOKS:

1. David Broek, "Elementary Engineering Fracture Mechanics", Fifthoff and Noerdhoff International Publisher, 1978.
2. Kare Hellan,"Introduction of Fracture Mechanics", McGraw-Hill Book Company, 1985.
3. Suresh, S.," Fatigue of Materials", Cambridge University Press, 2 nd edition, 1998.
   Ashok Saxena," Nonlinear Fracture Mechanics for Engineers", CRC Press, 1998.
4. Schive, Jaap, "Fatigue of Structures and Materials", Kluwer Academic Publishers, 2001.
4. Sin, C.G., "Mechanics of fracture" Vol. I, Sijthoff and w Noordhoff International Publishing Co., Netherlands, 1989
5. Knott, J.F., "Fundamentals of Fracture Mechanics", Buterworth & Co., Ltd., London, 1983
   Subra suresh, "Fatigue of materials" , II edition, 1998.
6. T. L. Anderson, "Fracture mechanics: Fundamentals and applications", III edition, 2004.

COURSE OUTCOMES:

At the end of this course, students will able to

1. To describe the geometry of stress & strain elastic and plastic deformations.
2. To provide solutions for stationary crack under static loading.
3. To analyse energy balance and crack growth using Grifith analysis and linear fracture mechanics
4. To develop empirical relations describing crack growth by fatigue.
5. To analyse different elements of applied fracture mechanics.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	1	-	-	-	-	-	2	-	-	-	2	1	2
CO2	3	3	3	-	2	-	-	-	2	-	-	2	3	3	2
CO3	3	3	3	-	2	-	-	-	2	-	-	2	3	3	2
CO4	3	3	3	-	2	-	-	-	2	-	-	2	2	3	1
CO5	3	1	2	-	-	-	-	-	2	-	-	-	1	2	2

OPEN ELECTIVES

22MMOEXXX	**FUNDAMENTALS OF SOFT COMPUTING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

1. To familiarize with soft computing concepts
2. To introduce and use the idea of Neural networks, fuzzy logic and use of heuristics based on human experience
3. To introduce and use the concepts of Genetic algorithm and its applications to soft computing using some applications.

UNIT I

Soft Computing: Introduction – Soft versus hard computing. - Artificial Neural Networks: Fundamentals of Neural Networks - Model of an Artificial Neuron - Neural network Architectures – Learning methods - Taxonomy of Neural network Architectures - Standard Back propagation Algorithms - Selection of various-parameters - Variations - Applications of Back Propagation Algorithms.

UNIT II

ANN Architectures: Associative Memory - Exponential BAM - Associative Memory for Real Coded Pattern Pairs - Applications Adaptive Resonance Theory - Introduction - ART 1 - ART2 - Applications - Neural Networks based on Competition - Kohenen Self Organizing Maps - Learning vector Quantization - Counter Propagation Networks Industrial Applications.

UNIT III

Introduction to Fuzzy Logic Principles: Basic concepts of Fuzzy Set theory - Operations of Fuzzy sets - Properties of Fuzzy sets - Crisp relations - Fuzzy relational equations - operations on Fuzzy Relations Fuzzy systems - Propositional Logic - Inference - Predicate Logic - Inference in Predicate Logic - Fuzzy Logic Principles - Fuzzy Quantifiers - Fuzzy Inference – Fuzzy rule based systems – Fuzzification and Defuzzification – types.

UNIT IV

Advanced Fuzzy Logic Applications: Fuzzy Logic Controllers - principles - Review of Control systems theory -Various industrial applications of FLC - Adaptive Fuzzy systems - Fuzzy Decision making Multi objective Decision making - Fuzzy Classification – c Means Clustering -Fuzzy pattern Recognition - Image processing applications - Syntactic Recognition - Fuzzy optimization - Various Fuzzy measures.

UNIT V

Evolutionary Algorithm - Genetic Algorithm - Implementation of Genetic Algorithm - Evolutionary Programming - Simulated Annealing: basic simulated annealing algorithm - The acceptance probability function - Ant Colony Optimization: Feature Selection - Applications of Feature Selection - Common Problems - Tabu Search Algorithm: Search space and neighborhood structure, Tabus, Aspiration criteria, template for simple tabu search, Termination criteria, Probabilistic TS and candidate lists.

TEXT BOOKS:

1. Timothy J.Ross,"Fuzzy Logic with Engineering Applications". N1cGraw Hill, 1995.
2. Laurence Fausett, "Fundamentals of Neural Networks", Prentice Hall. 1992.
3. Kuntal Barua, Prasun Chakrabarti, Fundamentals of Soft Computing, BPB Publications, 2017

REFERENCE BOOKS:

1. S.N.Sivanandam , S.N.Deepa, “Principles of Soft Computing”, Wiley India Pvt. Ltd., 2nd Edition, 2011.
2. S.Rajasekaran, G.A.Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications “, PHI Learning Pvt. Ltd., 2017.

COURSE OUTCOMES:

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

1. Apply various soft computing concepts for practical applications
2. Choose and design suitable neural network for real time problems
3. Use fuzzy rules and reasoning to develop decision making and expert system
4. Explain the importance of optimization techniques and genetic programming
5. Review the various hybrid soft computing techniques and apply in real time problems

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	3	2	2	-	-	-	-	-	-	2	3	1	2
CO2	2	-	3		2	-	-	-	-	-	-	1	2	-	-
CO3	3	-	2	2	2	-	-	-	-	-	-	1	3	1	-
CO4	3	-	2	1	-	-	-	-	-	-	-	-	2	-	-
CO5	2	-	2	1	2	-	-	-	-	-	-	-	3	1	-

22MMOEXXX	**MAINTENANCE AND SAFETY ENGINEERING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the basics of different types of Maintenance Engineering.
- To apply the concepts of inventory, quality and safety in Maintenance.
- To calculate the Maintenance costing by using various cost estimation models.

UNIT – I

Introduction, Need for Maintenance, Facts and Figures, Modern Maintenance, Problem and Maintenance Strategy for the 21st Century, Engineering Maintenance Objectives and Maintenance in Equipment Life Cycle, Terms and Definitions. Maintenance Management and Control: Maintenance Manual, Maintenance, Facility Evaluation, Functions of Effective Maintenance Management, Maintenance Project Control Methods, Maintenance Management Control Indices

UNIT – II

Types Of Maintenance: Preventive Maintenance, Elements of Preventive, Maintenance Program, Establishing Preventive Maintenance Program PM Program Evaluation and Improvement, PM Measures, PM Models, Corrective Maintenance, Corrective Maintenance Types, Corrective Maintenance Steps and Downtime Components, Corrective Maintenance Measures, Corrective Maintenance Models.

UNIT – III

Inventory Control In Maintenance: Inventory Control Objectives and Basic Inventory Decisions, ABC Inventory Control Method, Inventory Control Models Two-Bin Inventory Control and Safety Stock, Spares Determination Factors Spares Calculation Methods

UNIT – IV

Quality And Safety In Maintenance: Needs for Quality Maintenance Processes, Maintenance Work Quality, Use of Quality Control Charts in Maintenance Work

pmSampling, Post Maintenance Testing, Reasons for Safety Problems in Maintenance, Guidelines to Improve Safety in Maintenance Work, Safety Officer's Role in Maintenance Work, Protection of Maintenance Workers.

UNIT – V

Maintenance Costing: Reasons for Maintenance Costing, Maintenance Budget Preparation Methods and Steps, Maintenance Labor Cost Estimation, Material Cost Estimation, Equipment Life Cycle Maintenance Cost Estimation, Maintenance Cost Estimation Models.

TEXT BOOKS:

1. Reliability, Maintenance and Safety Engineering, Dr. A. K. Gupta, Laxmi Publications, 2015
2. Industrial Safety Management, L.M. Deshmukh, TMH, 2007

REFERENCE BOOKS:

1. Maintenance Engineering & Management, CR. Mishra and K. Pathak, PHI, 2012
2. Reliability Engineering, Elsayed, Pearson, 2012
3. Engineering Maintenance: A Modern Approach, B.S Dhallon, C.R.R Publishers, 2002.

COURSE OUTCOMES:

At the end of this course, students will able to

1. Acquired knowledge on Modern Maintenance Management and control
2. Classify different types of Maintenance of its functions
3. Apply the concepts of inventory in Maintenance.
4. Examine the qualitys of safety related issues in Maintenance
5. Evaluate the cost of maintenance of equipments.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	-	2	-	1	2	-	1	-	1	-	2	1	2
CO2	3	2	2	2	1	1	2	-	2	-	1	2	3	2	2
CO3	2	2	1	2	-	1	2	-	1	-	1	1	2	1	2
CO4	3	2	2	2	-	2	2	-	1	-	2	2	3	2	2
CO5	3	3	2	2	-	1	2	-	2	-	1	2	3	2	2

22MMOEXXX	**RENEWABLE ENERGY TECHNOLOGY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

1. To get exposure on solar radiation and its environmental impact to power.
2. To know about the various collectors used for storing solar energy.
3. To know about the various applications in solar energy.
4. To learn about the wind energy and biomass and its economic aspects.
5. To know about geothermal energy with other energy sources

UNIT I: PRINCIPLES OF SOLAR RADIATION

Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

UNIT II: SOLAR ENERGY COLLECTION

Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

UNIT III: SOLAR ENERGY STORAGE AND APPLICATIONS

Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applicationssolar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.

UNIT IV: WIND ENERGY

Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria BIO-MASS: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C.Engine operation and economic aspects.

UNIT V: GEOTHERMAL ENERGY:

Resources, types of wells, methods of harnessing the energy, potential in India. OCEAN ENERGY: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics. DIRECT ENERGY CONVERSION: Need for DEC, Carnot cycle, limitations, principles of DEC.

TEXT BOOKS:

1. R.K.Rajput, Non- Conventional Energy Sources and Utilization, 2011
2. D.SChauhan, S.K.Srivastava, Non- Conventional Energy Resources, 2010
3. G.D.Rai, Non Conventional Energy Sources, 2012

REFERENCE BOOKS:

1. Tiwari and Ghosal, “Renewable energy resources”, Narosa Publishing House, 2007
2. Ramesh R & Kumar K.U , “Renewable Energy Technologies”,Narosa Publishing House, 2004
3. Mittal K M, “Non-Conventional Energy Systems”, Wheeler Publishing Co. Ltd, New Delhi, 2003.
4. Kothari D.P, Singhal ., K.C., “Renewable energy sources and emerging technologies”, P.H.I, New Delhi, 2010

COURSE OUTCOMES:

Understanding the physics of solar radiation.

1. Knowledge in principles of solar radiation.
2. Ability to classify the solar energy collectors.
3. Knowledge in applying solar energy and methodologies of storing solar energy in a useful way.
4. Knowledge in wind energy and biomass with its economic aspects.

5. Knowledge in capturing and applying other forms of energy sources geothermal energy & Ocean energies.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	1	2	-	-	-	-	1	-	3	-	-
CO2	1	-	1	-	-	-	-	-	-	2	2	-	-	2	1
CO3	-	1	2	2	-	-	-	1	-	-	-	-	-	-	1
CO4	-	1	-	1	-	2	-	-	-	2	-	-	-	2	-
CO5	1	-	2	1	-	-	-	-	-	1	-	-	2	-	1

22MMOEXXX	ENGINEERING ECONOMICS	L	T	P	C
		3	0	0	3

UNIT I: INTRODUCTION TO ECONOMICS

Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics – Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis – V ratio, Elementary economic Analysis – Material selection for product Design selection for a product, Process planning.

UNIT II: VALUE ENGINEERING

Make or buy decision, Value engineering – Function, aims, Value engineering procedure. Interest formulae and their applications –Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor – Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.

UNIT III: CASH FLOW

Methods of comparison of alternatives – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods.

UNIT IV: REPLACEMENT AND MAINTENANCE ANALYSIS

Replacement and Maintenance analysis – Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset – capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.

UNIT V: DEPRECIATION

Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation-

Evaluation of public alternatives- Introduction, Examples, Inflation adjusted decisions – procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset.

TEXT BOOKS:

1. Engineering Economics, Panneer Selvam, R., Prentice Hall of India Ltd, 2001.
2. Engineering Economy, Smith, G.W., lowa State Press, 1973.

REFERENCE BOOKS:

1. Contemporary Engineering Economics, Park, C.S., Prentice Hall of India, 2002.
2. Engineering Economics and Analysis, Newman, D.G. and Lavelle, J.P.,Engineering Press, 2002.
3. Engineering Economy,Degarmo, E.P., Sullivan, W.G. and Canada, J.R, Macmillan, 1984.
4. Principles of Engineering Economy, Grant, E.L., Ireson, W.G. and Leavenworth, R.S.,Ronald Press, 1976.

COURSE OUTCOMES:

Upon completing this course, students should be able to:

1. Summarize the basic terms of economics
2. Understand the principle of money and depreciation
3. Apply present worth criterion of money
4. Develop and compare different replacement policies
5. Recognize the cost volume profit relationship

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	1
CO2	2	2	-	-	-	-	-	-	-	-	-	-	1	-	-
CO3	1	2	-	-	-	-	-	-	-	-	-	-	-	1	2
CO4	3	1	2	-	-	-	-	-	-	-	2	-	1	2	1
CO5	3	-	1	-	-	-	-	-	-	-	1	-	2	3	1

22MMOEXXX	**SENSORS AND CONTROL SYSTEMS IN MANUFACTURING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- The main objectives of the course for the students is
- To have clear view on different type sensor, performance and product monitoring and control applications.
- To familiarize the use of advance instrumentation and sensing method.
- To study the various elements of CIM, FMS and the integration of manufacturing functions.
- To acquire knowledge about different components of sensor network architecture and networks in manufacturing and sensors interfacing.
- To illustrate the concepts of current trends in areas related to fiber optics in sensor and biomedical technology.

UNIT I

Sensor Fundamental, Classification and Types of Sensors, Desirable Sensor Attributes, Sensor Performance and Power dissipation -a trade-off, Self-Checking and Self Compensating Sensors- Sensor for Work Pieces and Product Monitoring.

UNIT II

Identification of Manufactured Components, Digital Encoders, Opto Electronic Color Sensors - Principles, Properties, Features and Control Applications in Robotics.

UNIT III

Design of CIM, Decision Support System for CIM, Analysis and Design of CIM, and Development of CIM Strategy with Sensor and Control. FMS- Robot Control with Vision Sensors, Multi Sensor Controlled Robots, Measurement of Robot Density, Robot Programming.

UNIT IV

Sensor Network Architecture, Sensor Tracking, Sensors to Detect Machinery Faults, Networks in Manufacturing, Computer Communications- Interface of Sensors with Single Board Computer for PLC and Numerical Control. Networking with Electro Optic Link using Fiber Sensors.

UNIT V

Fiber Optics in Sensor and Control System.- Fiber Optics Parameters, Configurations, Photo Electric Sensor for Long Distance, Sensor Alignment Techniques, Sensors for Biomedical Technology.

TEXT BOOKS:

1. Sabrie Soloman, "Sensors and Control systems in manufacturing", McGraw-Hill Publications, 2th edition 2010.

REFERENCE BOOKS:

1. Tonshoff, H.K., and Inasaki, I., "Sensor Applications, vol. 1 sensors in Manufacturing", Wileyvch Publications 2001.
2. Mark W. Spong, Seth Hutchinson, and M. Vidyasagar 'Robot Dynamics and Control' John Wiley & Sons 2008.
3. Mikell .P. Groover "Automation, Production Systems and Computer Integrated Manufacturing", PEARSON, 2018.
4. Fu, K.S., Gonzalez, R.C. and Lee, C.S.G., "Robotics: Sensing, Vision and Intelligence", Tata McGraw-Hill, New Delhi, 2008.
5. Kant Vajpayee S., "Principles of Computer Integrated Manufacturing", Prentice Hall India, 2003.

COURSE OUTCOMES:

Upon completing this course, students should be able to:

1. Select suitable sensor requirement for product monitoring.
2. Understand identification of manufactured components through robotics applications.
3. Design and develop new CIM and FMS with suitable robotic control.
4. Understand the basic working of sensors and architecture of sensors.
5. Understand the usage of fiber optics in sensors and its integration with the control system.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	2	-	-	-	-	-	-	-	3	-	1
CO2	3	-	2	1	3	-	-	-	-	-	3	-	2	1	
CO3	2	3	2	-		-	-	-	-	3	-	2	3	2	1
CO4	3	2	3	1		-	-	-	-	-	-	2	2	-	-
CO5	2	1	3	-	2	-	-	-	-	-	3	-	1	-	-

22MMOEXXX	SUPPLY CHAIN MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To discuss the fundamental concepts of supply chain management
- To impart knowledge on how to align the management of a supply chain with corporate goals and strategies.
- To understand the issues on different types of supply chain

UNIT I

Introduction to Supply Chain Management- Definition- Decision phases in supply chain, Process Vs Push pull view of supply chain-The development chain - Design the right Supply Chain- functional Vs innovative products- product life cycle and SC design – clock speed.

UNIT II

Supply chain (SC) performance and evaluation: Order Winning to Order fulfillment- SCOR Model – Balance Score card model. Supply Chain Strategies: Efficient Vs Responsive strategy- Agile Vs Lean supply chain, postponement strategy- push pull strategy.

UNIT III

Supply Chain Integration - Building partnership and trust in SC Value of Information - Bullwhip Effect -Effective forecasting - Coordinating the supply chain - Concepts of MTO, MTS, ETO and ATO -demand driven strategies- impact of internet on SCM.

UNIT IV

Supply network – factors influencing supply chain network design - Distribution Center Location Models - Supply Chain Network optimization models. Impact of uncertainty on Network Design - Network Design decisions using Decision trees.

UNIT V

Global Supply Chain - International Issues in SCM- Introduction- risks and advantages- Supply chain Restructuring – Supply chain Mapping –Supply chain process restructuring–Reverse Supply chain - Agro Supply Chains

TEXT BOOKS:

1. Simchi - Levi Davi, Kaminsky Philip and Simchi-Levi Edith, Designing and managing the Supply Chain, Tata McGraw Hill Publishing Company Ltd, New Delhi, 2003

2. Sunil Chopra and Peter Meindl, Supply chain management, Pearson Education, New Delhi, 2nd edition, 2003.

REFERENCE BOOKS:

1. Janat Shah, Supply Chain Management: Text and Cases, Pearson Education India, 2009.
2. Robert B Hand Field and Ernest Nichols, Supply Chain Management, Prentice Hall, New Jersey, 1999.
3. Ling Li, Supply chain management: concepts, techniques and practices, world scientific press, 2011
4. R Mohanty and S G Deshmukh , Supply chain management (Theories & practices), Ist edition, Biztantra innovation in management, 2005.
5. Altekar Rahul V, Supply Chain Management-Concept and Cases, PHI, 2005

COURSE OUTCOMES

Upon completing this course, students should be able to:

1. Understand the roles of supply chain among various business functions and their roles in the organizations‟ strategic planning and gaining competitive advantage
2. Actively employ supply chain performance measurement models
3. Apply supply chain techniques in both manufacturing and service industries
4. Analyze the principles, concepts and challenges for developing sourcing, manufacturing and distribution strategies in a global market.
5. Describe the issues in global supply chain and restructuring of supply chain

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	-	-	-	-	-	-	-	-	2	3	-	2
CO2	3	3	-	-	2	-	-	-	-	-	1	-	3	-	2
CO3	3	-	-	-	3	-	-	-	-	-	2	-	2	-	1
CO4	2	2	3	-	-	-	-	-	-	-	2	-	3	2	2
CO5	2	-	-	-	2	-	1	-	-	-	-	2	2	-	1

22MMOEXXX	MATERIALS SCIENCE AND ENGINEERING	L	T	P	C
		4	0	0	4

COURSE OBJECTIVES:

- To impart fundamental knowledge on the structure of Engineering Materials,
- To impart knowledge about characteristics of polymer, ceramic and metal matrix composite materials.
- To impart knowledge about magnetic characteristics of engineering materials

UNIT I

Unit cell, Crystal systems, BCC, FCC & HCP structures, Crystallographic planes & direction, Miller indices, Crystal imperfections - point, line & area defects. Constitution of alloys, compounds & solid solutions, Gibbs phase rule, lever rule. Diffusion in Solids, Fick‟s laws – Solidification, Nucleation and grain growth, Phase diagrams: eutectic, peritectic, eutectoid and peritectoid reactions

UNIT II

Classification of steels - Plain carbon steels - effect of C, Mn, Si, P & S. Purpose of alloying, effect of important alloying elements. - Important low alloy steels, stainless steel, tool steels - types, compositions and applications; Cast iron - types, composition and applications. Non ferrous metals: Physical, Mechanical, Metallurgical properties of Aluminum alloys, Magnesium alloys, Copper alloys, Nickel alloys and Titanium alloys – Classification of these alloys and applications.

UNIT-III

Polymers – types of polymers, Processing of plastic materials – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS,PAI, PPO, PPS, PEEK, PTFE, Thermo set polymers – Urea and Phenol formaldehydes; Polymer Matrix Composites: Hand layup processes - Spray layup processes - Compression moulding - Reinforced reaction injection moulding - Resin transfer moulding - Pultrusion - Filament winding - Injection moulding. Fibre reinforced plastics (FRP), (Glass fibre reinforced plastics (GRP))

UNIT-IV

Engineering Ceramics – Introduction – Traditional and engineering ceramics – Electrical properties of ceramics – Mechanical properties of ceramics – Thermal properties of ceramics – Glasses – applications, Properties and applications of Al2O3, SiC, Si3N4, PSZ and SIALON; Ceramic Matrix composites - oxide ceramics - non oxide ceramics aluminium oxide - silicon nitride - reinforcements particles - fibres - whiskers. Sintering - Hot pressing Cold isostatic pressing (piping) - Hot isostatic pressing. (HIPing)

UNIT V

Types of magnetism – Magnetization and Demagnetization of ferromagnetic metal – Soft magnetic materials – Hard magnetic material – Ferrites – applications. Semiconductor materials – Conductor and resistor materials – Super conducting materials – Di-electric materials – applications.

TEXT BOOKS:

1. William F. Smith., “Principles of Materials Science and Engineering”, Third Edition, McGraw-Hill, Inc., 1996.
2. Raghavan, V., “Materials Science and Engineering”, Prentice Hall of India, 1991.

REFERENCE BOOKS:

1. Kenneth. G. Budinski, Michael K. Budinski, “Engineering Materials Properties and Solution”, 6th Edition, Prentice Hall International, 1999.
2. Higgins, R.A., “Properties of Engineering Materials”, Viva low priced student edition, 2 nd Edition, 1998.
3. Mathews .F.L. and Rawings .R.D, Composite materials, Engineering and Science, Chapman & Hall, 2001.
4. Weatherhead, R.G FRP Technology (Fibre Reinforced Resin System), Applied Science Publishers Limited, London, 1990

COURSE OUTCOMES:

Upon completing this course, students should be able to:

1. Understand the basic structures of Engineering materials
2. Impart fundamental knowledge about Polymer composites;
3. Use Bio degradable materials for the future will keep the environment clean

4. Implement Fiber based composites results in high industrial productivity
5. Understand the properties of ferric and non-ferric materials

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	1	2	-	-	1	3	-
CO2	3	-	-	-	-	-	-	-	2	1	-	-	3	2	-
CO3	1	-	-	-	3	-	-	-	-	2	-	-	2	3	-
CO4	-	-	3	-	2	-	-	1	-	-	-	-	-	1	3
CO5	3	-	-	-	1	-	-	-	2	-	-	-	3	-	2

22MMOEXXX	NANO MATERIALS TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- This course has been designed to provide in depth knowledge on nano materials fabrication methods, characterization techniques and application of nano materials

UNIT-I:

Introduction to nano technology : Scientific revolutions - Types of nanotechnology and nanomachines - The periodic table - Atomic structure - Molecules and phases - Energy - Molecular and Atomic Size, Surfaces and Dimensional space - Atoms by inference - Scanning probe microscopy: atomic force microscope - Scanning tunneling microscope – Nanomanipulator, Nanotweezers - Atom Manipulation - Nanodots - Self assembly - Dip pen nanolithography.

UNIT-II

Nanopowders and Nanomaterials: Classification of nano materials - Properties of nano materials - characteristics of nano particulate materials; Production Methods: Top down approach - mechanical milling, Chemical Etching, Electro explosion, Sputtering, Laser ablation; Bottom up approach Plasma spraying, Chemical vapour deposition, Sol Gels, Laser pyrolosis, Atomic or molecular condensation.

UNIT-III

Characterisation and Detection Techniques: Atomic structure and chemical composition: spectroscopic methods, vibrational spectroscopies, Nuclear magnetic resonance, X-ray and UV spectroscopies, X-ray and neutron diffraction. Determination of size, shape and surface area: Electron microscopes, BET and Zeta potential, Elliptically polarised light scattering; Determination of nanoparticles in aerosols and in biological tissues

UNIT-IV

Applications of Nanomaterials: New forms of carbon - Types of Nanotubes - Formation of Nanotubes - Assemblies Purification of carbon nanotubes - Properties of Nanotubes - Uses of Nanotubes : electronics, hydrogen storage, materials, mechanical machines - Space elevators. Application of Nanomaterials : insulation materials, machine tools, batteries, high power magnets, motor vehicles and aircraft, medical implants and other medical uses, Nanocomposites and Nanowires.

UNIT-V

Applications of Nanotechnology: Nanotechnology in industries - Nanotechnology in computing: quantum computing and molecular computation - Nanotechnology in electronics: computational nanotechnology and optoelectronics, mechanical nanocomputers, super computing systems Nanotechnology in health and life sciences: drug delivery, drug encapsulation, tissue repair and implantation, bio-restorable materials - Nanotechnology in smart materials: sensors and smart instruments, ageless materials, nanoparticle coatings.

TEXT BOOKS:

1. J.Schulte, Nanotechnology: Applications and Trends, , John Wiley and Sons, 2005.
2. G.L.Timp Nanotechnology, , Springer-Verlog, New York, 1999.

REFERENCE BOOKS:

1. Nanotechnology: Basic Science and Emerging Technologies, Michael Wilson and Geoff Smith, Chapman and Hall, London, 2002.
2. Industrial application of nanomaterials - chances and risks, Wulfgang Luther, Future Technologies Division, Germany, 2004.
3. Handbook of Nanotechnology, Editor: B.Bhushan, SpringerVerlog, New York, 2004.

COURSE OUTCOMES:

1. Understand the basics of nano sized materials
2. Understand the production methods of nanomaterials
3. Acquire the knowledge on Characterize the Nanomaterials
4. Applications of nanomaterials for engineering applications
5. Select suitable nano materials for appropriate applications

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	-		1	-	-	-	-	2	-	-	1	2	-
CO2	2	-	-	3	-	-	-	-	-	-	-	1	2	3	1
CO3	1	-	2	3	-	-	-	-	-	-	-	-	3	1	2
CO4	-	-	-	-	3	-	-	2	-	-	-	1	1	3	-
CO5	2	-	-	-	-	-	-	3	-	-	-	1	3	-	2

22MMOEXXX	**SMART MATERIALS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

PRE-REQUISITES: Basic knowledge in Engineering Metallurgy.

COURSE OBJECTIVES:

- To discuss Smart Materials and their applications in Engineering
- To demonstrate the constitutive equations and mathematical models for the smart and functionally graded materials
- To explain sensing devices and structures using smart materials
- To explore the methods of energy harvesting using ambient vibrations
- To describe smart materials in damage detection and structural health monitoring

UNIT I

Introduction: Smart material age, Classification, Magnetostrictive materials, Shape memory alloys, Elastomers, Piezoelectric materials, Ferro fluids.

UNIT II

High Bandwidth Low Strain (HBLS) materials:Villari and Matteuci effect, Galfenol and Metglas materials, Magneto mechanical coupling coefficients of magnetostrictive materials, constitutive relationships, HBLS smart actuators, Magnetostrictive mini actuators, discretely distributed actuation, magnetostrictive composites, modelling and applications

UNIT III

Piezoelectric actuators - Constitutive equations and properties of piezoelectric materials, Variation of coupling coefficients for hard and soft materials, Piezoelectric smart structures, Piezo composite beam, Numerical analysis, Rectangular and Circular shape distributed piezoelectric actuators, Electro mechanical performance, Active fiber composites, Piezoelectric energy harvesting, mathematical modelling of an energy harvester, experimental methods

UNIT IV

Low Bandwidth High Strain (LBHS) materials: Classification of shape memory alloys, methods of fabrication, Control design for shape memory alloys and polymers, Electro active polymers and their applications in engineering

UNIT V

Smart structures: Smart sensing devices- piezoelectric, magnetostrictive, EAP, SMA based sensors, fiber optic sensors, Structural Health Monitoring using smart sensors and devices, monitoring structural integrity using fiber optic and piezoelectric sensors

TEXT BOOKS:

1. Thompson and Gandhi Smart Materials and Structures, Chapman and Hall, 1992
2. Bryan Culshaw, Smart Structures and Materials, Bryan Culshaw, Artech House, 1996

REFERENCE BOOKS:

1. Alper Erturk and Daniel J Inmann, Piezoelectric energy harvesting, Wiley Publications, 2011
2. Victor GIuriutiu, Structural Health monitoring with Piezoelectric Wafer Active sensors, by, Academic Press, 2008.

COURSE OUTCOMES:

After Completion of this course students will be able to

1. Identify Smart Materials and their applications in Engineering
2. Develop constitutive equations and mathematical models for the smart and functionally graded materials
3. Develop sensing devices and structures using smart materials
4. Evaluate the methods of energy harvesting using ambient vibrations
5. Adapt smart materials in damage detection and structural health monitoring

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	3	-	-	-	2	3	-	-	2	3	2
CO2	3	-	-	-	3	-	-	-	2	3	-	-	2	2	2
CO3	3	-	-	-	3	-	-	-	2	3	-	-	1	3	2
CO4	3	-	-	-	3	-	-	-	2	3	-	-	2	3	3
CO5	3	-	-	-	2	-	-	-	3	3	-	-	2	2	3

22MMOEXXX	CONSTITUTION OF INDIA	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To realise the significance of constitution of India to students from all walks of life and
  help them to understand the basic concepts of Indian constitution.
- To identify the importance of fundamental rights as well as fundamental duties.
- To understand the functioning of Union, State and Local Governments in Indian federal
  system.
- To learn procedure and effects of emergency, composition and activities of election commission and amendment procedure.

UNIT-I Introduction to Constitution:

Meaning and importance of the Constitution, salient features of Indian Constitution. Preamble of the Constitution. Fundamental rights - meaning and limitations. Directive principles of state policy and Fundamental duties – their enforcement and their relevance.

UNIT-II Union Government:

Union Executive- President, Vice-president, Prime Minister, Council of Ministers. Union Legislature- Parliament and Parliamentary proceedings. Union Judiciary-Supreme Court of India –composition and powers and functions.

UNIT-III State and Local Governments:

State Executive- Governor, Chief Minister, Council of Ministers. State Legislature- State Legislative Assembly and State Legislative Council. State Judiciary - High court. Local Government-Panchayat raj system with special reference to 73rd and Urban Local Self Govt. with special reference to74th Amendment.

UNIT-IV Election provisions, Emergency provisions, Amendment of the constitution:

Election Commission of India-composition, powers and functions and electoral process. Types of emergency-grounds, procedure, duration and effects. Amendment of the constitution- meaning, procedure and limitations.

TEXT BOOKS:

1. M.V.Pylee, “Introduction to the Constitution of India”,4th Edition, Vikas publication,2005.

2. Durga Das Basu(DD Basu) , "Introduction to the constitution of India",(Student Edition),19th edition,Prentice-Hall EEE, 2008.

REFERENCE BOOKS:

1. Merunandan, "Multiple Choice Questions on Constitution of India", 2 nd Edition,Meraga publication,2007.

COURSE OUTCOMES:

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

1. Understand and explain the significance of Indian Constitution as the fundamental law of the land.
2. Exercise his fundamental rights in proper sense at the same time identifies his responsibilities in national building.
3. Analyse the Indian political system, the powers and functions of the Union, State and Local
   Governments in detail.
   Understand Electoral Process, Emergency provisions and Amendment procedure.

22MMOEXXX	ENTREPRENEURSHIP	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To develop and strengthen entrepreneurial quality and motivation in students.
- To impart basic entrepreneurial skills and understandings to run a business efficiently and effectively.

UNIT I: ENTREPRENEURAL COMPETENCE

Entrepreneurship concept – Entrepreneurship as a Career – Entrepreneurial Personality - Characteristics of Successful, Entrepreneur – Knowledge and Skills of Entrepreneur.

UNIT II: ENTREPRENEURAL ENVIRONMENT

Business Environment - Role of Family and Society - Entrepreneurship Development Training and Other Support Organisational Services - Central and State Government Industrial Policies and Regulations - International Business.

UNIT III 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.

UNIT IV LAUNCHING OF SMALL BUSINESS

Finance and Human Resource Mobilization Operations Planning - Market and Channel Selection - Growth Strategies - Product Launching – Incubation, Venture capital, IT startups.

UNIT V MANAGEMENT OF SMALL BUSINESS

Monitoring and Evaluation of Business - Preventing Sickness and Rehabilitation of Business Modules- Effective Management of small Business.

TEXTBOOKS:

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi, 2018.
2. S.S.Khanka, Entrepreneurial Development, S.Chand and Company Limited, New Delhi, 2001.

REFERENCE BOOKS:

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, 2019.
3. Arya Kumar. Entrepreneurship. Pearson. 2012**.**
4. Donald F Kuratko, T.V Rao. Entrepreneurship: A South Asian perspective.
5. Cengage Learning. 2012

COURSE OUTCOMES:

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

1. Identify the real time entrepreneur and to impart the knowledge of entrepreneur.
2. Impart the knowledge of training activities and the policies of the government.
3. Identify the product both economical and viable ways to stabilize in the market.
4. Explore the financial activities and finding the partner for the development of product.
5. Maintain relation between successes of the product against financial activities of the company.

22MMOEXXX	AN INTRODUCTION TO GENDER AND GENDER EQUALITY	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

- To familiarize students with the concepts of sex and gender through literary and media texts.
- To help students ask critical questions regarding gender roles in society.
- To provide students with the material to discuss gender issues such as gender based discrimination, violence and development.
- To help students think critically about gender based problems and solutions.

UNIT-I

Conceptualizing Gender: Sex and Gender, Types of Gender. Concepts in relation with Gender- Gender needs, Gender Roles, Gender Stereotyping, Gender Discrimination, Gender Identity.

UNIT-II

Gender in India: Gender Status and gender disparity in Education, Labour force participation and economy, Political participation, Health. Gender and Media- Role of Media in constructing ideologies, Gender sensitivity, Gender equality, Gender and development

UNIT-III

Gender Issues and Gender based Violence: Human Rights violations, Major gender-based violence: Sexual abuse, Domestic Violence, Female infanticide, dowry death, workplace harassment.

UNIT-IV

International and National response to gender discrimination: International Convention on Elimination of all forms of Discrimination against Women (CEDAW), National Human Rights Commission, National and State Women's Commission

UNIT-V

State Initiatives to promote Gender Equality. Law Enforcing Agencies: All Women's Police Stations, Vigilance Cell, Legal Aid− Cells, Women's cell, Family Courts, Childline, Jagrata Samithi, Equal opportunity cell, Service Providers and Helplines for Women and Children.

REFERENCE BOOKS:

1. Mukherjee, Mukul (1992), Human Rights and gender issues, New Delhi: Institute of Social Sciences.
2. Bhasin Kamala (2000): Understanding gender, kali for women, N. Delhi.
3. Gupta K R (2009), Gender: Problems and policies, New Delhi: Atlantic Publishers.
4. Manoranjan pal (2009), Gender and Discrimination: Health, Nutritional status and role of women in India, London : Oxford University Press

COURSE OUTCOMES:

Upon completing this course, students should be able to:

1. Define and Evaluate gender as a social construct.
2. Analyze current social events in the light of gender perspectives.
3. Discuss, analyze and argue about issues related to gender and their impact on society, culture and development.
4. Articulate connections between global, regional, and local issues human rights, with an awareness of the importance of context.
5. Explain key concepts related to curb gender inequality

22MMOEXXX	YOGA AND HEALTH	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Develop healthy mind in a healthy body thus improving social health also improve efficiency
- Invent Do's and Don't's in life through Yam
- Categorize Do's and Don't's in life through Niyam
- Develop a healthy mind and body through Yog Asans
- Invent breathing techniques through Pranayam

UNIT-I:

Yoga – Meaning and Relevance. Tradition and origin of yoga. The body, mind and role interlink with yoga. Concepts of yoga. Types of yoga – Hatha Yoga, Bhakti Yoga, Raja yoga, Karma yoga, Jnana yoga, Kundalini yoga, Mantra Yoga, Tantra Yoga and integral Yoga (Sri Aurobindo) .

UNIT-II

Components of fitness – Flexibility, Strength, speed, ability, co-ordinative abilities and Endurance. Fitness development – cycling, Aerobic activities, Jogging, calisthenics, Rhythmic exercise and circuit Training. Components of wellness – Factors (Psychological,

Physiological and Anatomical), Progression, warming up and Limbering down, Special Physical Fitness Exercise and Principles of Physical fitness development.

UNIT-III

Bandhas and yogic purification: Bandhas: Jallandhar bandha, uddiyana Bandha, moola bandha and Mahabandha. Yogi purification: Bamana Dhouti, Barisara Dhouti, sahaj Agnisara Dhouti, Nouli, Neti kriya, Nasa-polar shahaj Bastrikria, Water bath, Tub-bath, Hip-bath, sun bath, spinal bath, Air bath, Hot foot bath, The sitz bath, Tratak and message.

UNIT-IV

Yogic Diet Food and meditation Food types : Sattvic (Cheese, Butter, curd, Ghee, sweet fruits, Honey, apples, bananas, Grapes, Papaya, Pomegranates, Mangoes, pears, Pineapple, Guavas, Figs etc. Rajasic (Eggs, Meat, Salt, Chillies, Chutney, Asafoetida, Pickles, Tea, Coffee etc.) and Tamasic (Beaf, Pork, wine, onion, Garlic, Rotten, state things). Balanced diet, carbohydrate, proteins, Fats and vitamins (Fat and water soluble).

UNIT- V

Yoga therapy Curative power for life – threatening diseases and disorders (Arthritis, Arteriosclerosis, Chronic fatigue, diabetes, Asthma and obesity). Yoga control the respiratory problem, high blood pressure, Body pain and weight reduction. Yogic practices reduce anxiety, create self awareness and provide personal social values.

REFERENCE BOOKS:

1. George Feuerstein : The Yoga Tradition (Its history, literature, Philosophy and practice) Sri Ananda : the complete Book of Yoga Harmony of Body and Mind (Orient Paper Backs : Vision Book Pvt. Ltd., 1982)
2. Swamy Satyananda Saraswathi : Asana, Pranayama, Mudra, Bandha (India : Yoga Publications Trust, Munger, Bihar)
3. Swami Sivandana Practice of Yoga (The Divine Life Society, Shivananda Nagar P.O. U.P. Himalayas, India)
4. Swami Sivananda Practice of Karma Yoga (The Divine Life Society, Shivananda Nagar P.O. U.P. Himalayas, India)
5. B.K.S. Iyenkar : Light on the Yoga Sutras of Patanjali (Haper Collinks Publications India Pvt. Ltd., New Delhi)

COURSE OUTCOMES:

Upon completing this course, students should be able to:

1. Demonstrate the ability to create and present various yoga sequences.
2. Demonstrate an understanding of health problems associated with inadequate fitness levels
3. Demonstrate the ability to perform yoga movements in various combination and forms.
4. Demonstrate and understanding of sound nutritional practices as related to health and physical performance.
5. Identify and apply injury prevention principles related to yoga activities

22MMOEXXX	NATIONAL SERVICE SCHEME	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the community in which they work and their relation
- Identify the needs and problems of the community and involve them in problem-solving
- Develop capacity to meet emergencies and natural disasters
- Practice national integration and social harmony and
- Utilize their knowledge in finding practical solutions to individual and community problems

UNIT-I: National Service Scheme

History and its Objectives - Organizational structure of N.S.S. at National, State, University and College Levels - Advisory committee and their - functions with special reference to college principal - Programme officer, N.S.S. group leader and N.S.S. volunteers in the implementation.

UNIT-II: National Integration

Need of National integration - Various obstacles in the way of National Integration; such as caste, religion, language and provisional problems etc.

UNIT-III: Special Programme

Legal awareness - Health awareness - First-aid - Career guidance - Leadership training - cum - Cultural Programme - Globalization and its Economic Social Political and Cultural impacts.

UNIT IV: Special Camping Programme

Nature and its objectives - Selection of camp site and physical arrangement - Organization of N.S.S. camp through various committees and discipline in the camp. d) Activities to be undertaken during the N.S.S. camp - Use of the mass media in the N.S.S. activities.

UNIT V: N.S.S. Regular Activities

Traffic regulation - Working with Police Commissioner's Office - Working with Corporation of Chennai - Working with Health Department - Blind assistance - Garments collection - Non-formal education - 'Environmental Education, Awareness and Training (EEAT)' - Blood donation.

REFERENCE BOOKS:

1. National Service Scheme Manual, Government of India, 2006.
2. Training Programme on National Programme scheme, TISS.
3. Orientation Courses for N.S.S. Programme officers, TISS.
4. Case material as Training Aid for field workers, Gurmeet Hans.
5. Social service opportunities in Hospitals, KapilK.Krishan,TISS.

COURSE OUTCOMES:

Upon completing this course, students should be able to:

1. Develop social and civic responsibility
2. Acquire competence for group living and sharing responsibilities
3. Acquire leadership qualities and democratic attitude;
4. Develop capacity to meet emergencies and natural disasters; and
5. Practice national integration

22MMOEXXX	NATIONAL CADET CORPS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- This course is designed especially for NCC Cadets. This course will help develop character, camaraderie, discipline, secular outlook, the spirit of adventure, sportsman spirit and ideals of selfless service amongst cadets by working in teams, learning military subjects including weapon training.

UNIT – I (Lecture): NCC Organisation and National Integration

NCC Organisation – History of NCC- NCC Organization - NCC Training- Promotion of NCC cadets – Aim and advantages of NCC Training- NCC badges of Rank- Honours and Awards – Incentives for NCC cadets by central and state govt. National Integration- Unity in diversity- contribution of youth in nation building- national integration council- Factors affecting national integration.

UNIT – II (Lecture): Personality Development and Leadership

Introduction - Factors influencing / shaping Personality - Self-Awareness – Know yourself/ Insight - Communication Skills - Leadership Traits – Types – Attitude - Time Management - Effects of Leadership - Stress Management Skills - Interview Skills - Conflict Motives - Resolution - Importance of Group / Team Work - Influencing Skills - Body Language - Sociability: Social Skills

UNIT – III (Lecture): Social Awareness and Community Development

Aims of Social service-Various Means and ways of social services- family planning – HIV and AIDS- Cancer its causes and preventive measures- NGO and their activities- Drug trafficking- Rural development programmes - MGNREGA-SGSY-JGSY-NSAP-PMGSY-Terrorism and counter terrorism- Corruption – female foeticide -dowry –child abuse-RTI Act- RTE Act- Protection of children from sexual offences act- civic sense and responsibility

UNIT – IV (Lecture): Specialized Subject (Army Wing)

Basic structure of Armed Forces- Military History – War heroes- battles of Indo-Pak war- Param Vir Chakra- Career in the Defence forces- Service tests and interviews-Fieldcraft and Battlecraft-Basics of Map reading.

UNIT – IV (Lecture): Specialized Subject (Navy Wing)

Naval Orientation - Naval Communication - Navigation - Seamanship - Fire Fighting Flooding & Damage Control - Ship and Boat Modeling-Swimming Basics.

UNIT – V (Practical): Basic Physical Training and Weapon Training

Basic physical Training – various exercises for fitness (with Demonstration) - Food – Hygiene and Cleanliness. Drill- Words of commands- position and commands- sizing and forming- saluting- marching (WITH DEMONSTRATION)

Main Parts of a Rifle- Characteristics of .22 rifle- Characteristics of 7.62mm SLR- Characteristics of 5.56mm INSAS rifle - stripping and assembling – position and holding- safety precautions – range procedure- firing simulation.

TEXT BOOKS:

1. "National Cadet Corps- A Concise handbook of NCC Cadets", Ramesh Publishing House, New Delhi, 2014.

REFERENCE BOOKS:

1. "Cadets Handbook – Common Subjects SD/SW", published by DG NCC, New Delhi.
2. "Cadets Handbook- Specialized Subjects SD/SW", published by DG NCC, New Delhi.
3. "NCC OTA Precise", published by DG NCC, New Delhi.

COURSE OUTCOMES:

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

1. Display sense of patriotism, secular values and shall be transformed into motivated youth who will contribute towards nation building through national unity and social cohesion.
2. Acquaint and provide knowledge on personality development, self awareness, communication skills with leadership traits to work as a team and sociability values.
3. understanding about social evils and shall inculcate sense of whistle blowing against such evils and ways to eradicate such evils.
4. Acquaint, expose & provide knowledge about Army/Navy/ Air force and to acquire information about expansion of Armed Forces, service subjects and important battles.
5. Demonstrate health exercises, the sense of discipline, improve bearing, smartness, turnout, develop the quality of immediate and implicit obedience of orders and basic knowledge of weapons and their use and handling.

22MMOEXXX	ROBOTICS SIMULATION FOR MANUFACTURING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the current industry scenario and scope of automated machining.
- Analyzer the work holding procedures there simulation software.
- To evaluate the robot kinematics using robo analyzer

Introduction to Robotics:

Introduction to Robotics - Quiz on Anatomy of Robot - Quiz on Robot Configuration - Quiz on DOF, cartesian movement & Drive - Systems and End Effectors - Quiz on Sensors in Robotics - Quiz on Industrial Applications of Robots - Quiz on Robotic Safety.

Spatial Representation of Object:

Relative Position and Orientation - Object with respect to a reference - Quiz on Homogeneous representation of Position and orientation of an Object - Assignment - Relationship between visual and homogeneous representation of an object using HTM module in Robo Analyzer - Assignment on Translation - Transformation, rotation transformations and DH Parameter.

Practical component: Virtual models of Industrial robots

Robot Kinematics using RoboAnalyzer:

Introduction to robot kinematics - Forward Kinematics - Inverse Kinematics - Motion planning of Robots - Joint and Cartesian motion

Practical component:

Assignment on forward and inverse kinematics -Understanding coordinate frames and transformations - Inverse and forward Dynamics of robots - Creating robot joint trajectories Assignment on Motion planning in cartesian space - Case Study: Workspace analysis of a 6axisRobot.

COURSE OUTCOMES:

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

1. Visuvlize the Anatomy of robot and its configuration.
2. Evaluate the spatial representation of an object
3. Illustrate the robot kinematics of motion planning
4. Analyze the dynamics of robots of perform work speed analysis
5. Distinguish the virtual models of industrial robots.

22MMOEXXX	INDUSTRY 4.0	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To train and equip individuals with the basic technologies behind Digital Transformation.
- To Analyze and utilize the building blocks of Industry 4.0.
- To Utilize and create the key technologies involved in Industry 4.0, change management, and implementation strategies.

UNIT - I

Introduction to Industry 4.0, Digital Transformation & Smart Manufacturing, and Building Blocks of Industry 4.0

Theory component:

Overview of Industry 4.0 and Evolution in Various Industries - Opportunities for Digital Transformation - Traditional Vs Smart Manufacturing - Key Concepts and Drivers for Digital transformation - Industrial Revolutions (1.0 to 4.0) - Additive Manufacturing - Augmented Reality/Virtual Reality - Autonomous Robots - Big Data and Analytics - The Cloud - Horizontal and Vertical System Integration - The Industrial Internet of Things (IIoT) - Digital Twin - Cybersecurity

Practical component:

Identify various wastes enterprise level in manufacturing organizations and make the list of it and analyze the source of it and list its root causes.

UNIT-II

Opportunities in Industry 4.0, Transformation & Change Management and Key Uses of Smart Manufacturing

Theory component:

Risk of Data security - IT Infrastructure - Legacy machines - Operational Excellence - Competitive Edge - Increased Work Safety - Flexible Production - Customer Satisfaction - Transforming Customer Experience, Operational Processes, and Business models - Change Management and its Theories - Vision and Strategies - Role of Leadership in Digital Transformation - Adoption Issues and Implementation Challenges - AR for Maintenance and Training - Predictive Maintenance - Virtual Training - Cobots in Manufacturing - Real-Time Dashboards and Alerts

Practical component:

Propose a solution to eliminate each waste with industry 4.0 technologies learned and do process mapping.

UNIT-III

Implementing Industry 4.0 for Smart Manufacturing, Introduction to Smart Factories, Its Use Cases and Examples

Theory component:

Typical Industrial Set-up - Implementing Industry 4.0 - Industry Wise Pain Points and Challenges - Key Performance Indicators in Industries - Connected Manufacturing Solutions: Use Cases and Examples - Connected Supply Chain: Use Cases and Examples - Manufacturing Analytics: Concepts, Examples and Use Cases

Practical component:

1. Creation of Key Performance Indicator (KPI) Dashboard for an Automotive
2. Manufacturing company.
3. Understand the key KPIs and their calculations.
4. Perform Vertical Integration.
5. Perform conditional monitoring of process and quality parameters.
6. Create a working KPI dashboard based on production data.
7. Create a manufacturing dashboard using Industrial IoT tools.

UNIT - IV

Impact of Industry 4.0 on Environment & Sustainability and Overview of Digital Twins

Theory component:

Environmental Management in Industry 4.0 - Technologies for Environmental Management - Challenges in Implementing Industry 4.0 for Environment and Sustainability - Introduction to Digital Twins and Their Functions - Role of Digital Twins in Smart Manufacturing - Digital Twins Built on IoT Platform - Implementation of Digital Twins - Applications of Digital Twins in Automotive Industry - Future Trends

Practical component:

Hands-on project demo using IOT platform that mimics the real world scenario.

UNIT-V

Smart Machines and Digital Industry Transformation

Theory component: Introduction to Smart Machines - Evolution of Smart Machines - Building Blocks of Smart Machines - Sensors and Signal Processing - Controllers in Smart Machines - Smart Machines and Future Technology - Product Life Cycle Management - Material Requirement Planning - Manufacturing Process Management - Manufacturing Execution System - Enterprise Resource Planning

Practical component:

1. ROI case study
2. Prepare an ROI report based on the Cost of Technology

COURSE OUTCOMES:

At the end of this course, students will able to

1. Identify the location of their institute and calculate the energy consumption and utilization of the identified place
2. Design a dashboard for real-time monitoring of electricity consumption and utilization of the identified place using node MCU
3. Connect appropriate sensors with all resources to be monitored and communicate the real-time data to the central server
4. Calculate & prepare the wastage report due to poor utilization of the resources and prepare a plan and schedule to prevent wastages for the identified place
5. Prepare an ROI report for the energy saved

22MMOEXXX	ELECTRIC SYSTEMS FOR E-MOBILITY (MECHANICAL)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

Students to get exposed to Electric vehicle & mobility dynamics & Battery Management Systems. Understand and build strong foundation on advanced concepts of switched-mode converter circuits. Learn about motors and its control units & Implement the motor and accompanying rotary sensor into a motor control circuit in both hardware and software. Demonstrate equivalent circuit cell model simulation.

UNIT I INTRODUCTION TO ELECTRIC VEHICLES & AUTOMATION

THEORY COMPONENT:

Future of Mobility – Electrification : The Basic Technologies (Part 1) Electric Vehicles, batteries, EVs Made - up of- Electrification : The Basic Technologies (Part 2) – Charging & Charging Infrastructure - EV & the power systems, Industry Perspective on Applications of Electrification - Electrification Impacts –Vehicle Automation – The Basic Technologies - Automation – The Impacts.

UNIT II CONVERTER CIRCUITS

THEORY COMPONENT:

Single-, Two, and Four-Quadrant Switches - Basic issues of Power Semiconductors-Introduction to DCM and Mode Boundary - Converter Topologies.

PRACTICAL/ASSIGNMENT COMPONENT:

1. Understand why a diode works in some cases, while a transistor is needed in others

2. Understand when single-quadrant, two-quadrant, or four-quadrant switch realizations are needed
3. Complete Assignment to Understand the tradeoff between voltage breakdown, switching time, and forward voltage drop in a power semiconductor device
4. Complete Assignment to Model switching loss using equivalent circuits
5. Complete Assignment to Design gate drivers
6. Work on LT spice File: Synchronous Boost Converter, with associated driver, dead time generator, and PWM models
7. Work on assignment origin of discontinuous conduction modes
8. Will be able to Analyze a converter to find the CCM-DCM mode boundary
9. Will be able to Analyze a converter circuit to find its conversion ratio in DCM
10. Switching Loss Modeling and DCM Analysis
11. Conversion ration analysis of the Cuk Converter in DCM
12. Get exposed to solved study problems on DCM analysis
13. Understand the origins of basic converter topologies
14. Student will be able to Analyze converter circuits containing transformers
15. Apply transformer analysis techniques to the forward converter
16. Apply transformer analysis techniques to the flyback converter

UNIT III MOTOR AND MOTOR CONTROL
THEORY COMPONENT:

AC motor Designs - AC motor Control - DC motors – DC motor control and stepper motors.

UNIT IV INTRODUCTION TO BATTERY MANAGEMENT SYSTEM
THEORY COMPONENT:

Battery Boot Camp - How lithium-ion cells works - BMS sensing and high-voltage control - BMS design requirements 2-5 - How are cells made? How can they fail?

UNIT V : EQUIVALENT CIRCUIT CELL MODEL SIMULATION
THEORY COMPONENT:

Defining an equivalent-circuit model of a Li-ion cell - Identifying parameters of static model - Identifying parameters of dynamic model- Simulating battery packs in different configurations - Co-simulating battery and electric-vehicle load

COURSE OUTCOMES:
Students will be able to,

1. Get exposed to the concepts & need of Electric vehicles , Mobility & Automation
2. How to implement the power semiconductor devices in a switching converter
3. Understand the origins of the discontinuous conduction mode and be able to solve
4. converters operating in DCM
5. Demonstrate the basic dc-dc converter and dc-ac inverter circuits

22MMOEXXX	MACHINE LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- The objective of this course is to provide a view of data science, machine learning, basic implementation using Python and how machine learning is applied in various domains in the industry.

UNIT I - INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Why AI? - What is AI? - AI in Practice - AI in Business - AI Platforms.

UNIT II - INTRODUCTION TO DATA SCIENCE

Data Science: The Data Revolution - Components of Data Science - Data Science in Action – Conclusion.

UNIT III - PYTHON FOR DATA SCIENCE

Why Python Libraries – NumPy - Introduction to NumPy - Operations on NumPy – Pandas – Introduction to Pandas – Introduction to Pandas Object – Working with datasets – Pandas Plots - Matplotlib – Introduction to Matplotlib – Types of Plots – Scikit-learn – Machine Learning using sklearn. [Practical hands-on exercises using NumPy, Pandas, Matplotlib]

UNIT IV - DATA VISUALIZATION USING PYTHON

Data visualization using Python: Data Visualization: Developing insights from data using Basic Plots using Matplotlib (Box, Scatter, Line, Bar, Pie, Histogram), Statistical analysis using Heatmap, Kernel Density plot using Seaborn, Network Graphs, Choropleth Map Using Ploty, Word Cloud. [Practical hands-on exercises for creating charts]

UNIT V - EXPLORE MACHINE LEARNING USING PYTHON

Introduction to Machine Learning - Regression – Classification – Clustering – Introduction to Artificial Neural Network. [Hands-on Exercises for Practicing Machine Learning Models Using Capstone Project]

REFERENCE BOOKS:

1. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_8840337130015322000_shared/overview (Introduction to AI)
2. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_12666306402263577000_shared/overview (Introduction to Data Science)
3. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013330636980609 02494_shared/overview (Python for Data Science)
4. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012605191343693 8241455_shared/overview (Data visualization using Python)
5. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012600400790749 184237_shared/overview (Explore Machine Learning Using Python)

COURSE OUTCOMES:

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

1. Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.
2. Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.
3. Assess and select appropriate data analysis models for solving real-world problem.
4. Demonstrate the importance of data visualization, design, and use of visual components.

22MMOEXXX	POWERING IOT USING ARDUINO / RASPBERRY PI	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamental knowledge about Hardware & Software platforms for design is development of IOT application.
- To educate the students to create a pick and plate robotic arm and develop a safety monitor system & machine to machine communication in the industry.
- To enable the students to design an IOT based monitoring & control system using a prototyping board, temperature sensor LED, Buzzer, Stepper motor, Embedded C/Python based code development.
- To enhance the skill of the students by giving them challenging projects & by providing them guidance through interactive LMS platform.
- To enhance the skill of the students by giving them challenging projects & by providing them guidance through interactive LMS platform.

UNIT I – Smart Farming:

The student can develop the smart farming system, they can develop the automation systems in the farming processes. They will be able to develop, monitor, and control the processes of farming using the Internet of things, they can handle the use cases like smart irrigation systems, drone fertilization, and agricultural robots and monitor the soil using sensors like humidity, temperature, PH level, and fertility.

UNIT II – Smart Industry:

Industrial automation is possible only by IoT. So students who are well versed in IoT can develop automated systems in the Tech-industries. For instance, they can create a pick-and-place robotic arm, they can develop a safety monitor system in industries, and they can either develop a machine-to-machine communication in the industry.

UNIT III – Smart Health:

The student can develop a health monitor system, they can monitor the patient health with the help of health care sensors like EMG sensors, ECG, a body temperature monitor, and breathing monitor sensors. They can monitor the patient using the digital twinning mechanism that is created using the sensors incorporated system for the human body. There by jobs in Healthcare Segment.

UNIT IV - Smart City:

The student can develop the use cases of a smart city like traffic monitor systems, garbage collectors, and monitor systems and can either create a simulation of the auto-driven vehicle using IoT simulators.

UNIT V – Smart Home:

The student will be able to form a network of household appliances. They can develop a home automation system where the household appliances can communicate with each other using wireless communication like Wi-Fi or Bluetooth. They can automate the garage door, smart fridge, smart AC, smart washing machine, and a voice control echo system. They will be able to identify the suitable IoT protocol for each use case.

Prerequisites: Basic Knowledge in Analog and Digital Electronics, C and Python Programming (Entry-level) For those , not meeting the pre-requisite, a six hours bridge course will be conducted

COURSE OUTCOMES:

At the end of this course, students will able to

1. Apply effectively the various enabling technologies like Embedded C for design of End device using ESP32 & Network infrastructure protocols.
2. Design suitable communication technologies like WPAN, WLAN, LPWAN to meet the requirement of End & Edge mode connectivity.
3. Understand the integration of Edge & Cloud computing infrastructure with IOT End devices and development of closed loop IOT system from sensing to reaching.
4. Design and build IOT system for a few interesting use cases like smart fridge, smart A/C, smart washing machine and voice control echo system of smart home.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	2	3	-	-	1	2	-	-	2	2	3	-
CO2	3	3	3	2	3	-	-	1	2	-	-	2	2	3	-
CO3	3	3	3	2	3	-	-	1	2	-	-	2	2	3	-
CO4	3	3	3	2	3	-	-	1	2	-	-	2	2	3	-
CO5	3	3	3	2	3	-	-	1	2	-	-	2	2	3	-

HONOURS ENGINEERING ELECTIVES

22MMHEEXXX	**MECHANICAL BEHAVIOUR OF MATERIALS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**4**

COURSE OBJECTIVES:

- To impart a sound understanding of the tensile, hardness and toughness behaviour of materials.
- To understand the factors affecting the fatigue and fracture behaviour of materials.
- To study the time dependant mechanical behaviour of materials.

UNIT I

Tensile behaviour: Engineering stress-strain curve: Derivation of tensile strength, yield strength, ductility, modulus of elasticity, resilience and toughness from stress strain curves, comparison of stress-strain curves for different materials - True Stress - Strain Curve: true stress at maximum load, true fracture strain, true uniform strain, Necking strain - necking Criteria - Effect of strain rate, temperature and testing machine on flow properties - Notch tensile test - Tensile properties of steel - strengthening mechanisms - Strain hardening - Strain aging - Yield point phenomena - Solid solution strengthening - Martensite Strengthening - Grain refinement, Hall-Petch relation**.**

UNIT II

Hardness & Toughness behaviour: Hardness Measurements: Brinnell hardness, Meyer's hardness, Vickers hardness, Rockwell hardness and Microhardness - Relationship

between hardness and the flow curve - Hardness at elevated temperatures - Toughness measurements: Charpy, Izod and Instrumented Charpy - Transition Temprature Curves: significance, various criteria, metallurgical factors affecting the curves, Drop weight test, explosion crack starter test, Dynamic tear test and Robertson crack arrest test - Fracture Analysis Diagram.

UNIT III

Fatigue behaviour: Introduction: Stress cycles, S-N curves Goodman diagram, Soderberg diagram, Gerbar diagram - Cyclics stress strain curve - Low cyle fatigue - Strain life Equation - Fatigue mechanisms - High cycle fatigue - Effect of following paramenters on Fatigue: mean stress, stress concentration, specimen size, surface roughness, residual stress, microstructure and temperature. Fatigue crack propagation - Fatigue under combined stresses - Cumulative fatigue damage - Design for fatigue.

UNIT IV

Fracture behaviour: Types of fracture in metals: ductile and brittle fracture - Theoretical cohesive strength of metals - Griffith theory - Metallographic aspects of fracture - Fractography - Notch effect - Concept of fracture curve - Fracture under Combined Stresses - Environment sensitive fracture: hydrogen embrittlement, stress corrosion cracking - Fracture mechanics: strain energy release rate, stress intensity factor, crack deformation modes, fracture toughness testing, plastic zone size correction, crack opening displacement, J-integral and R-curve.

UNIT V

Time dependant mechanical behaviour: Creep curve - Stress rupture Test - Structural changes during creep - Mechanisms of creep deformation - Deformation mechanisms maps - Activation energy for steady state creep - Fracture at elevated temperature - Introduction to high temperature alloys - Predication of long time properties - Creep under combined stresses - Creep- Fatigue Interaction.

REFERENCE BOOKS:

1. George E.Dieter, Mechanical Metallurgy, Tata McGraw – Hill Education Pvt.Ltd, 3rd Edition. New Delhi, 2014.
2. Hertzberg R.W., Richard W. Hertzberg , Richard P. Vinci , Jason L. Hertzberg, Deformation and Fracture Mechanics of Engineering Materials, John Wiley & Sons, Inc., 5th Revised Edition, New York, 2012.
3. Thomas Courtney. H, Mechanical Behavoiur of Materials, McGraw Hill 2nd Edition, 2005.
4. M.A.Meyers and K K.Chawla, Mechanical Behavior of Materials, Cambridge University Press, 2009
5. H. Kuhn and D. Medlin , Metals Handbook, Mechanical Testing, Vol.8, American Society for Metals, Metals Park, Ohio, 2000.
6. Broek.D, Elementary Engineering Fracture Mechanics, 4th Edition., Martinus Nijhoff Publishing, The Hague, 2008.

COURSE OUTCOMES:

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

1. Evaluate the tensile behavior of the metals and to study the various strengthening mechanisms
2. Evaluate the hardness and impact behavior of the metals

3. Illustrate the fatigue properties of Metals
4. Illustrate the fracture and fracture mechanics of metals.
5. Describe the time dependent behavior and the various creep mechanisms

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	3	-	-	-	-	-	-	-	-	2	-	-	-
CO2	1	1	3	3	-	-	-	-	-	-	-	2	-	2	-
CO3	1	1	3	3	-	-	-	-	-	-	-	2	3	2	-
CO4	1	1	3	3	-	-	-	-	-	-	-	2	-	2	-
CO5	1	1	-	-	-	-	-	-	-	-	-	2	-	2	-

22MMHEXXX	DESIGN FOR MANUFACTURING AND ASSEMBLY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the relationship between customer desires, functional requirements, and product design.
- The aim is to make the student aware of fits and tolerance that are used in the industry.
- To make students aware of the necessity to produce best design processes and systems for the best use of material.
- To acquaint the students with recent developments in reverse engineering and rapid prototyping.
- To build an efficient design by minimizing material usage on an application perspective

UNIT I

Fits and tolerance -Terminology for limits and fits, general limits of tolerance, limit system, selective assembly- problem. Gauges and gauge design-Plain gauge, design of limit gauges, manufacturing of limit gauges, choice of limit gauges-problem.

UNIT II

Jigs and fixtures -Design principles common to jigs and fixtures, fundamentals of jigs and fixtures design, materials for jigs and fixtures, construction-problem.

UNIT III

Forging -Die design for machine forging, determination of stock design, selection of forging equipment, size of die blocks-problem. Extrusion -Design of parts of extrusion block, analysis of extrusion process, variation of extrusion pressure-problem. Sheet metal drawing - Press selection, cutting forces, methods of reducing cutting forces, blanking die design, piercing die design, pilots, drawing die, bending dies, design procedure for progressive dies.

UNIT IV

Welding-Basic consideration, introduction, critical dimensions of weld connections, stress analysis in static loading, tensile load in butt welds, bending load in butt welded joints, fillet welds, concentric and eccentric loading of fillet welds, some typical structural parts, design of spot welds and plug welds-problem.

UNIT V

CMM, reverse engineering, rapid prototyping, 3D printing, design to minimize material usage, Design For Assembly, Design For Recyclability.

REFERENCE BOOKS:

1. P.C, Sharma, "Production engineering", S. Chand and Co. Pvt. LTD. New Delhi.
2. V.M. Radhakrishnan, "Welding technology and design", New age international publishers.
3. Chua C.K, Leong K.F and Lim C.S, "Rapid prototyping: Principles and applications", Third Edition, World Scientific Publishers, 2010.
4. Liou L.W and Liou F.W, "Rapid prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2007.

COURSE OUTCOMES:

Upon successful completion of the course, the students are able to:

1. To make the student aware of fits and tolerance those are used in the industry.
2. To study the fundamentals and design principles of Jigs and fixtures and their construction-problem
3. To make students aware of the different manufacturing process such as Forging, Extrusion and Sheet metal drawing and to study the equipment design procedures
4. To aware the welding activity in fabrication and to study the design of welded joints
5. To acquaint the knowledge in the advanced manufacturing techniques such as in reverse engineering, rapid prototyping and 3D printing and to aid in efficient in design to minimize material usage on an application perspective.

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	-	2	-	-	-	-	-	-	2	2	1	2
CO2	1	1	1	-	2	-	-	-	-	-	-	2	2	1	2
CO3	1	1	1	2	2	-	-	-	-	-	-	2	2	1	1
CO4	1	1	1	1	2	-	-	-	-	-	-	2	2	1	1
CO5	1	1	1	1	1	1	1	2	-	-	2	2	1	1	1

22MMHEEXXX	PRECISION ENGINEERING AND NANO-TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To impart fundamental knowledge on Precision Engineering
- To impart knowledge about Nano Technology

UNIT I

Introduction: Definition - Introduction to Precision Engineering and Manufacturing- Accuracy, Repeatability - Principles of Measurement - Precision Flexure Design. Precision Optical Manufacturing - Micro - Optics - Precision Machine Design - Micro - Sensors: Design - fabrication - Testing and packaging.

UNIT II

Principles: Principles and Application of precision Engineering to the design of

Instruments and Manufacturing Equipment. Principles of Metrology – Accuracy and Resolution - Sensors, Actuators. Bearings flexures for Precision Motion Generation.

UNIT III

Precision Manufacturing: Manufacturing Methods in Precision Engineering - Joining Technologies - Finishing processes - Special Casting techniques - Etching techniques - Coatings with metals & Inorganic Materials - Optical Production Methods - Vacuum Deposition MEMS & Micro Machining.

UNIT IV

Nano Technology & Instrumentation: Nano Technology - Introduction to Scanning Probe Microscopy (SPM) - contact mode, Tapping Mode, Scanning Tunneling Mode (STM), Atomic Force Microscope (AFM), Advanced SPM - Electrostatic Force Mode (EFM)- Magnetic Force Mode(MFM)- Scanning Capacitance Mode (SCM), Nano-indentation - High Resolution, Drexlerian Nano Technology. Introduction to biological Applications, Quantum Effects & Futures, Quantum Dots, Quantum Computing

UNIT V

Smart structures, Materials and Micro Actuators: Smart structures – smart sensors – micro valves – MEMS - micro motors - micro pumps - micro dynamometer - micro machines - structures assembly - cooling channels - micro optics - micro nozzIes.

REFERENCE BOOKS:

1. Principles of Precision Engineering, NakazawaH. Oxford University press, 1994.
2. Nano Technology, Mark Ratner and Daniel Ratner, Pearson Education, Delhi 2003.
3. Precision engineering in Manufacturing, Murthy.R.L. New Age international Pvt. Limited.
4. Hand book of Surface and Nano Technology, D.J. White House.
5. Institute of Physics Publishing, Bristol and Philadelphia, Bristol. BSI 6BE U.K.
6. The Science and Engineering of Micro-electronic Fabrication, Stephen A. Campbell, Oxford University Press, 1996.
7. Understanding Smart Sensors, Randy Frank, Artech. House, Boston, 1996.

COURSE OUTCOMES:

Upon successful completion of the course, the students are able to:

1. Understand the basic concepts of Precision Engineering.
2. Impart fundamental knowledge about MEMS.
3. Evaluate the Quantum Effect Futures
4. Design the smart materials for specific applications.
   Acquire knowledge about the nano instrumentation

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	1	2	-	2	-	-	-	-	-	-	2	1	-	-
CO2	1	-	-	-	2	-	-	2	-	-	-	-	-	1	-
CO3	-	-	2	1	2	-	-	-	-	2	-	-	2	-	-
CO4	2	-	-	1		-	2	-	-	-	-	-	-	1	-
CO5	-	2	-	-	1	-	-	2	-	-	-	-	-	2	3

22MMHEEXXX	ROBOTICS AND AUTOMATIONS	L	T	P	C
		3	0	0	4

COURSE OBJECTIVES:

- To know about the basic concepts in industrial automation
- Be exposed to pneumatic, electric, hydraulic and electronic systems in automation of mechanical operations
- Describe in detail how industrial robot systems are used, structured and operate,
- Identify fundamental issues within sustainable industrial development from an automation perspective and be able to exemplify the consequences of these,
- Implement and present a basic automation task with an industrial robot, including pilot study, online and offline programming and evaluation of the results, based on a given specification.

UNIT I

Fundamental concepts in manufacturing and automation, definition of automation, reasons for automating. Types of production and types of automation, automation strategies, levels of automation

Transfer Lines And Automated Assembly: General terminology and analysis, analysis of transfer lines without storage, partial automation. Automated flow lines with storage buffers. Automated assembly - design for automated assembly, types of automated assembly systems, part feeding devices, analysis of multi-station assembly machines. AS/RS, RFID system, AGVs, modular fixturing, Flow line balancing

UNIT II

Design of Mechatronic Systems: Stages in design, traditional and mechatronic design, possible design solutions. Case studies-pick and place robot

UNIT III

Programmable Automation: Special design features of CNC systems and features for lathes and machining centers. Drive system for CNC machine tools. Introduction to CIM; condition monitoring of manufacturing systems

Design for High Speed Automatic Assembly: Introduction, Design of parts for high speed feeding and orienting, high speed automatic insertion. Analysis of an assembly. General rules for product design for automation

UNIT IV

Basic Concepts: Automation and Robotics - Brief history of Robotic technology - Robot classifications and specifications - Various manipulators: End effectors and Tools - Sensors - work cell - Programming methods – Robot vision system

UNIT V

Types of Robots: Application of robots in various fields: Non-conventional industrial robots, Service industry, Robots for agriculture, mining, exploration, underwater, civilian and

military applications, nuclear applications, Space applications. Humanoid robots: Wheeled and legged

TEXT BOOKS:

1. Mikell P Groover, Automation Production Systems and Computer Integrated Manufacturing, Pearson Education, New Delhi, 2001
2. Bolton W, Mechatronics, Pearson Education, 1999
3. Mikell P Groover, Industrial Robots – Technology, Programming and Applications, McGraw Hill, New York, USA. 2000

COURSE OUTCOMES:

Upon completing this course, students should be able to:

1. gain fundamental knowledge in types of manufacturing and automation
2. expertise in designing automated transfer lines and assembly lines
3. update their knowledge in the advancement of hydraulics and pneumatics systems
4. gain fundamental knowledge on the importance of robots in automation
5. suggest suitable robots for specific applications

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	-	-	-	1	-	-	-	-	-	-	-	-	1	2
CO2	-	-	-	-	3	2	-	-	-	-	-	-	1	-	-
CO3	-	-	2	1	2	-	-	-	-	-	-	-	2	2	-
CO4	-	1	1	2	-	-	-	2	-	-	-	-	1	-	1
CO5	-	-	1	1	-	-	-	-	-	-	-	-	1	1	-

22MMHEEXXX	**PLANT LAYOUT AND MATERIAL HANDLING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To introduce the concepts of layout planning and the various algorithms used in and also to introduce the design of material handling systems, mechanized assembly, hoppers and feeders and transfer systems.

UNIT I

Plant Layout: Need for Layout Planning – Layout Objectives and Determinants. Process Layout: Operation Sequence Analysis – Load-Distance Analysis – Travel Chart – Muthur's systematic layout planning – Pair-wise Exchange Method–Simple Problems. Product Layout: Line Balancing– Largest Candidate Rule – Kilbridge & Wester's Method – Ranked Positional Weight Method – COMSOAL.

UNIT II

Apples plant layout procedure – Reed's plant layout procedure - Computer Aided Plant Layout Planning: CORELAP, PLANET, MAT, ALDAP, CRAFT - Plant Layout Algorithms: Modified spanning tree algorithm – Graph based method – BLOCPLAN Algorithm

UNIT III

Facilities planning - Introduction to models for single row machine layout problem - multi-row layout problem and quadratic assignment model - introduction to algorithms for the multi-row layout problems.

UNIT IV

Material Handling Functions - Principles - Types of Material Handling Systems. Analysis of Material Handling Equipment. Economic Analysis of Material Handling Equipments: Breakeven Analysis – Equipment Operating Cost Per Unit Distance – Work Volume Analysis – Illustrative Problems. Productivity / Indicator Ratios. Packaging: Functions – Materials – Palletizing – Packaging Equipments.

UNIT V

Mechanized Assembly: Principles and Operating characteristics of Part Feeders such as Vibratory Bowl Feeder, Reciprocating Tube Hopper, Centrifugal Hopper Feeder and Center Board hopper feeder – Orientation of Parts – In-bowl and Out-of-bowl tooling – Different Types of Escapements Transfer Systems and Indexing Mechanisms.

REFERENCE BOOKS:

1. Material Handling, John R. Immer, McGraw Hill Book Coy, 1953
2. Facility Layout and Location: An Analytical Approach, Francis R. L., McGinnis L. F., & White J. A., PHI, 1999
3. Manufacturing Facilities: Location, Planning & Design. Sule D. R., PWS Publishing Co., Boston, 2nd Edition, 1994
4. Facilities Design, Sunderesh Heragu, PWS Publishing Co., Boston, 1997
5. Materials Management & Materials Handling, Sharma S. C., Khanna Publishers, New Delhi
6. Production and Operations Management – Principles and Techniques, Ray Wild, ELBS
7. Analysis and control of production systems, 2nd edition, Elsayed A., and Thomas O. Bouchar Prentice Hall, NJ, 1994
8. Theory and Problems in Operation and Production Management, Chary S. N., Tata-McGraw Hill, 1994
9. Mechanised Assembly, Boothroyd & Redford
10. Automation, Production Systems and Computer-Integrated Manufacturing, Groover M.P., PHI, New Delhi, 2002
11. Facilities Planning, III Edition, Tompkins, White, Bozer, Tanchoco, John Wilery & Sons Pvt.Ltd, Singalore, 2003

COURSE OUTCOMES

Upon completing this course, students should be able to:

1. Understand the different layout planning and its techniques such as process layout and product layout
2. Differentiate various types of layout procedure, computer aided plant layout planning and plant layout Algorithm
3. Select appropriate facilitate planning for different layout problems
4. Classify various types of material handling functions of material handling system, and analysis of material handling system
5. Evaluate the Mechanized assembly on part feeders and Transfer system

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	-	-	-	-	-	-	-	-	-	1	2	-
CO2	3	1	2	1	1	-	-	-	-	-	-	-	2	2	-
CO3	2	3	1	-	2	-	-	-	-	-	-	-	1	2	-
CO4	2	3	-	1	2	1	-	-	-	-	-	-	1	1	-
CO5	2	-	1	-	1	-	-	-	-	-	-	-	1	1	-

22MMHEEXXX	MAINTENANCE MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To impart a better understanding of the fundamental philosophies of Maintenance Management, and the different techniques that enable the selection of the optimum maintenance strategy. It also discuss the concepts of reliability engineering and spare parts management

UNIT I

Maintenance system: Types of Maintenance - Maintenance strategies and planning – quantitative analysis – Breakdown – time frequency distributions – Breakdown maintenance policy, preventive maintenance policy- Selection of repair Vs preventive maintenance policy – simple problems. Introduction to TPM – six big losses – pillars of TPM – 5s – Overall Equipment Effectiveness (OEE)

UNIT II

Maintenance facilities planning: Planning of Maintenance Function – Long range planning – Short range planning – Man power allocation - Planning techniques – Planning steps - Optimal number of machines / crew size - Use of waiting line and Simulation model.

UNIT III

Replacement strategies and Policies: Basic concepts of replacement analysis, economic service life, opportunity costs - cash flow approaches to replacement analysis - Replacement analysis using specified time period - probabilistic replacement models – simple problems

UNIT IV

Reliability Engineering: Bath tub curve - Failure data analysis and life testing – Reliability parameters – Reliability models – Reliability evaluation methods – Weibull analysis – System reliability with components in series, parallel and mixed configuration – Active, partial and standby redundancy – Availability and Maintainability concepts - Reliability centered maintenance – FTA, FMECA.

UNIT V

Spares management: Spare parts management - Characteristics of spare parts inventory – Approaches for selective inventory control – VED/ABC analysis – Models for breakdown spares, capital spares, insurance spares and rotable spares – simple problems. Introduction to Maintenance Resource Planning (MRP) – maintenance Manpower Resources and Spares Requirement Planning (MRSRP).

REFERENCE BOOKS:

1. Production and Operations Management: Theory and Problems, Chary S.N., TMH, New Delhi, 1990
2. Operation Management: Theory & Problems Monks J.G., McGraw Hill, 1987
3. Concepts in Reliability Engineering, Srinath L.S., East west press Ltd. 1991
4. Terrotechnology: Reliability Engineering and Maintenance Management, Bikas Bhadury and S.K. Basu, Asian Books Pvt., Ltd., New Delhi, 2003
5. Introduction to Total Productive Maintenance, Seiichi Nakeiima, Productivity Press (India) Pvt Ltd., Madras, 1988
6. Maintenance and Engineering Management, Mishra R.C., Pathak K., Prentice hall India Private Limited, New Delhi, 2002

COURSE OUTCOMES:

Upon completing this course, students should be able to:

1. Develop a maintenance plan for a technical system
2. Have a working knowledge of the techniques of reliability engineering
3. Apply learned concepts to improve the maintenance, the maintainability, hazard risk and the safety of the plant
4. Apply problem solving models to maintenance
5. Analyze different failure of a component/equipment

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	3	3	-	3	-	2	2	2	-	3	2	2
CO2	3	3	-	-	3	-	3	-	-	3	3	-	3	2	-
CO3	3	3	-	-	-	-	-	-	-	3	3	-	2	-	-
CO4	2	2	-	-	3	-	-	-	3	3	2	-	1	2	2
CO5	1	2	-	-	2	-	2	-	3	2	3	-	2	2	3

MINOR ENGINEERING ELECTIVES

22MMMEEXXX	MANUFACTURING PROCESSES	L	T	P
		4	0	3

COURSE OBJECTIVES:

- To provide fundamental knowledge on the various conventional manufacturing processes such as casting, forming, machining and welding and application of these processes in manufacturing industries.

UNIT I METAL CASTING PROCESSES:

Sand Casting – Sand Mould – Type of patterns - Pattern Materials – Pattern allowances – Molding sand Properties and testing – Cores –Types and applications – Molding machines – Types and applications– Melting furnaces – Principle of special casting processes- Shell, investment – Pressure die casting – Centrifugal Casting - CO casting - Stir casting – Squeeze casting, Continuous casting - Defects in casting.

UNIT II BULK METAL FORMING PROCESSES

Introduction to plastic deformation and yield criteria - Hot working and cold working of metals – Forging processes – Open, impression and closed die forging – Characteristics of the processes – Typical forging operations; Rolling of metals – Types of Rolling – Flat strip rolling – shape rolling operations – Defects in rolled parts; Principle of rod and wire drawing – Tube drawing – Principles of Extrusion – Types – Hot and Cold extrusion.

UNIT III SHEET METAL FORMING PROCESSES

Press Tool operations: Types of presses; Shearing operations: Blanking and Piercing; Deep Drawing: Draw die design; Spinning, Banding, Stretch Forming, Embossing and Coining; Sheet metal characteristics – Formability of sheet metal – Test methods – Sheet metal die design: Types of dies, Die construction, Punch design, Pilots, Stripper and stock guide, Die stops.

UNIT IV METAL MACHINING PROCESSES:

Cutting tools: Single point and multi point cutting tools; Tool nomenclature and Tool signature; Tool materials; Mechanism of Chip formation, orthogonal and oblique cutting, Cutting forces, Heat generation and cutting tool temperature; Tool wear, Tool life and machinability; Cutting fluids; Machining processes: Principles and operation of Turning, Drilling, Boring. Shaping, Milling, Grinding machines

UNIT V METAL JOINING PROCESSES:

Fusion welding processes – Type of Gas welding – Flame characteristics – Filler and Flux materials – Principles and types of Resistance welding – Arc welding, Electrodes, Coating and specifications – Manual meta arc welding, Gas metal arc welding – Flux cored arc welding - Submerged arc welding – Electro slag welding – Gas Tungsten arc welding - Weld defects – Brazing and soldering – methods and process capabilities – Adhesive bonding, Types and application

TEXT BOOKS:

1. Kalpakjian. S, “Manufacturing Engineering and Technology”, Pearson Education India Edition, 2006.
2. Roy. A. Lindberg, Processes and materials of manufacture, PHI / Pearson education, 2006.

REFERENCE BOOKS:

1. Gowri.S, P. Hariharan, A.SureshBabu, Manufacturing Technology I, Pearson Education, 2008.
2. HajraChouldhary S.K. and Hajra Choudhury. A. K., Elements of Workshop Technology, Volume I and II, Media Promoters and Publishers Private Limited, Mumbai, 1997.
3. Paul Degarma E., Black J.T. and Ronald A. Kosher, Materials and Processes, in Manufacturing, Eight Edition,Prentice Hall of India, 1997.
4. Rao. P. N., Manufacturing Technology Foundry, Forming and Welding, 2 ndEd.Tata McGraw Hill, 2003. 5. Sharma, P.C., A Textbook of Production Technology, S.Chand and Co. Ltd

COURSE OUTCOMES:

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

1. Understand the concept of mould making and casting processes

2. Anlayse the deformation behaviour of metals under various metal forming processes
3. Select a appropriate forming technique to produce a component using sheets
4. Understand the mechanism of metal removal by cutting tools
5. Choose a suitable joining method to assemble/fabricate components

Mapping with Programme Outcomes													Mapping with PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	-	-	-	-	3	-	-	3	2	3	-
CO2	3	3	3	2	1	-	-	-	3	-	-	3	2	3	-
CO3	3	3	3	2	1	-	-	-	3	-	-	3	2	3	-
CO4	2	1	1	1	-	-	-	2	3	-	-	1	2	-	2
CO5	2	1	1	1	-	-	-	2	3	-	-	1	2	-	2

22MMMEEXXX	MANUFACTURING TECHNOLOGY	L	T	P
		4	0	4

COURSE OBJECTIVES:

- To acquaint the students with recent developments in modern manufacturing technologies such as casting, forming, welding and machining processes.
- To impart knowledge to the students on processing of plastics, powder metallurgy and additive manufacturing concepts.

UNIT I

Advanced casting processes - plaster mold and ceramic mold casting – vacuum casting – Evaporative pattern casting, ceramic shell investment casting, slush casting, squeeze casting and semisolid metal forming Special forming processes - Working principle and applications – Hydro forming – Rubber pad forming – Metal spinning – Introduction of Explosive forming, magnetic pulse forming, Super plastic forming – Micro forming – Incremental forming.

UNIT II

Advanced welding processes: Basic principle, Process variables, Chief characteristics and applications of the following processes: Laser beam welding, Electron beam welding, Plasma arc welding, Rotary Friction Welding, Friction stir welding, Explosive welding, Ultrasonic welding Diffusion welding, Vacum Brazing and Hybrid welding.

UNIT III

Non Traditional Machining processes: Basic principle, Process variables, Chief characteristics and applications of the following processes: Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, Electrical Discharge Machining, Electro-chemical machining (ECM), Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining (EBM), Introduction to Micro machining.

UNIT IV

Manufacturing processes for plastics: Extrusion, Injection, Blow and rotational moulding of plastics-Thermoforming-Compression moulding – Transfer moulding - Casting– Foam moulding - Processing of reinforced plastics and composites –Moulding – compression, vacuum bag – contact – resin transfer – transfer / injection. Hand Layup and Filament winding.

UNIT V

Powder metallurgy processes: Methods of Powder production – Blending of metal powders- Compaction of metal powders- Sintering – hot pressing – Isostatic pressing – hot and cold (HIP and CIP), Selective Laser Sintering; Additive Manufacturing: Introduction – Stereo lithography – Fused deposition moulding – selective laser machining – Laminated object manufacturing – solid base curing – Direct manufacturing and rapid tooling.

TEXT BOOKS:

1. Serope Kalpakjian, and Steven R. Schemid, "Manufacturing processes for Engineering Materials", 4th edition, Pearson Education, 2003.
2. Serope Kalpakjian, and Steven R. Schemid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education, 2003

REFERENCE BOOKS:

1. Brahem T. Smith, "Advanced machining", I.F.S., U.K.1989.
2. Amstead, B.H., Ostwald Phylips and Bageman.R.L., "Manufacturing Processes" John Wileys Sons, 1987.
3. Muccic, E.A., "Plastic Processing Technology", Materials park, OHIO, ASM Int.,1994.
4. Jaeger, R.C., "Introduction to microelectronic Fabrication", Addision-Wesley, 1988.

COURSE OUTCOMES:

After the completion of the course, the students are able to

1. Understand the advances in casting and forming techniques
2. Select appropriate joining technique to fabricate components using newer materials
3. Prescribe the suitable non-traditional machining process to machine precision components
4. Demonstrate the processing of various plastic components
5. Produce components using powder metallurgy and additive manufacturing techniques

Mapping with Programme Outcomes													Mapping with PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	2	-	2	1	-	-	-	-	1	1	-	2	1	-
CO2	-	2	-	2	1	-	-	-	-	1	1	-	2	1	-
CO3	-	2	-	2	1	-	-	-	-	-	-	-	2	1	-
CO4	-	2	-	2	1	-	-	-	-	-	-	-	2	1	-
CO5	-	2	-	2	1	-	-	-	-	-	-	-	2	1	-