ANNAMALAI UNIVERSITY

Annamalainagar

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MANUFACTURING ENGINEERING

B.E. Mechanical Engineering (Manufacturing)

Choice Based Credit System

2018

DEPARTMENT OF
MANUFACTURING ENGINEERING

VISION

Provide high quality education to create technically competent 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 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.

PROGRAMME EDUCATIONAL OBJECTIVES

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

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.

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

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

B.E. MECHANICAL ENGINEERING (MANUFACTURING)

PROGRAM OUTCOMES

After the successful completion of the B.E. Mechanical Engineering (Manufacturing) 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.

PO4: 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.

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

ANNAMALAI UNIVERSITY

FACULTY OF ENGINEERING AND TECHNOLOGY

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

Choice Based Credit System (CBCS)

REGULATIONS 2019

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 (listed in Annexure-I) 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	-	Chemical Engineering
BRANCH II	-	Civil Engineering
BRANCH III	-	Civil and Structural Engineering
BRANCH IV	-	Computer Science and Engineering
BRANCH V	-	Electrical and Electronics Engineering
BRANCH VI	-	Electronics and Communication Engineering
BRANCH VII	-	Electronics and Instrumentation Engineering
BRANCH VIII	-	Information Technology
BRANCH IX	-	Mechanical Engineering
BRANCH X	-	Mechanical Engineering (Manufacturing)
BRANCH XI	-	Computer Science and Engineering (AI and Machine learning)
BRANCH XII	-	Computer Science and Engineering (Big Data Analytics)

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 six components namely Humanities / Social Sciences /Management, Basic Sciences, Engineering Sciences, Professional Core, Professional Electives and Open Electives in addition to Seminar & Industrial Training and Project. Each semester curriculum shall normally have a blend of theory and practical courses. The total credits for the entire degree Programme is 166 (124 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

5.1 Earn a minimum of 166 credits (124 for lateral entry students).

5.2 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

5.3 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 186. Out of 186 credits (144 credits for lateral entry students), 20 credits must be earned by studying additional course offered by the same or allied Departments (listed in Annexure-II) in sixth, seventh and eighth semesters. These additional 20 credits could be acquired through the MOOC courses of SWAYAM portal also.

5.4 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 186 credits, 20 credits must be earned from the courses offered by any one of the Departments (listed in Annexure-II) in the Faculty of Engineering and Technology in sixth, seventh and eighth semesters . These additional 20 credits could be acquired through the MOOC courses offered in SWAYAM portal also.

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 166 (124 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 Advance Learners

The advance 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. Mandatory Internship (Industrial Training)

To promote industrial internship at the graduate level in technical institutes and also to enhance the employability skills of the students passing out from Technical Institutions, the internship for the students at different stages of the programme, is included in the curriculum. The student has to undergo the internship during the summer vacation, after the II semester / IV semester / VI semester of the programme as per the details outlined below. Further the student has to submit a report on completion of the internship during the subsequent Odd semester that is in the III / V / VII semesters respectively.

9.1 During the summer vacation, after the II Semester,

The student must get involved in any of the following Inter/ Intra Institutional Activities for 4 weeks duration:

(i) Training with higher Institutions; Soft skill training organized by Training and Placement Cell.

(ii) Contribution at incubation/ innovation /entrepreneurship cell of the institute.

(iii) Participation in conferences/ workshops/ competitions.

(iv) Learning at Departmental Lab/ Institutional workshop.

(v) Working for consultancy/ research project within the University.

(vi) Participation in activities like IPR workshop / Leadership Talks/ Idea/ Design/ Innovation/ Technical Expos.

9.2 During the summer vacation, after the IV Semester and also after the VI Semester,

The student may choose any of the following Internship / Innovation / Entrepreneurship related activities for 4 weeks duration:

(i) Work on innovation or entrepreneurial activities resulting in start-up

(ii) Undergo internship with industry/ NGO's/ Government organizations/ Micro/ Small/
Medium enterprises
(iii) Undergo internship with National Employment Enhancement Mission (NEEM) Facilitator.

10. 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.

11. 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

12. Electives

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

12.1 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.

12.2 Open Elective courses

Apart from the various Professional elective courses, a student must study three open elective courses two of which offered by the Department concerned and the other open elective course offered by any other Department in the Faculty of Engineering & Technology during either sixth or seventh or eighth semester of study, with the approval of the Head of the Department and the Head of the Department offering the course.

12.3 MOOC (SWAYAM) Courses

Further, the student can be permitted to earn not more than 20 % of his total credits (that is 32 credits) by studying the Massive Open Online Courses offered through the SWAYAM Portal of UGC with the approval of the Head of the Department concerned. These courses will be considered as equivalent to the professional elective and/or open elective courses. Thus the credit earned through MOOC courses can be transferred and considered for awarding Degree to the student concerned.

12.4 Value added courses (Inter Faculty Electives)

Of the four open elective courses, a student must study one value added course that is offered by other Faculties in our University either in sixth or seventh semester of the B.E programme.

12.5 One Credit Courses

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

12.5.1 Industry Expert

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 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 one credit courses (one each in VI and VII semesters). They shall be allowed to take 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 one credit courses.

12.5.2 NSQF Courses

A student can be permitted to acquire additional credits not more than two by undergoing any two of the one credit courses conducted under the auspices of National Skills Qualification Framework (NSQF). NSQF is a nationally integrated education and competency based skill and quality assurance framework that will provide for multiple pathways, horizontal as well as vertical, including vocational education, vocational training, general education and technical education, thus linking one level of learning to another higher level. This will enable a student to acquire desired competency levels, transit to the job market and at an opportune time, return for acquiring additional skills to further upgrade their competencies.

13. Assessment

13.1 Theory Courses

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

First assessment (Mid-Semester Test-I)	:	10 marks
Second assessment (Mid-Semester Test-II)	:	10 marks
Third Assessment	:	5 marks
End Semester Examination	:	75 marks

13.2 Practical Courses

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

First assessment (Test-I)	:	15 marks
Second assessment (Test-II)	:	15 marks
Maintenance of record book	:	10 marks
End Semester Examination	:	60 marks

13.3 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.

13.4 Industrial Internship

After attending the internship during the summer vacation of even semester (II / IV / VI semester), the student has to present a report at the start of the subsequent odd semester (III / V / VII semester) to the committee which will assess and award marks out of 100. The committee is constituted with an Internship Coordinator and a minimum of two members nominated by the Head of the Department for each class.

14. 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.

15. 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.

16. 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.

17. 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.

18. 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.

19. 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.

20. 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-valuation 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.

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

21. Awarding Degree

After successful completion of the programme, the degree will be awarded with the following classification based on CGPA.

21.1 Honours Degree

To obtain Honours Degree a student must earn a minimum of 186 credits within four years (144 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 CGPA of 8.25 or above.

21.2 First Class with Distinction

To obtain B.E Degree First Class with Distinction, a student must earn a minimum of

166 Credits within four years (124 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.

21.3 First Class

To obtain B.E Degree First Class, a student must earn a minimum of 166 credits within ***five*** years (124 credits within ***four*** years for lateral entry students) from the time of admission and obtain a 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).

21.4 Second Class

For Second Class, the student must earn a minimum of 166 credits within seven years (124 credits within six years for lateral entry students) from the time of admission.

21.5 B.E Degree with Minor Engineering

For Minor Engineering, the student must earn a minimum of 186 credits within four years (144 credits within three years for lateral entry students) from the time of admission, pass all the courses. The rules for awarding the B.E degree in First Class with Distinction or in First Class or in Second Class will be applicable for this also.

22. Ranking of Candidates

The candidates who are eligible to get the B.E. degree with Honours will be ranked together on the basis of 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 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 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.

23. 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-I

Diploma Programmes Eligible for the B.E (Lateral Entry) Programmes offered in FEAT (from 2019-2020)

Sl.No.	Branches of Study	Eligible Diploma Programme (FT / PT / SW)
1.	**Chemical Engineering**	i. Petrochemical Engineering ii. Chemical Engineering iii. Environmental Engineering and Pollution Control iv. Leather Technology (Footwear) v. Leather Technology vi. Plastic Technology vii. Polymer Technology viii. Sugar Technology ix. Textile Technology x. Chemical Technology xi. Ceramic Technology xii. Petro Chemical Technology xiii. Pulp & Paper Technology xiv. Petroleum Engineering
2.	**Civil Engineering**	i. Civil Engineering ii. Civil Engineering (Architecture) iii. Environmental Engineering and Pollution Control (Full Time)
3.	**Civil and Structural Engineering.**	iv. Architectural Assistantship v. Civil Engineering (Rural Tech.) vi. Civil and Rural Engineering vii. Agricultural Engineering
4.	**Computer Science and Engineering**	i. Electronics and Communication Engineering ii. Computer Technology iii. Computer Science and Engineering iv. Information Technology v. Computer Engineering vi. Computer Networking vii. Electronics(Robotics) viii. Mechatronics Engineering
5.	**Electrical and Electronics Engineering**	i. Electrical and Electronics Engineering ii. Electronics and Communication Engg. iii. Electronics and Instrumentation Engg iv. Electronics Engineering(Instrumentation) v. Instrument Technology vi. Instrumentation and Control Engineering vii. Electrical Engineering (Instruments and Control) viii. Electrical Engineering ix. Instrumentation Technology x. Electronics (Robotics) xi. Mechatronics Engineering
6.	**Electronics and Communication Engineering**	i. Electronics and Communication Engineering ii. Computer Technology iii. Computer Science and Engineering iv. Information Technology v. Computer Engineering vi. Computer Networking vii. Electronics(Robotics) viii. Mechatronics Engineering ix. Electrical and Electronics Engineering x. Electronics and Instrumentation Engg

Sl.No.	Branches of Study	Eligible Diploma Programme (FT / PT / SW)
7.	**Electronics and Instrumentation Engineering**	i. Electrical and Electronics Engineering ii. Electronics and Communication Engg. iii. Electronics and Instrumentation Engg iv. Electronics Engineering(Instrumentation) v. Instrument Technology vi. Instrumentation and Control Engineering vii. Electrical Engineering (Instruments and Control) viii. Electrical Engineering ix. Instrumentation Technology x. Electronics (Robotics) xi. Mechatronics Engineering
8.	**Information Technology**	i. Electronics and Communication Engineering ii. Computer Technology iii. Computer Science and Engineering iv. Information Technology v. Computer Engineering vi. Computer Networking vii. Electronics(Robotics) viii. Mechatronics Engineering
9.	**Mechanical Engineering**	i. Mechanical Engineering ii. Mechanical and Rural Engineering iii. Mechanical Design and Drafting iv. Production Engineering v. Production Technology vi. Automobile Engineering vii. Automobile Technology viii. Metallurgy ix. Mechatronics Engineering x. Machine Tool Maintenance and Repairs xi. Tool and Die making xii. Tool Engineering xiii. Tool Design xiv. Foundry Technology xv. Refrigeration and Air Conditioning xvi. Agricultural Engineering xvii. Agricultural Technology xviii. Marine Engineering xix. Mechanical Engineering(Production) xx. Mechanical Engineering(Tool &Die) xxi. Mechanical Engineering (Foundry) xxii. Mechanical Engineering(R & A.C.) xxiii. Electronics(Robotics) xxiv. Mining Engineering xxv. Agricultural Engineering and Farm Machinery xxvi. Equipment Technology
10.	**Mechanical Engineering (Manufacturing Engineering)**	
11	**Computer Science and Engineering (AI and Machine learning)**	i. Electronics and Communication Engineering ii. Computer Technology iii. Computer Science and Engineering iv. Information Technology v. Computer Engineering vi. Computer Networking vii. Electronics(Robotics) viii. Mechatronics Engineering

12	**Computer Science and Engineering (Big Data Analytics)**	i. Electronics and Communication Engineering ii. Computer Technology iii. Computer Science and Engineering iv. Information Technology v. Computer Engineering vi. Computer Networking vii. Electronics(Robotics) viii. Mechatronics Engineering

Annexure-II

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.	Chemical Engineering	1. Chemical Engineering 2. Pharmacy 3. Electronics and Instrumentation Engineering	1. Civil Engineering 2. Mechanical Engineering 3. Electronics and Instrumentation Engg 4. Information Technology 5. Civil and Structural Engg 6. Electrical Engineering 7. Electronics and Communication Engg 8. Mechanical (Manufacturing) Engg 9. Computer Science and Engineering 10. Computer Science and Engineering. (AI and Machine learning) 11.Computer Science and Engineeringg. (Big Data Analytics)
2.	Civil Engineering	1. Civil Engineering 2. Civil and Structural Engg.	1. Mechanical Engineering 2. Electrical Engineering 3. Chemical Engineering 4. Computer Science and Engineering. 5. Computer Science and Engineering. (AI and Machine learning) 6. Computer Science and Engineering (Big Data Analytics) 7. Mechanical (Manufacturing) Engg 8. Electronics and Instrumentation Engg 9. Information Technology 10. Electronics and Communication Engg
3.	Civil and Structural Engineering		

4.	Computer Science and Engineering	1. Computer Science and Engg. 2. Information Technology 3. Electronics and Communication Engineering 4. Computer Science and Engineering. (AI and Machine learning) 5. Computer Science and Engineering. (Big Data Analytics)	1. Civil Engineering 2. Electronics and Instrumentation Engg 3. Electronics and Communication Engg 4. Mechanical Engineering 5. Mechanical (Manufacturing) Engg 6. Civil and Structural Engg 7. Electrical Engineering 8. Chemical Engineering
5.	Computer Science and Engineering (AI and Machine learning)		
6.	Computer Science and Engineering (Big Data Analytics)		
7.	Electrical and Electronics Engineering	1. Electrical Engineering 2. Electronics and Instrumentation Engineering 3. Electronics and Communication Engineering	1. Civil Engineering 2. Civil and Structural Engg 3. Mechanical Engineering 4. Chemical Engineering 5. Mechanical (Manufacturing) Engg 6. Computer Science and Engineering 7. Computer Science and Engineering (AI and Machine learning) 8. Computer Science and Engineering (Big Data Analytics) 9. Information Technology
8.	Electronics and Communication Engg.		
9.	Electronics and Instrumentation Engg.		
10.	Information Technology	1. Computer Science and Engg. 2. Information Technology 3. Electronics and Communication Engineering 4. Computer Science and Engineering. (AI and Machine learning) 5. Computer Science and Engineering (Big Data Analytics)	1. Civil Engineering 2. Electronics and Instrumentation Engg 3. Electronics and Communication Engg 4. Mechanical Engineering 5. Mechanical (Manufacturing) Engg 6. Civil and Structural Engg 7. Electrical Engineering 8. Chemical Engineering
11.	Mechanical Engineering	1. Mechanical Engineering 2. Mechanical (Manufacturing) Engg.	1. Civil Engineering 2. Civil and Structural Engg 3. Electrical Engineering 4. Chemical Engineering 5. Computer Science and Engineering 6. Computer Science and Engineering (AI and Machine learning)

12.	Mechanical (Manufacturing) Engg.		7. Computer Science and Engineering (Big Data Analytics) 8. Electronics and Instrumentation Engg 9. Information Technology 10. Electronics and Communication Engg

COURSES AND CREDITS - SUMMARY

Semester	No. of Courses		HS	BS	ES	PC	PE	OE	S&IT	Proj.	Total Credit
	T+P	Total									
I	3+3	**6**	-	9.5	8	-	-	-	-	-	17.5
			-	3	3						
II	4+3	**7**	3	9.5	8	-	-	-	-	-	20.5
			1	3	3						
III	6+3	**9**	-	4	9.5	10	-	-	4	-	27.5
			-	1	4	4					
IV	6+3	**9**	-	3	2	16.5	-	-	-	-	21.5
				1	1	7					
V	6+3	**9**	-	-	-	16.5	6	-	4	-	26.5
						7	2				
VI	6+2	**8**	-	-	-	9	9	3	-	-	21
						4	3	1			
VII	5+2+1	**8**	2	-	-	4.5	6	3	4	-	19.5
			1			2	2	1	1		
VIII	2+0+1	**3**	-	-	-	-	-	6	-	6	12
								2	-	1	
Total Courses	**38+20 +2**	**60**	**2**	**8**	**11**	**24**	**7**	**4**	**1**	**1**	**-**
Total credits		**-**	**5**	**26**	**27.5**	**56.5**	**21**	**12**	**2**	**10**	**166**

DETAILS OF COURSE CODE

S. No.	Code	Branch	S. No.	Code	Branch
1.	CH	Chemical Engineering	6.	EC	Electronics & Communication Engg
2.	CE	Civil Engineering	7.	EI	Electronics & Instrumentation Engg
3.	CS	Computer Science & Engg	8.	IT	Information Technology
4.	CZ	Civil & Structural Engineering	9.	ME	Mechanical Engineering
5.	EE	Electrical & Electronics Engg.	10.	MM	Mechanical Engg. (Manufacturing)

S. No.	Code	Category	S. No.	Code	Category
1	HS	Humanities	6	PE	Professional Elective Theory
2	BS	Basic Science	7	OE	Open Elective Theory
3	ES	Engineering Science	8	PV	Project work Viva-voce
4	PC	Professional Core Theory	9	ST	Seminar & Industrial Training
5	CP	Professional Core Practical			

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SEMESTER I									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
ETBS101	**BS-I**	Physics	3	1	0	25	75	100	4
ETBS102	**BS-II**	Mathematics – I	3	1	0	25	75	100	4
ETES103	**ES-I**	Basic Electrical Engineering	3	1	0	25	75	100	4
ETBP104	**BSP-I**	Physics Laboratory	0	0	3	40	60	100	1.5
ETSP105	**ESP-I**	Electrical Engineering Laboratory	0	0	2	40	60	100	1
ETSP106	**ESP-II**	Engineering Graphics and Design	1	0	4	40	60	100	3
						Total Credits			**17.5**

SEMESTER II									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
ETHS201	**HS-I**	English	2	0	0	25	75	100	2
ETBS202	**BS-III**	Chemistry	3	1	0	25	75	100	4
ETES203	**ES-II**	Programming for Problem Solving	3	0	0	25	75	100	3
ETBS204	**BS-IV**	Mathematics – II	3	1	0	25	75	100	4
ETHP205	**HSP-I**	Communication Skills and Language Laboratory	0	0	2	40	60	100	1
ETBP206	**BSP-II**	Chemistry Laboratory	0	0	3	40	60	100	1.5
ETSP207	**ESP-III**	Computer Programming Lab	0	0	4	40	60	100	2
ETSP208	**ESP-IV**	Engineering Workshop/ Manufacturing Practices	1	0	4	40	60	100	3
						Total Credits			**20.5**
Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming III Semester.									

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SEMESTER III

Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
ETBS301	**BS-V**	Engineering Mathematics III	3	1	-	25	75	100	4
ETES302	**ES-III**	Environmental Studies	3	-	-	25	75	100	3
ETES303	**ES-IV**	Engineering Mechanics	3	-	-	25	75	100	3
MMES304	**ES-V**	Thermal Engineering	2	-	-	25	75	100	2
MMPC305	**PC-I**	Machine Tool Technology	3	-	-	25	75	100	3
MMPC306	**PC-II**	Engineering Metrology	3	1	-	25	75	100	4
MMSP307	**ESP-V**	Thermodynamics Lab	-	-	3	40	60	100	1.5
MMCP308	**PCP-I**	Machine Tool Lab	-	-	3	40	60	100	1.5
MMCP309	**PCP-II**	Metrology Lab	-	-	3	40	60	100	1.5
ETIT310	**IT-I**	Internship Inter/ Intra Institutional Activities*	***Four*** *weeks during the summer vacation at the end of* ***II Semester***				100	100	**4.0**
For the **Lateral entry students total credit for III Semester is **23.5** as they are exempted from internship during summer vacation of II semester.*							**Total Credits**		**27.5**

SEMESTER IV

Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
EEBS401	**BS-VI**	Probability, Random Process and Numerical Methods	3	-	-	25	75	100	3
MMES402	**ES-VI**	Material Science	2	-	-	25	75	100	2
MMPC403	**PC-III**	Kinematics and Dynamics of Machinery	3	-	-	25	75	100	3
MMPC404	**PC-IV**	Metal Joining Processes	3	-	-	25	75	100	3
MMPC405	**PC-V**	Metal Machining Processes	3	-	-	25	75	100	3
MMPC406	**PC-VI**	Industrial Management & Engineering	3	-	-	25	75	100	3
MMCP407	**PCP-III**	Dynamics lab	-	-	3	40	60	100	1.5
MMCP408	**PCP-IV**	Metal Joining Lab	-	-	3	40	60	100	1.5
MMCP409	**PCP-V**	Metal Machining Lab	-	-	3	40	60	100	1.5
						Total Credits			**21.5**

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

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SEMESTER V									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
MMPC501	**PC-VII**	Casting Technology	3	-	-	25	75	100	3
MMPC502	**PC-VIII**	Metal Forming Processes	3	-	-	25	75	100	3
MMPC503	**PC-IX**	Engineering Metallurgy	3	-	-	25	75	100	3
MMPC504	**PC-X**	Mechanics of Materials	3	-	-	25	75	100	3
MMPE505	**PE-I**	Professional Elective - I	3	-	-	25	75	100	3
MMPE506	**PE-II**	Professional Elective - II	3	-	-	25	75	100	3
MMCP507	**PCP-VI**	Metal Forming Lab	-	-	3	40	60	100	1.5
MMCP508	**PCP-VII**	Metallurgy Lab	-	-	3	40	60	100	1.5
MMCP509	**PCP-VIII**	Strength of Materials Lab	-	-	3	40	60	100	1.5
ETIT510	**IT-II**	Industrial Training / Rural Internship/Innovation / Entrepreneurship	***Four** weeks during the summer vacation at the end of **IV Semester***				100	100	**4.0**
						Total Credits			**26.5**

SEMESTER VI									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
MMPC601	**PC-XI**	Mechatronics	3	-	-	25	75	100	3
MMPC602	**PC-XII**	Fluid Mechanics & Machinery	3	-	-	25	75	100	3
MMPE603	**PE-III**	Professional Elective - III	3	-	-	25	75	100	3
MMPE604	**PE-IV**	Professional Elective - IV	3	-	-	25	75	100	3
MMPE605	**PE-V**	Professional Elective - V	3	-	-	25	75	100	3
*YYOE606	**OE-I**	Open Elective – I (Inter department, FEAT)	3	-	-	25	75	100	3
MMCP607	**PCP-IX**	Design & Automation Lab (CAD/CAM)	-	-	3	40	60	100	1.5
MMCP608	**PCP-X**	Hydraulics Lab	-	-	3	40	60	100	1.5
						Total Credits			**21**

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

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COURSES OF STUDY AND SCHEME OF EXAMINATIONS (REGULATION -2019)

SEMESTER VII									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
ETHS701	**HS-II**	Engineering Ethics	3	-	-	25	75	100	2
MMPC702	**PC-XIII**	Design of Machine Elements	3	-	-	25	75	100	3
MMPE703	**PE-VI**	Professional Elective - VI	3	-	-	25	75	100	3
MMPE704	**PE-VII**	Professional Elective - VII	3	-	-	25	75	100	3
YYOE705	**OE-II**	Open Elective – II (Inter department, Allied)	3	-	-	25	75	100	3
MMCP706	**PCP- XI**	Machine Drawing	-	-	3	40	60	100	1.5
ETIT707	**IT-III**	Industrial Training / Rural Internship/Innovation / Entrepreneurship	***Four** weeks during the summer vacation at the end of **VI Semester***				100	100	**4.0**
						Total Credits			**19.5**

SEMESTER VIII									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
MMOE801	**OE-III**	Open Elective - III	3	-	-	25	75	100	3
MMOE802	**OE-IV**	Open Elective - IV	3	-	-	25	75	100	3
MMPV803	**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

PE-PROFESSIONAL ELECTIVES

1. MMPESCN Non-Traditional Manufacturing Processes
2. MMPESCN Tool Engineering
3. MMPESCN Computer Integrated Manufacturing Systems
4. MMPESCN Computer Aided Product Design
5. MMPESCN Production & Operation Management
6. MMPESCN Total Quality Management
7. MMPESCN Advanced Manufacturing processes
8. MMPESCN Non-Destructive Testing

OE-OPEN ELECTIVES

1. MMOESCN Operations Research
2. MMOESCN Machine Tool Design
3. MMOESCN Neural Network and Fuzzy Logic
4. MMOESCN Engineering Economics
5. MMOESCN Sensors and Control Systems in Manufacturing
6. MMOESCN Surface Engineering
7. MMOESCN Composite Materials
8. MMOESCN Supply Chain Management

HONOURS ELECTIVES

			Credits
1.	MMHESCN	Mechanical Behaviour of Materials	4
2.	MMHESCN	Modern Manufacturing Strategies	3
3.	MMHESCN	Robotics and Automations	4
4.	MMHESCN	Plant Layout and Material Handling	3
5.	MMHESCN	Maintenance Management	3
6.	MMHESCN	Precision Engineering and Nano-Technology	3

MINOR ENGINEERING ELECTIVES

			Credits
1.	MMMISCN	Machine Tools and Metal Cutting	4
2.	MMMISCN	Metal Casting, Forming and Joining Processes	4
3.	MMMISCN	Total Quality Management	3
4.	MMMISCN	Computer Integrated Manufacturing Systems	3
5.	MMMISCN	Engineering Metrology	3
6.	MMMISCN	Non-Destructive Testing	3

ETBS301	ENGINEERING MATHEMATICS - III	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

- The students will be trained on the basics of chosen topics of mathematics, namely, partial differential equations, Fourier series, Boundary value problems, Fourier transform and Z-transform.
- The above topics introduced in this course will serve as basic tools for specialized studies in engineering.

UNIT I

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

Dirichle'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

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

UNIT IV

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

TEXT BOOKS

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

REFERENCES

1. Veerarajan, T., "Engineering Mathematics", 3rd edition, Tata McGraw Hill Pub, 2005.
2. Singaravelu, A., "Engineering Mathematics", Meenakshi Publications, Chennai, 2004.

COURSE OUTCOMES

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

1. acquire basic understanding of the most common partial differential equations and learn some methods of solving them
2. gain basic understanding of the Fourier series and Fourier transform and solving them
3. decipher boundary value problems
4. crack problems in dimensional equations

5. acquire basic understanding of Z-transform and to solving them

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					2			1	1		1
CO2	3		3						1					1	1
CO3		2		1				1				1			
CO4	3		2										1	1	
CO5	3	1	2	2				1						1	

ETES302	ENVIRONMENTAL STUDIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To familiarize the students about the environmental resources and their importance.
- To provide basic knowledge of Eco system and bio diversity and their threats. To illustrate the Cause, effects and control measures of various pollution and
- To study the population explosion, Family Welfare Programme, Human Rights and Value Education.

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 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. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email:mapin@icenet.net (R)

REFERENCES

1. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
2. Clark R.S., Marine Pollution, Clanderson Press Oxford (TB)
3. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumabai, 1196p
4. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
5. Down to Earth, Centre for Science and Environment (R)
6. Gleick, H.P. 1993. Water in crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute Oxford Univ. Press. 473p
7. Hawkins R.E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R)
8. Heywood, V.H & Waston, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press 1140p.
9. Jadhav, H & Bhosale, V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284 p.

10. Mckinney, M.L. & School, R.M. 1996. Environmental Science systems & Solutions, Web enhanced edition. 639p.
11. Mhaskar A.K., Matter Hazardous, Techno-Science Publication (TB)
12. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB)
13. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p
14. Rao M N. & Datta, A.K. 1987. Waste Water treatment. Oxford & IBH Publ. Co. Pvt. Ltd. 345p.
15. Sharma B.K., 2001. Environmental Chemistry. Geol Publ. House, Meerut
16. Survey of the Environment, The Hindu (M)
17. Townsend C., Harper J, and Michael Begon, Essentials of Ecology, Blackwell Science (TB)
18. Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Stadards, Vol I and II, Enviro Media (R)
19. Trivedi R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication (TB)

COURSE OUTCOMES

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

1. cognize the various resources available and the importance of their conservation
2. attain knowledge on the various characteristic features, structure and function of the various ecosystem
3. gain knowledge on the bio-diversity and its conservation
4. know the causes, effects and control means of various types of pollution
5. appreciate the value of environment and human health

	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	3	1	1	1	3	1		1		
CO2		1				2				3	2		1	1	
CO3	3					2			2	2					1
CO4									1	3	1			1	
CO5	2					3				3	3	1			1

ETES303	**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.

REFERENCES

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. Khurmi R.S., Engineering Mechanics, (2010), S. Chand & Co.
7. 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			

MMES304	**THERMAL ENGINEERING**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

COURSE OBJECTIVES

- To give an idea regarding the basic concepts and laws of thermodynamics
- To introduce the fundamentals of thermal engineering such as internal combustion engines and steam turbines
- To introduce the fundamentals of air compressors, refrigeration and air conditioning
- To introduce the basic concepts of steam turbines

- To introduce the fundamentals of various modes of air heat transfer.

UNIT I

Thermodynamics - Definition - heat and work - open system and closed system - state, property and change of state of a system - properties of vapor - internal energy - entropy, dryness fraction - Calorimeter for determination of dryness fraction.

UNIT II

Cycles of operation - Otto, Diesel and Semi-diesel - calculation of air standard efficiency and relative efficiency - Indicator diagram - Power and Mechanical efficiency - performance curves - heat balance - problems.

UNIT III

Reciprocating air compressor - single and multistage compression - inter cooling - calculation of main dimensions - Effect of clearance volume - Volumetric efficiency.

UNIT IV

Rankine cycle with reheating and regenerating, feed heating, steam turbines - details - compounding of turbine - velocity diagram - blade efficiency - reaction turbine - height of blade and diameter of drum.

UNIT V

Primary modes of heat transfer - basic laws of conduction, convection and radiation - simple problems - refrigeration and air-conditioning - General principles of refrigeration - C.O.P calculations of psychometric chart - air conditioning methods.

TEXT BOOKS

1. Khurmi R.S., Thermal Engineering, S.Chand & Co., New Delhi.
2. Ballaney P.L., Thermal Engineering, Khanna Pub., New Delhi. 1997.

REFERENCES

1. Gupta C.P and Rajendra Prasad, Engineering Thermodynamics.
2. Spalding and Cole, Engineering Thermodynamics, ELBS.

COURSE OUTCOMES

Upon completing this course, students should be able to:

1. gain knowledge on the laws of thermodynamics and their applications
2. identify the different types combustion engines and differentiate Otto and diesel cycles
3. obtain knowledge about air compressors, refrigeration and air conditioning, and modes of air heat transfer
4. obtain basic knowledge of steam turbines
5. gain knowledge about refrigeration and air-conditioning

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		1	1	1		1	2		1
CO2	2	2		1						1				2	
CO3	3		2			1			1					1	
CO4		2	3		1								1		1
CO5	3		3						1						

MMPC305	**MACHINE TOOL TECHNOLOGY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To impart knowledge on different types of metal cutting machine tools and their functions.
- To provide in depth knowledge about various machine tools and operating procedures.
- To demonstrate different mechanisms used in metal cutting machines.
- To understand the basic concepts of computer numerical control (CNC) machine tool and CNC programming.
- To afford proficiency in manual part programming and computer aided part programming

UNIT I

Lathe: Specifications of centre lathe - operations performed - accessories and attachments - principle of capstan and turret lathes - layout of tools.
Shaper, Planner and slotter: General arrangement - principle of operation - drive mechanisms.

UNIT II

Milling machine: Types - specification - operations - types of cutters - attachments and accessories - examples of work.
Drilling and Boring: Types - specification of drilling machines - operations - accessories and attachments - types of boring machines - jig boring.
Sawing: Power saws - types and principle of operation.

UNIT III

Purpose – classification – surface finish – applications – grinding wheel – types – specifications – selection – surface grinding machine – block diagram – functions of each part – cylindrical grinding – Centreless grinding – Comparison – infeed, end feed and through feed. Balancing, dressing, loading and Truing of wheel

UNIT IV

Overview of NC, CNC and DNC –CNC System – Constructional features of CNC machines - Machining center – Turning center – Turn mill center. Drives – Transmission belting – axial feed drives – slideways – feedback devices. Work and Tool holding devices.

UNIT V

Manual part programming – sample programs: Turning, milling, drilling and face milling –Computer aided part programming – languages – geometric statements - point to point program – programming the tool path – mission commands – Simple examples of APT programming.

TEXT BOOKS

1. Suresh Dalela, "Manufacturing Science & Technology", Vol. I & II, Umesh Publications, 1997.
2. Radhakrishnan, P., "Computer Numerical control of Machine Tools", New central Book Agency, 2002.

REFERENCES

1. Jain, R.K., "Production Technology", Khanna Publications, New Delhi, 1995.
2. Hajra Choudhry, S.K., "Elements of Workshop Technology", Media Promoters & Publications Pvt. Ltd, 1994.
3. HMT Hand Book, "Production Technology", Tata McGraw-Hill Publication Co. Ltd, 1996.
4. Kalpakjian, S., "Manufacturing Engineering & Technology", 3rd Edition, Addition Wesley Inc. 1997.
5. Kumar, B., "Manufacturing Technology", Khanna Publishers, New Delhi, 2000.
6. Jonathan Lin. S.C., "Computer Numerical Control from Programming to Networking", Delmar Publishers, 3rd Edition 2009.
7. Krar, S.F., and Check, A.F., "Technology of Machine Tools", Tata McGraw-Hill, New Delhi, 1998.

COURSE OUTCOMES

Upon completing this course, students should be able to:

1. Understand the different types of metal cutting operations and importance of cutting tools.
2. Realize the importance of Milling and Drilling machines in the field of Metal cutting.
3. Obtain knowledge on the surface finishing processes and their importance in metal cutting.
4. Obtain information on Constructional features of CNC machines and work holding devices.
5. Gain and apply the knowledge of manual part programming and computer aided part 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	3		1						1					3	3
CO2	3		1						1				1	2	3
CO3	3	1		1					2				1	2	
CO4	2	2													2
CO5	3	2		1										2	

MMPC306	ENGINEERING METROLOGY	L	T	P	C
		3	1	0	4

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.

REFERENCES

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		

MMSP307	**THERMODYNAMICS LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

COURSE OBJECTIVES

- To inculcate the knowledge about the working of I.C engines and different types of dynamometers.
- To study the valve timing and port timing of an IC engine
- To make the students understand the working principle of various flow and pressure measuring devices.

LIST OF EXPERIMENTS

1. Study and valve timing on four stroke diesel engine.
2. Study and port-timing on two stroke petrol engine.
3. Dismantling and assembling of four stroke diesel engine.
4. Study of Carburettor
5. Study of fuel injection pump
6. Study of cooling system
7. Study of lubrication system
8. Study of air compressor
9. Measurement of temperature using resistance temperature detector

10. Determination of coefficient of discharge of orifice /Venturimeter
11. Measurement of displacement using LVDT
12. Experiments on DC Servo motor controller
13. Experiment on DC motor position control system

COURSE OUTCOMES

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

1. Obtain fundamental knowledge about the various types of engines viz. petrol and diesel engines and it working principles
2. know the dismantling and assembling procedure of a four stroke CI engines
3. exposed to the various accessories of the different types of engines
4. explain the working principles of dynamometers
5. describe the construction and working of various gadgets used with I. C. engines

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		1	1	1		1	1		2
CO2	3		1		1		1						3		
CO3		2					1	1				1			
CO4	3	2	1		1				1				2		2
CO5	3	2			1							1	1		3

MMCP308	**MACHINE TOOL LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

COURSE OBJECTIVES

- To provide hands-on experience on the use of metal working machines such as lathe shaper and slotter.
- To study the constructional features of automatic and turret lathe
- To study the constructional features of cylindrical and surface grinding machines.
- To provide hands-on experience in wood Turning of simple models.

LIST OF EXPERIMENTS:

1. Plain Turing
2. Step Turing
3. Taper Turing
4. Thread Cutting (Internal & External)
5. Knurling
6. Key way machining on a slotter
7. Convex profile machining on a slotter
8. T-slot milling
9. Keyway machining using a shaper
10. External dovetail machining on a shaper
11. Internal dovetail machining on a shaper

12. Study of Single-spindle automatic lathe
13. Study of capstan lathe and turret lathe
14. Study of gear hobbing machine
15. Study of cylindrical grinding machine
16. Study of surface grinding machine

COURSE OUTCOMES

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

1. understand the construction and working of metal working machines such as lathe, shaper, milling machine and slotter
2. handle and carry out simple operations on lathe, shaper, milling machine and slotting machine
3. elucidate the constructional features of automatic and turret lathe
4. describe the construction and working of a gear hobbing machine
5. explain the constructional features of cylindrical and surface grinding machines

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	1				3		2
CO2	3											1	3	1	2
CO3			2					1	2					2	1
CO4	3								1			1	3	2	
CO5	3		3					1					3		2

MMCP309	METROLOGY LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- To educate the students on the handling and use of precision measuring instruments used during the manufacturing processes.

LIST OF EXPERIMENTS:

1. Checking the straightness of straight edge
2. Calibration of a dial gauge
3. Measurement of internal diameter (4 balls)
4. Calibration of micrometer
5. Measurement of internal taper
6. Measurement of external taper (Sine Bar and Roller)
7. Calibration of plain plug gauge
8. Measurement of external radius and internal radius
9. Inspection of screw thread
10. Gear inspection
11. Checking the flatness of surface plate
12. Process capability

COURSE OUTCOMES

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

1. gain fundamental knowledge on the usage of many precision instruments and their handling methods
2. learn to calibrate a few commonly used precision instruments
3. compute the unknown values of few profiles
4. inspect and find out the errors in screw threads, gears and surface plates
5. do quality control check of a set of given 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			1				1	1				2	2	
CO2	3						1								1
CO3				1			1	1	1					1	1
CO4	3							2					2	1	
CO5	3								1				1		

EEBS401	**PROBABILITY, RANDOM PROCESSES AND NUMERICAL METHODS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To introduce the probability, random processes, and statistical methods designed to contribute to the process of making scientific judgments in the face of uncertainty and variation.
- To develop the skills of the students in numerical mathematics - using method of finite difference interpolation,
- Finding numerical solution of algebraic and transcendental equations.
- Finding numerical solution of ordinary and partial differential equations.

UNIT I

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

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

UNIT III

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: 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 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.
2. Veerarajan, T., "Probability theory and Random Process", Tata McGraw-Hill Co. Ltd, New Delhi, 2005.

REFERENCES

1. Lipschutz, S., and Schiller, J., "Schaum's outlines – Introduction to probability and statistics", McGraw-Hill, New Delhi, 1998.
2. Kandasamy, P., Thilagavathy, K., and Gunavathy, K., "Numerical Methods", S. Chand & Co. Ltd., New Delhi, 2004.
3. Venkataraman, M.K., "Numerical method in science and Engineering", National Publishing Co., Chennai, 2003.

COURSE OUTCOMES

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

1. define random variables and probability distribution functions
2. acquire skills in handling situations involving random variables, random processes
3. test hypothesis and derive conclusions
4. solve problems for engineers in using numerical methods
5. gain knowledge on the concept of algebraic and transcendental 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							1	1		2	2	2	
CO2	3	1										1			
CO3	3	2												1	
CO4	2	3										1	2		
CO5	3	3											2	2	

MMES402	**MATERIAL SCIENCE**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

COURSE OBJECTIVES

- To impart fundamental knowledge on the structure of Engineering Materials and defects in crystalline structures.
- To instruct fundamental characteristics of polymer matrix composite materials and its

applications.

- To pass on awareness about ceramic matrix composites and its applications.
- To teach different types of fiber and matrix materials and also about natural polymer based composite materials.
- To differentiate hard and soft magnetic materials and importance of di electric materials in the engineering.

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, Gibb's phase rule, lever rule.

UNIT II

Introduction – Processing of plastic materials – Thermo plastics – Thermosetting plastics – Elastomers – applications - Materials selection for engineering designs using plastic materials.

UNIT III

Introduction – Traditional and engineering ceramics – Electrical properties of ceramics – Mechanical properties of ceramics – Thermal properties of ceramics – Glasses – applications.

UNIT IV

Introduction – Fiber reinforced plastic composite materials - Fibers and matrix materials – Concrete – Asphalt and asphalt mixes – Wood – Sandwich structures – Metal matrix and ceramic matrix composites-applications. Natural Fiber and Natural Polymer based Composite materials - Introduction

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.

REFERENCES

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, 2nd Edition, 1998.
3. Raghavan, V., "Materials Science and Engineering", Prentice Hall of India, 1991.

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 that 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				3		
CO2									2						
CO3	3	3		1								1	3		
CO4	2								1				1		
CO5		3													

MMPC403	KINEMATICS AND DYNAMICS OF MACHINERY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the different types of mechanism.
- To provide in depth knowledge about power loss in different types of bearings and clutches.
- To draw the turning moment diagram of reciprocating engines.
- To illustrate the different types of problem in balancing and vibration of rotating masses
- To introduce as a tool for static and dynamic analysis of mechanisms for use in design and engineering

UNIT I

Kinematics – links- pairs, chain – mechanisms and inversions – velocity and acceleration of single slider crank chain by relative velocity method. Klein's construction for velocity and acceleration of single slider crank chain.

UNIT II

Friction: frictional loss of power in journal, pivot and collar bearings. Clutches – single plate multiple plate and cone clutches. Belt and rope drives- ratio of tension- power transmitted.

UNIT III

Turning moment: De Alembert's principle-inertia force, calculation of turning moment in reciprocating engines. Co-efficient of fluctuation of energy, coefficient of fluctuation of speed - fly wheels for punch press.

UNIT IV

Balancing - static and dynamic balancing - Balancing of rotating masses, balancing of reciprocating masses – introduction to primary and secondary balancing.

UNIT V

Vibrations: Definitions for free Forced and damped oscillations of single degree freedom system with examples. Whirling of shafts. Torsional oscillations of two rotor systems

TEXT BOOKS

1. Ballaney, P.L., “Theory of machines”, Khanna Publishers New Delhi
2. Khurmi, and Gupta, “Theory of machines”, Chand & Co.

REFERENCES

1. Thomas Bevan, “Theory of machines”, Longman.
2. Abdulla Sheriff, “Theory of machines”, Danpat Rai & Co.

COURSE OUTCOMES

Upon completing this course, students would be able to:

1. acquire knowledge on different types of links and pairs in a kinematic chain
2. know the reasons for power loss in friction for different types of clutches and bearings
3. gain knowledge about the turning moment diagram for reciprocating engines
4. know the balancing methods of various static and dynamic system
5. identify the basic types of vibration systems and the means to solve it

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			1	3	2	
CO2		2	3						2			1	2		
CO3	2	3	2											1	
CO4	3		3						1			1	3		
CO5	3	3											3		

MMPC404	**METAL JOINING PROCESSES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- Apply knowledge of materials to prescribe appropriate welding process for specific applications;
- Model and simulate welding processes to conduct experiments and analyze the performance using modern tools
- Understand the environmental issues related to each welding methods and try to develop ‘green welding’ methods.

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, simple problems 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), CO_2 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

Solid state welding processes, Basic principles, Process parameters, Process characteristics and applications of the following Processes: Friction welding – Friction stir welding - Explosive welding - Ultrasonic welding - Diffusion Bonding. **Allied processes**: Basic principles, Process variables, Chief characteristics and applications of the following processes: Electron Beam Welding (EBW) - Laser Beam Welding (LBW) - Thermit welding - Gas welding - Soldering - Brazing - Adhesive Bonding - Welding of plastics.

UNIT V

Defects in welding in various processes - Causes and remedies; Ultrasonic dye penetrant, magnetic particle inspection. X ray testing procedures and identification of defects – case studies. Automation in welding – Seam tracking vision and arc sensing welding robots. Design of weldments-Welding symbols positions of welding joint and groove design. Weld stress –Calculations – Design of weld size.

TEXT BOOKS

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.

REFERENCES

1. Nadkarni, S.V., "Modern Arc Welding Technology", Oxford & IBH Publishing Co.Pvt.Ltd, NewDelhi, 1996.
2. Khanna, O.P., "Welding Technology" Dhanpat Rai & Sons Publishers, New Delhi, 1993.
3. O'Brien, R.L., "Welding Hand Book, Welding Process", Vol.II, 8th Edition, American Welding Society, 1991.
4. Little, R.L., "Welding and Welding Technology", Tata McGraw Hill Publishing Company Limited, New Delhi, 1990.

COURSE OUTCOMES

Upon completing this course, students should be able to:

1. gain knowledge on the basic science of the welding arc and heat flow equations
2. distinguish between fusion welding processes and solid state welding processes
3. select appropriate welding process for joining specific materials
4. inspect welding defects using non-destructive testing methods
5. classify 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		1						1					3	3
CO2	3		1						1				1	2	3
CO3	3	1		1					2				1	2	
CO4	2	2													2
CO5	3	2		1									1	2	1

MMPC405	**METAL MACHINING PROCESSES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To impart knowledge on different types of cutting tool materials and standards used in tool designation.
- To teach about the various types of chip formation during turning, milling and drilling operations.
- To teach the difference between orthogonal and oblique cutting processes and calculation of forces.
- To give introduction about tool wear, tool life and machinability index.
- To enlighten thermal aspects of machining and measurement of tool temperature.

UNIT I

Tool Materials: HSS, Carbide and coated tools, CBN, Ceramic and PCD. Tool geometry - single point cutting tool and multi point cutting tool - Tool Signature-Tool designation: ASM, DIN, British standards and their relationships.

UNIT II

Metal Cutting Process: Chip formation - Types of chips - chip breakers- Chip thickness ratio, radius of chip curvature, cutting speed, feed and depth of cut –Theories of formation of built-up edge and their effect - Chip formation in drilling and milling.

UNIT III

Introduction to Orthogonal and Oblique cutting processes- The force system- Velocity relationship- forces in turning and milling- Relationship between forces, speed, feed and depth of cut- - Forces and energy calculations (Merchant's Analysis) Single Point Cutting Tool: Various systems of specifications, single point cutting tool geometry and their inter-relation.

UNIT IV

Tool Life and Tool Wear: Theories of tool wear – adhesion, abrasive and diffusion wear mechanisms, forms of wear, Tool life criteria and machinability index. Effect of machining parameter on tool life- measurement techniques for tool wear- Tool economics-basic concepts- simple problem

UNIT V

Thermal Aspects of Machining and Cutting Fluid: Regions of heat generation; Heat In the Primary Shear Zone, Heat at the Tool/work Interface, Heat Flow at the Tool Clearance Face, Average shear plane temperature; Average chip-tool interface temperature; method of tool temperature measurement, temperature distribution in tool, Cutting Fluid: Types and composition of cutting fluids, selection of cutting fluid.

TEXT BOOKS

1. Boothryd, "Fundamentals of Machining", Edward Amold Publishers Ltd, 1975.
2. David Son, LacainGoud , "Tool Design" , Tata Me GrawHill.
3. Juneja. B. L and Sekhon.G.S, "Fundamentals of metal cutting and machine tools", New Age International(p) Ltd., 2003.

REFERENCES

1. Sehrawat, M.S., and Narang, J.S., "Metal Cutting Principles", Milton C Saw, Oxford.
2. MC Shaw, "Metal Cutting Principles", Oxford and IBH Publications, New Delhi, 1969.

COURSE OUTCOMES

Upon completing this course, students should be able to:

1. Gain knowledge on various tool materials Tool geometry and tool signature.
2. Classify the different types of chips formed during metal cutting.
3. Distinguish oblique and orthogonal cutting and able to calculate forces during machining using Merchant's circle.
4. Understand the basics of abrasive, adhesive and diffusion wear mechanism.
5. Understand the concepts of thermal aspects of machining and able to classify different types of cutting fluids.

	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				2	3	2
CO2	3	2	1										1	2	2
CO3	3	1		1					2				1	2	
CO4	2								1						2
CO5	3												2	2	

MMPC406	**INDUSTRIAL MANAGEMENT & 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.

REFERENCES

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		

MMCP407	**DYNAMICS LABORATORY**	**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 verification 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. determine the mass moment of inertia of connecting rod and flywheel either experimentally of theoretically or both
2. acquire knowledge on the construction and working of various types of governors
3. gain knowledge on the working of cams and its application
4. compute the critical speed of engines
5. calculate the stiffness of springs

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		1	1	1		1	1		2
CO2	3		1		1		1						2	1	
CO3		2					1					1			
CO4	2	2	1		1								2		2
CO5	2	2										1	1		3

MMCP408	**METAL JOINING LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

COURSE OBJECTIVES

- To inculcate the knowledge of making different types of joints in welding
- To study effect of welding power sources on heat input and bead geometry
- To provide on hand experience in the non-destructive testing of weldments

LIST OF EXPERIMENT

1. But Joint
2. Lab Joint
3. Corner Joint
4. ‘T’ Joint
5. Comparative evaluation of welding performance of Arc Welding power source.
6. Effect of heat input on bead geometry.
7. Effect of Electrode Polarity Arc Welding Performance
8. Influence of Multi-Pass Welding on Micro structure and hardness.
9. Temperature Measurement in Arc Welding Process
10. Comparative evaluation of cutting performance of different gas Flames.

11. Distortion Measurement
12. Magnetic particle test
13. Dye penetrant test

COURSE OUTCOMES

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

1. fabricate basic types of weld joints
2. compute effect of heat input on bead geometry
3. identify the effect of power sources in arc welding
4. compare the performance of different gas flames in gas welding
5. inspect the soundness of weld beads

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		1	1	1	1		1	1	2
CO2	2		1		1		1						3	2	
CO3		1					1	1	2		1			1	1
CO4	3	1							1				2	2	2
CO5	3	2											1		3

MMCP409	**METAL MACHINING LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

COURSE OBJECTIVES

- To provide hands-on experience on spur and helical gear machining
- To provide hands-on experience on clutch milling and flute milling
- To carry out alignment test on lathe
- To learn to measure the forces in lathe and grinding

LIST OF EXPERIMENTS

1. Lathe tool dynamometer
2. Power measurement in a lathe
3. Estimation of cutting forces by Merchant's theory
4. Alignment test on lathe
5. Grinding tool dynamometer
6. Plain milling
7. Spur gear milling
8. Helical gear milling
9. Flute milling
10. Pantograph milling
11. Straight tooth clutch milling (3/4 dogs)

COURSE OUTCOMES

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

1. appreciate the need and usage of dynamometers in lathe and grinding
2. compute the power requirements on a lathe for various cutting conditions

3. inspect the alignment of lathe structure
4. fabricate simple models using spur, helical and to flute milling machines
5. make scaled models on a pantograph milling machine

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	1	1	1		1	1	2
CO2		1	1		1		1						2	2	
CO3	2	1					1	1	1		1			1	1
CO4	3									1			2	2	2
CO5	3	2											1		

MMPC501	**CASTING TECHNOLOGY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To impart knowledge about the sand casting process and its importance of pattern making in foundry.
- To teach the working principle of Cupola and dissolved gases in molten metal.
- To illustrate the solidification of metals and alloys and the stress relieving operations during casting.
- To demonstrate the pouring methods and equipment used for testing of casting.
- To explain advanced casting process and their working principles.

UNIT I

Sand: Moulding Sands- Properties- Additives used, Control of Moulding Sands. Moulding -Types of Moulding- Moulding Processes, Instruments used for different methods. Moulding Materials- Quality moulds- Dressing of moulds. Moulding machine.

Pattern: Types of Pattern - Pattern Materials - Pattern Allowances- Pattern Making Machinery. Core: Purpose of Cores- Preparation of Cores- Core Materials and Additions- Core Dressing, Effect on Castings- Location and Fixing.

UNIT II

Melting: Melting Furnaces- Ferrous and Non-Ferrous Metals- Charging Operation in Cupola- Dissolved Gases in Molten Metal, Degassing Methods- Analysis and Composition of the Metal Ladle- Fluxes, Effect of Inoculation.

UNIT III

Pouring and Feeding: Solidification of Metals- Equilibrium Diagram- Feeding Systems- Design of Runners and Risers- Cooling Rates of Different Sections, Casting Defects and Remedies- Stresses in Casting and Relieving Operations.

UNIT IV

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

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

UNIT V

Advanced Casting Processes: Pressure die casting – Centrifugal – continuous – investment – shell moulding – squeeze – electro slag casting – CO_2 moulding – Plaster Mould castings – Slush casting - Evaporative pattern casting

TEXT BOOKS

1. Campbell, "Casting and Forming Process", McGraw-Hill, 1997.
2. Heine, R.W., Rosenthal, P.C., & Loper, C.R., "Principles of Metal Casting", Tata McGraw-Hill, 1997.

REFERENCES

1. Jain, P.L., "Principles of Foundry Technology", Tata McGraw-Hill, 1997.
2. Merck, "Fundamentals in the Design and Production of Casting", McGraw Hill.
3. Banga, T.R., Agarwal, R.E., and Tahil Manghrani, "Foundry Engineering", Khanna Publishers, New Delhi, 1992.

COURSE OUTCOMES

Upon completing this course, students will be able to:

1. Understand the basic features and terminologies in casting process, gating and reserving system
2. Gain knowledge on melting furnaces and degassing methods
3. To understand the design aspects and the basics in solidification or the casting formation.
4. Study the types of defects occurred in casting and provide remedial solutions.
5. To obtain knowledge in the advanced casting process

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			2		2
CO2	3		3											3	2
CO3		1	1						1				2	2	
CO4	2		2						1				1	1	2
CO5	2		3												

MMPC502	**METAL FORMING PROCESSES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To familiarize the students the types of stress, in two and three dimensional.
- 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 in two dimensions – two and three dimensions - Principal stresses, Stress deviator, Vonmises criteria, yield criteria. Comparison of yield criteria, Forming load

calculation - Fundamentals of Metal working: Flow curve, Relationship between true stress and true strain, Temperature in metal forming, hot cold and warm working – residual stresses.

UNIT II

Forging: Types of Process & hammers defects & remedies. Forging classification, open die forging, Closed die forging - calculations of forging loads, Defects - causes - remedies.

Rolling: Rolling of blooms billet, Slab & Sheet, types of rolling mills – hot and cold rolling - forces & geometrical relationship in rolling, Analysis of rolling load, torque & power, defects - causes and remedies.

UNIT III

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

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

UNIT IV

Sheet Metal Forming: Forming methods – shearing and blanking – 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 Speed Forming: Basic principle, process variables, Characteristics and application of the following processes: Electro hydraulic forming, electromagnetic forming, explosive forming, fuel combustion process, water hammer forming. Comparison between conventional forming and high speed forming.

TEXT BOOKS

1. Rowe, G.W., “An Introduction to the Principles of Metal Working”, Edward Arnold Publication.
2. George E. Dieter “Mechanical Metallurgy”, McGraw-Hill International Edition, Newyork, 1998

REFERENCES

1. Robert H. Wagoner and Jean Loup Chenot., “Fundamentals of Metal Forming”, John Wiley & Sons Inc., New York, 1992.
2. Calladine, C.R., “Plasticity for Engineers”, John Wiley & Sons, 1991.
3. Metals Handbook, “Material Information Society”, ASM, Vol.4, 1979.
4. Rao, P.N., “Manufacturing Technology – Foundry, Forming and Welding”, Tata McGraw-Hill, 1998.
5. Davies, R., and Austin, E.R., “Developments in High Speed Metal forming”, The Machinery Publishing Co. Ltd., London, 1970.
6. Haslehurst, “Manufacturing Technology”, ELBS, 1973.

COURSE OUTCOMES

Upon completing this course, students should be able to:

1. Identify the 2-D and 3-D stresses and component of stresses in material processing operations
2. expertise different forming process to manufacture near net-shape products
3. gain knowledge in different types of drawing and extrusion process
4. cognize on various types of sheet metal forming methods
5. gain basic knowledge on various high speed forming 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	2						1	1				2	1
CO2	3		3						1					2	1
CO3		1	1										2		
CO4	2												1	1	
CO5															

MMPC503	**ENGINEERING 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 metals and alloys.
- To introduce the concept of powder metallurgy and different type of corrosion.

UNIT I

Constitution of alloys, compounds & solid solutions, Gibbs phase rule, lever rule - Diffusion in Solids, Fick's laws – Solidification, Nucleation and grain growth - constitutional supercooling, formation of dendrites - Directional solidification, Micro segregation, Macro segregation, Porosity and inclusions - Metallography - metallurgical microscope - preparation of specimen, micro & macro examination. Grain size ASTM grain size number, grain size measurement.

UNIT II

Phase diagrams, isomorphous, eutectic, peritectic, eutectoid and peritectoid reactions, Iron - Carbon equilibrium diagram - Classification of steel - 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.

UNIT III

Heat treatment of steel: Isothermal transformation diagram - Time Temperature Transformation Diagram, Continuous cooling transformation diagrams, full annealing, stress relief annealing, spheroidzing, normalizing, Hardenability and Jominy end quench test- Austempering and martempering - case hardening, carburising, nitriding, cyaniding, and carbon nitriding, flame hardening, induction hardening, vacuum hardening and cryogenic treatment- Precipitation and Age hardening

UNIT IV

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.

Powder metallurgy : Process fundamentals, production of metal powders, characteristics, powder blending, compacting, Sintering, applications

Corrosion - Factors influencing corrosion, pitting corrosion, cavitation corrosion, cervice corrosion, fretting corrosion, inter - granular corrosion - corrosion prevention.

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 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. Raghavan, V., "Materials Science & Engineering", Prentice Hall of India Pvt.Ltd, 2015.

REFERENCES

1. George E. Dieter., "Mechanical Metallurgy", McGraw Hill Book Company, New York, 1988.
2. Rollason, E.C., "Metallurgy for Engineers", Butterworth-Heinemann Ltd, 4th Revised edition, 1987.
3. Williams, D., "Material Science and Engineering", Callister Wiley India Pvt. Ltd, Revised Indian edition, 2007.
4. Sinha, A.K., "Powder Metallurgy", Dhanpat Rai & Son, New Delhi, 1995.
5. Raj Narayan, "An Introduction to Metallic Corrosion & its Prevention", Oxford & IBH, NewDelhi, 1983.
6. Higgins, R.A., "Engineering Metallurgy - Part I, Applied Physical Metallurgy", ELBS., 1993.

COURSE OUTCOMES

Upon completing this course, students should be able to:

1. correlate between structure and properties of metals and alloys
2. select the appropriate alloys for specific applications
3. design heat treatment methods for specific applications
4. protect the metals and alloys from environmental degradation
5. evaluate the mechanical properties of materials by modern tools and 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	3	2	2	1					1	1	1	2	3	2	2
CO2	2	2												2	
CO3		1	2						1				2		
CO4	1			1									1		
CO5															

MMPC504	MECHANICS OF MATERIALS	L	T	P	C
		3	0	0	3

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 ration, stress versus strain diagrams for concrete, timber, mild steel sections, HYSD (High Yield Strength Deformed) bars. Elastic constants relationship- simple problem-Banding 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-Uni-axial 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 ship-spring deflections. 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.

REFERENCES

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. gain knowledge on identifying stress, strain and their effects
2. recognize the theory of various types of loading systems
3. critically analyses components like beams and twisting bars
4. expertise theories on columns and springs
5. employ 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	2							1	1	2	3		
CO2	3	2	2										3		
CO3	3	2										2			
CO4	2	2	2										3	1	1
CO5	2	2	2	1					1			2	3	2	1

MMCP507	**METAL FORMING LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

COURSE OBJECTIVES

- To educate the importance of various process parameters during metal forming processing methods such as rolling water hammer forming.
- To learn to plot the stress strain curve of compression and tension testing
- To provide hands-on experience on preparing various types of green sand mould.

LIST OF EXPERIMENTS

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

Foundry Shop – Green sand mould preparation using the following patterns

8. Face Plate (Solid Pattern)
9. Hexagonal Nut (Self Core solid Pattern)
10. Lathe Saddle (Loose Piece Pattern)
11. Oil Cup (Self Core solid Pattern)
12. Ball Handle (Split Pattern)
13. Pipe Flange (Split Pattern)
14. Pulley (Split Pattern)
15. Gear wheel (Solid Pattern)

COURSE OUTCOMES

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

1. determine formability of sheet metal for different falling weights
2. compute the various process parameters during rolling of metal strips
3. estimate the creep rate of the given specimen
4. estimate the properties of given specimen by conducting various standard tests
5. prepare green sand mould of various types of pattern

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	1	1	2		1	1	2	3	2	2
CO2	2	2		2					1			2			
CO3	3	2						1					2	1	
CO4	2		2						1		1	2		2	
CO5		2	1										1		

MMCP508	**METALLURGY LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

COURSE OBJECTIVES

- To study the Microstructure of ferrous non-ferrous and heat treated specimens etc.
- To learn to construct phase diagram
- To study effect of section size and quenching media on hardness

LIST OF EXPERIMENTS:

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. Estimation of creep rate
12. Characteristics of moulding sand
13. Corrosion test

COURSE OUTCOMES:

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

1. determine the effect of component profile and the quenching media on hardness
2. identify the microstructure of ferrous and non-ferrous specimens
3. identify the properties of the given specimen by its microstructure
4. construct phase diagram
5. Estimate the properties of the green sand mould

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	1	2		1	1	2		2	
CO2	2	2	2	2				1	1			2	3	2	2
CO3		2	1						1		1		2	1	
CO4	2											1			
CO5	1												1		

MMCP509	**STRENGTH OF MATERIALS LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

COURSE OBJECTIVES

- To impart practical training on simple machines like screw jack, worm wheel, etc.,
- To understand the theoretical and practical aspects of elasticity and plasticity of the materials through a variety of experiments

LIST OF EXPERIMENTS

1. Simple Machines - screw jack, worm and wheel, differential wheel and Axle, Handlowinch
2. Material Testing - Tension, compression and shear tests on different materials
3. Bending and deflection test on beams
4. Hardness, impact and ductility tests on metals
5. Torsion tests on rods, springs and fatigue tests (Demonstration only)

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	2	2		1	1	1	1			1	1	2	1		2
CO2				2					1			1	3		
CO3	2	2						2	1		1		2	1	1
CO4	2		2					1						2	
CO5	1	2	1									2		2	

MMPC601	**MECHATRONICS FOR AUTOMATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To provide basic knowledge about functioning of different control systems, the mechanical and electrical actuation systems.
- To familiarize the students the performance of different types of sensors and transducers, the principle of signal conditioning.
- To illustrate the concepts 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 - sequential controllers - microprocessor based controllers - Mechatronics approach.

Electrical actuation systems - electrical system - mechanical switches: solid state switches - solenoids - A.C. - D.C Motors - stepper motors.

UNIT II

Mechanical actuation systems - Types of motion - Kinematic chains - cams gear trains - ratchet and pawl - belt and chain drives - bearing - mechanical aspects of motor selection: Pneumatic and hydraulic actuation systems - directional control valves - pressure control valves - cylinders - 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,N., "Electronic Control System for Mechanical and Electrical Engineering Mechatronics", Longman, 1995.
2. Mechatronics, HMT. Tata McGraw-Hill, 1998.

REFERENCES

1. Daradaly, D.A., Dawson, D., "Mechatronics - Electronics in Products & Processes", Burd. N.C. & Hall, 1993.
2. Electro Mechanics - Principles Concepts and Devices Prentice Hall, 1995.
3. Mechatronics system Design - PWS Publishing Company, 1998.

COURSE OUTCOMES

Upon completing this course, students should be able to:

1. recognize the elements of mechatronic system
2. identify the construction and working principles mechatronic control systems, electrical and mechanical actuation systems
3. distinguish between sensors and transducers
4. identify suitable advanced control system for manufacturing processes
5. develop suitable mechatronics control system for given 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	3	2		1		1	1	1		2	1		3		
CO2	3		2		1								3		
CO3	2	2													1
CO4	2		1						1				2	1	
CO5	2	2	2						2			2	2	2	2

MMPC602	FLUID MECHANICS & MACHINERY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To study the applications of the conservation laws to flow through pipes and hydraulic machines.
- To understand the importance of dimensional analysis.
- To understand the importance of various types of flow in pumps and turbines

UNIT I

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

UNIT II

Types of flows and flow pattern (stream lines, stream tube, Path lines and streak line)– one dimensional flow analysis – General continuity equation – steady flow equation of continuity – Euler's equation- Bernoulli's equation and its applications.(Orifice meter, Venturimeter and pitot tube).

UNIT III

Boundary layer – laminar and turbulent flow separation – Transition- types of Boundary layer thickness – Flow through pipes- Weisbach equation and chezy's for friction loss in pipe- Major and minor losses – Buckingham ∏ theorem – non – dimensional numbers – Reynolds number – Froude numbers, Weber number, Euler's number and Mach number.

UNIT IV

Pressure of a jet a stationary and moving curved blades – impulse and reaction turbines – Pelton wheel – velocity diagram for impulse turbine – hydraulic, mechanical and overall efficiency – reaction turbines – types – Francis and Kaplan turbine – velocity diagrams – draft tubes – specific speed – cavitation.

UNIT V

Centrifugal pump – casing – velocity diagrams – manometric and hydraulic efficiency – minimum speed for starting a pump – specific speed. Reciprocating pump – slip and co-efficient of discharge – velocity diagrams – effect of friction and velocity & acceleration on pipes – air vessels – hydraulic appliances.

TEXT BOOKS

1. Bansal, R.K., "A Text Book of Fluid Mechanics and Hydraulic Machinery", Lakshmi Publications, Madras.
2. Modi, P.N., "Hydraulics and Fluid Mechanics", Seth S.M Standard Book House, NewDelhi, 1992.

REFERENCES

1. Khurmi, R.S., "Fluid Mechanics and Hydraulics Machinery", S. Chand and Co. New Delhi, 1991.
2. Jagdish Lal, "Fluid Mechanics and Hydraulics Machines", Metropolitan Book Co. Pvt. Ltd., New Delhi, 1991.

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 a fluids
2. critically analyze the performance of steady flow fluids
3. critically analyze laminar and turbulent flow
4. understand the working principles and design of turbines
5. understand the working principles and design of 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											1		
CO2	3	2													
CO3	3												1		2
CO4	3	2	2						1	1		1	3	2	2
CO5	3	2	2					1	1	1	1		3	2	3

MMCP607	**DESIGN & AUTOMATION LABORATORY (CAD/CAM)**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

COURSE OBJECTIVES

- To impart hands on experience to students in Geometric Modeling, Assembly and Engineering Drafting.
- To introduce the concepts of CNC programming and simulation on CNC turning, CNC Milling machines
- To provide hand on experience in the use of hydraulic & pneumatic components.
- To formulate simple circuits which enable the students to understand the concept of mechatronics.

LIST OF EXPERIMENTS

Creo:

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

Mechatronics:

7. Study of various pneumatic and electro-pneumatic components.
8. Study of pneumatic and electro-pneumatic symbols, circuits.
9. Study of PLC, Ladder Diagram and its applications.
10. Study of characteristics of sensors.
11. Study of image processing technique.

12. Modelling and analysis of pneumatic and electrical circuits using FluidSim/P Software.
13. Application on Pneumatics
14. Application on Electro Pneumatics
15. Application on Programming Logic Control (PLC)

COURSE OUTCOMES

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

1. gain practical experience in handling 2-D drafting and 3-D modeling using modeling software
2. apply G and M codes during manual part programming of simple turning and milling components
3. know the functional aspects of different pneumatic and hydraulic components and its use in circuits
4. construct and demonstrate pneumatic and electro pneumatic circuits for various applications
5. apply the concept of PLC in automation

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					2			2	3	2	2
CO2	2	1	3						1				2		2
CO3	2	1	2	2								2		2	2
CO4	3	1	1	2					1				3	2	
CO5	2	2	1	2					1			2	1		

MMCP608	**HYDRAULICS 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.

LIST OF EXPERIMENTS

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)

COURSE OUTCOMES

After completion of this course, student will be able to:

1. determine the properties of fluids, pressure and their measurements
2. measure flow in pipes and determine frictional losses
3. compute forces on immersed plane and curved plates applying continuity equation and energy equation in solving problems on flow through conduits
4. compute the coefficient of discharge of notch
5. develop characteristics of pumps and turbines

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	1			1	1			3	2	1
CO2	3	2										1			
CO3	3		2										3		
CO4		2										2	2	1	1
CO5	3	2	1										2	2	

ETHS701	**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.

REFERENCES

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. know 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

MMPC702	**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

REFERENCES

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

MMCP706	MACHINE DRAWING	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- To provide basic understanding of machine drawing.
- To study the provide assembly and disassembly drawings of bearings, screw jack ect.

UNIT I

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.

UNIT II

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.

REFERENCES

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

MMST707	**SEMINAR / INDUSTRIAL TRAINING**	**L**	**T**	**P**	**C**
		0	**1**	**2**	**2**

COURSE OBJECTIVES

- To expose students to the 'real' working environment and get acquainted with the organization structure, business operations and administrative functions.
- To have hands-on experience in the students' related field so that they can relate and reinforce what has been taught at the university.
- To promote cooperation and to develop synergetic collaboration between industry and the university in promoting a knowledgeable society.
- To set the stage for future recruitment by potential employers.

The student has to present a seminar on the chosen topic. However, the student can select a topic duly approved by the Seminar Coordinator and the Head of the Department concerned. The student who has presented the seminar has to submit a report and appear for viva-voce examination at the end of the semester conducted by faculty members nominated by head of the department.

For Industrial training, the student has to undergo training in a reputed industry for 15 days and has to submit a report on completion of the training. The report will be evaluated by a team of faculty members nominated by the head of the department.

COURSE OUTCOME

Upon completion of the training, students will have the

1. ability to work in a team
2. ability to take initiatives
3. ability to effectively communicate solution to problems (oral, visual, written)
4. ability to manage a project within a given time frame
5. ability to apply prior acquired knowledge in problem solving

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	2	2	1	1	1	2		2	
CO2		1					2		2				2		
CO3			1		1	1		3	1				2	2	1
CO4	1	1			1		2	3				1		3	2
CO5						1	2	2	2			1	2	3	3

MMPV803	**PROJECT WORK AND VIVA-VOCE**	**L**	**T**	**P**	**C**
		0	**8**	**4**	**10**

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. 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. acquire collaborative skills through working in a team to achieve common goals
4. learn on their own, reflect on their learning and take appropriate actions to improve it
5. acquire the skills to communicate effectively and to present ideas clearly and coherently to specific audience in both the written and oral forms

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	2	1	1	1	3	1	1	1	2	2	2	2
CO2	2	3		2		1			1	1		2	2	2	1
CO3	1		3		1			1					2		
CO4		3												1	2
CO5	2	2						2					3	2	2

PROFESSIONAL ELECTIVE COURSES

MMPESCN	NON-TRADITIONAL MANUFACTURING PROCESSES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the fundamentals of Non-Traditional Manufacturing Processes and their methods, applications advantages and disadvantages
- To introduce the concept of nano technology and rapid prototyping

UNIT I

Overview of non-traditional manufacturing – classification of processes under source of energy, transfer media and mechanism

Electric Discharge Machining (EDM): Principles – equipment – power supply, dielectric system, electrodes – process parameters – applications

Wire Electric Discharge Machining (WEDM): Principles – equipment – power supply, dielectric system, electrodes – process parameters – applications

UNIT II

Abrasive Jet Machining (AJM): Principles – equipment – abrasives – nozzles– process parameters – applications

Abrasive Flow Machining (AFM): Principles – equipment – tooling – media – process parameters – applications

Water Jet Machining (WJM): Principles – equipment – nozzles – process parameters – applications

Abrasive Water Jet Machining (AWJM): Principles – equipment – nozzles – Abrasive feed system – process parameters – applications

UNIT III

Ultrasonic machining (USM): Principles – equipment – transducers – tool horns – abrasives, abrasive slurry – process parameters – applications

Electro chemical machining (ECM): Principles – equipment – electrolytes – tools – process parameters – applications

Chemical machining (CHM): Principles – equipment – masks, etchants – process parameters – applications

UNIT IV

Electron Beam Machining (EBM): Principles – equipment – EB gun – power supply – process parameters – applications

Laser Beam Machining (LBM): Principles – equipment – power supply – process parameters – applications
Plasma Arc Machining (PAM): Principles – equipment – plasma torches – process parameters – applications Hot machining – Neutral particle technique – High speed machining.

UNIT V

Basic Principle of Nano technology - Rapid prototyping: basic concepts, techniques: Stereolithography, Selective Laser Sintering, Selective Powder Binding, Fused Deposition Modeling, Laminated Object Manufacturing – applications

TEXT BOOKS

1. Pandey, P. C., and Shan, S. H., "Modern manufacturing processes", Tata McGraw Hill Pub. Co. Ltd., New Delhi
2. Amitabha Ghosh, "Rapid prototyping – A Brief Introduction", East-West Press Ltd.

REFERENCES

1. Gary F. Benedict, "Non-Traditional Manufacturing Processes", Marcel Dekker, Inc., New York.
2. Amitabha Ghosh and Ashok Kumar Mallik, "Manufacturing Science", Affiliated East-West Press Pvt. Ltd.
3. Adithan, M.S., "Modern Machining Methods", Chand & Co. Ltd., New Delhi, 1990.

COURSE OUTCOMES

Upon completing this course, students should be able to:

1. appreciate the need for non-traditional manufacturing processes
2. gain knowledge on process parameters on mechanical means of metal removal by various non-traditional manufacturing processes
3. provide better knowledge on the chemical concepts in non-traditional manufacturing processes
4. comprehend the concepts of metal removal mechanical in advanced form of non-traditional manufacturing processes
5. acquire the basic knowledge of nano-technology and rapid proto typing

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						1		1	3	2	2
CO2	2	1	2									1	2	1	1
CO3		1		2						1				2	2
CO4	2		2	2									2		2
CO5	2													2	3

MMPESCN	**TOOL ENGINEERING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To introduce different production tools, including press tools, their design.
- To provide an understanding of design and use of jigs and fixtures.

UNIT I

Design principles of cutting tools – problems in cutting tool design – factors in tool design -. Single point cutting tool – chip breakers – determination of tool shank dimensions. Milling cutters – determination of number of teeth, teeth size and other features. Design features – drills – reamers - broaching tools

UNIT II

Press tool design: Press classification – selection and features press. Dies – types – clearances. Progressive die design for typical components for blanking and piercing – compound die –combination die. Strip layout design – influencing factors

UNIT III

Bending: Types of bending – determination of bending force – bend allowance – Springback. Drawing dies: Design of dies – blank development – Cup drawing - illustrative examples.

Ironing – calculation of number of draws. Design of forging dies – blank size. Materials for die block.

UNIT IV

Elements of Jigs and Fixure – Locating and clamping principles. Locating method and devices – Clamping devices. Types of Jigs: Plate, Template, Latch, Channel Leaf, Box and Indexing.

UNIT V

Modular work holding systems – POKA YOKE - quick change toolings - single minute exchange of dies – Computer aided fixture design – phases.

Plastic tooling – Plastic tool materials – construction methods – applications.

TEXT BOOKS

1. Sharma, P.C., "A Text Book of Production Engineering", S.Chand Publisher, 2001.
2. Donaldson, G.H., Lecain, and Goold, V.V., "Tool Design", Tata McGraw-Hill, 2000.

REFERENCES

1. Rodin, P., "Cutting Tool Design", MIR Publisher, Moscow,1968.
2. Wilson, F.W., "Die design Hand book", McGraw Hill.
3. Wilson, F.W., "Fundamentals of Tool Design", ASTME, Prentice Hall, 1974.

COURSE OUTCOMES

Upon completing this course, students should be able to

1. Gain knowledge of the cutting tool nomenclatures
2. develop and design progressive and compound dies for simple sheet metal operations
3. compute bending force, number of draws for the required cup shape, blank size for forged components
4. design jigs and fixture for specific applications
5. acquire knowledge about the parameters influencing tool design for plastic 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										1		
CO2	2	2	1									1	2		
CO3	2	1												1	1
CO4			2	2					1			1	3	2	2
CO5	3		2	2					1			2	3	2	2

MMPESCN	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

Product design & CAD, CAM, CAD/CAM and CIM – CIM Hardware and Software – Three Step Process for Implementation of CIM – Production Concepts and Mathematical Models Covering Production Rate, Manufacturing Lead Time, Capacity Utilization, Availability & WIP – Automation – Reason for Automation and Automation Strategies

UNIT II

Basic Elements of an Automated System – Advanced Automated Functions – Levels of Automation - Fundamentals of Automated Production Lines – Work Part Transfer Mechanisms – Storage Buffers – Control of the Production Line – Application to Machining System Material Handling and storage system: Overview of Materials Handling Equipment – Conveyors – Automated Guided Vehicle System: Types, Guidance Technology, Vehicle Management – Automated Storage and Retrieval Systems

UNIT III

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

Group Technology: Definition – Part Families – Visual – 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

UNIT V

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 and Personal Computer

Short 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", 2nd Edition, Prentice Hall of India Private Limited, New Delhi, 2007.
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,

REFERENCES

1. Radhakrishnan, P., Subramanyan, S., and Raju,.V,, "CAD/CAM/CIM", New Age International Publishers, 2000.
2. Yorem Koren, "Computer Integrated Manufacturing", McGraw-Hill, 2005.
3. Rao, P.N, "CAD/CAM - Principles and Applications", Tata McGraw-Hill Publications, 2007.

COURSE OUTCOMES

Upon completing this course, students should be able to:

1. Provide engineering knowledge on the importance of CAD / CAM / CIM
2. Actively employ the various aspects of automated assembly and control system
3. Gain knowledge on the basics of Industrial robots in modern manufacturing
4. Apply the concepts of group technology and flexible manufacturing
5. Recognize the usage of modern materials handling and storage system and industrial robots

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		
CO2		1											2		
CO3	3	2	1	3	1				1			2	3	2	1
CO4	3	1	3	3								1	2	2	3
CO5			1	2		1			2			1	2	1	2

MMPESCN	**COMPUTER AIDED PRODUCT DESIGN**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To introduce the concepts and applications of CAD
- To introduce the various concepts and techniques used for Product design.

- To develop product design skills.

UNIT I

Introduction to Engineering Design – Various phases of systematic design – sequential engineering and concurrent engineering – Computer hardware & Peripherals – software packages for design and drafting.

UNIT II

Computer graphics – applications – principals of interactive computer graphics – 2D 3Dtransformations – projections – Beziercurves, B-Spline and NURBS – Concepts.

UNIT III

Geometric Modeling – types – Wire frame surface and solid modeling – Boundary Representation, constructive solid geometry – Graphics standards – assembly modeling – use of software packages

UNIT IV

Product modeling – types of product models; step of product design product development process tools –Design for reliability – design for manufacturability – machining, casting, and metal forming –Design for environment; Bench marking – FMEA - Design for product life cycle.

UNIT V

Product Data Management – concepts – roles and responsibility Collaborative product design and commerce – Information Acquisition – Sourcing factor – manufacturing planning factor – Customization factor – Product life cycle management.

TEXT BOOKS

1. Ibrahim Zeid, "CAD/CAM theory and Practice", Tata McGraw Hill.
2. Radakrishan, P., Subramaniyan, S., and Raju, V., "CAD/CAM/CIM ", New age International (p) Ltd. Publishers.

REFERENCES

1. Biren Prasad, "Concurrent Engineering Fundamentals", Prentice Hall.
2. James G. Bralla, "Handbook of Product Design for Manufacturing", McGraw Hill. David, F., Rogers. J, Alan Adams, "Mathematical Elements for Computer Graphics", McGraw Hill.
3. Kevin Otto and Kristin Wood, "Product Design", Pearson Education.

COURSE OUTCOMES

Upon completing this course, students should be able to:

1. Gain knowledge on the basics of Engineering design
2. Apply the concepts of computer graphics.
3. Demonstrate the Geometric modeling principles of design.
4. Outline the various design principles for product modeling
5. Effectively manage the product data and life cycle of the 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		
CO2	2	2	2						2			1	2	1	
CO3		1		1									3	1	1
CO4	2	2	3	2					2			2	2	2	2
CO5	2	2	2	2					1			1	2		2

MMPESCN	PRODUCTION AND OPERATIONS MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To provide an understanding of the modern approaches to manage the operations,
- To present a broad conceptual framework for the management of the operations function in an organization

UNIT I

Production and operation management – Evolution and objectives - Concept of Production system - Types of Production systems – Continuous, Intermittent -Elements of Production planning and control, concept of Productivity - Production versus Services. Aggregate planning: Costs, Strategies – Application of chase and level strategies and Transportation model - Simple problems.

UNIT II

Capacity planning: Defining and measuring capacity –determinants of effective capacity –Developing capacity alternatives.

Forecasting - components of demand - Quantitative methods - Single moving average method - Single exponential smoothing method - Simple linear regression model –- Measures of accuracy - Illustrative examples - Qualitative Methods.

UNIT III

Inventory planning and control: Need, inventory costs, Determination of EOQ, EPQ/ELS (without shortages) - Effect of quantity discounts. Determination of ROL, Safety Stocks - Methods of calculating safety stock using Normal - single period inventory model, Inventory control systems - P, Q, and S-s System.

UNIT IV

Materials Requirements Planning (MRP) - Master Production Schedule (MPS), Bill of Materials (BOM), MRP concept, Lot sizing: Lot-for-lot technique, EOQ approach, Periodic order quantity approach – Illustrative Examples.

UNIT V

Operations scheduling and sequencing: Notations and definitions - Job shop scheduling: sequencing of n jobs through one machine - Priority decision rules – Measures of Performance - n jobs through 2 machines - Jackson's rule. Flow shop scheduling: sequencing

of n jobs through 2, 3 machines, Johnson's rule. n jobs through m machines - CDS algorithm.

TEXT BOOKS

1. Pannerselvam, R., "Production and Operations Management", PHI Learning Pvt. Ltd., 2008.
2. Charry, S.N., "Theory and Problems in Production and Operations Management", Tata McGraw-Hill, 2005.

REFERENCES

1. Joseph G. Monks, "Theory and Problems of Operations Management", Tata McGraw-Hill Publishing Company Limited, 2nd Edition, 2004.
2. Anil Kumar, S., and Suresh, N., "Production and Operations Management", New Age International (P) Limited Publishers, 2nd Edition, 2008.
3. Everett E. Adam, and Jr.Ronald J.Ebert, "Production and Operations Management", Prentice-Hall of India Private Limited, 5th Edition, 1994.

COURSE OUTCOMES

Upon completing this course, students should be able to:

1. Categorize the different types of production systems
2. Apply the concepts of capacity planning and various methods of forecasting
3. Utilize the various inventory control models to provide solutions
4. Select the appropriate MRP techniques for the given situation
5. Choose the scheduling methods and priority rules for the given production 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	2									1	2		
CO2	2	1											2		1
CO3	2	2	2					1	1				3	1	1
CO4	1	3	2					2				1	2	2	
CO5	2	2	2					2	2			2	3	2	1

MMPESCN	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To provide an understanding of modern techniques and tools of quality management
- To impart the knowledge and on the application of the statistical quality control techniques which are used in manufacturing and service industries.
- To provide knowledge and understanding of the modern manufacturing strategies and to present a broad conceptual framework for the management of the operations function across the supply chain.

UNIT I

Concepts of TQM – Definition of quality – Dimensions of quality - Deming, Crosby and Juran's philosophies – Barriers to TQM - Quality system – ISO 9000:2000 - ISO 14000 –

QS 9000 Quality system standards - Quality costs, Seven tools for Quality Control, Seven tools for Quality management, Quality Function Deployment (QFD) - Taguchi Loss function.

UNIT II

Objectives of statistical quality control - inspection and its importance – Introduction to Single sampling plan – OC Curve - differences between inspection and quality control - Causes and types of variations - Theory of control charts, Control charts for attributes - p, np, c and u charts.

UNIT III

Control charts for variables, X - $\overline{R}$ charts, standard deviation charts - Moving range chart. Relationship between statistical control limits and specification limits - modified control chart, process capability studies (Cp and Cpk) – concept of six sigma.

UNIT IV

Business Process Re-engineering (BPR) – basic concepts – Bench marking: Types – reasons – process of bench marking – overview and approaches to Concurrent engineering – Agile and Lean manufacturing – FMEA – FMECA.

UNIT V

Technology management – Strategic Management – Goal – Vision – Mission statements – order winner – order qualifier - 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 (CRM) – Database management system (DBMS) – Re-manufacturing.

TEXT BOOKS

1. Montgomery, D.C., “Introduction to Statistical Quality Control”, John Wiley, 1994.
2. James Evans, “Managing for Quality and Performance Excellence”, CENGAGE Learning, 2014.

REFERENCES

1. Gupta, R.C., “Statistical Quality Control”, Khanna Publication, 1998.
2. Besterfield, “Total Quality Management”, Pearson Education, 2nd Edition, 2003.

COURSE OUTCOMES

Upon completing this course, students should be able to:

1. Apply the core features of the Total quality management in terms of various dimensions of quality.
2. Measure the cost of poor quality and process effectiveness and efficiency to track performance quality and to identify areas for improvement
3. Develop an understanding on quality management philosophies and frameworks
4. Develop the ability to apply the tools of quality control and quality management.
5. Utilize the proven methodologies to enhance management processes, such as benchmarking and business process reengineering, lean manufacturing.

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	1	2	1									1	1	1	
CO3	2	2	2									2	2	2	2
CO4	2	1	2					2	1				2	2	1
CO5	1		2					1					2		2

MMPESCN	ADVANCED MANUFACTURING PROCESSES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To acquaint the students with recent developments in modern casting and welding processes.
- To introduce students to the working principles of advanced welding and their applications.
- To illustrate the fundamentals of powder metallurgy and working principles of selective laser sintering.
- To demonstrate different production techniques of Plastics
- To impart knowledge on Rapid prototyping and different types of tooling used in rapid proto typing.

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-Rapid solidification for Amorphous alloys.

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, Friction stir welding, Explosive welding, Ultrasonic welding and diffusion welding.

UNIT III

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 – Other shaping processes – Metal Injection moulding, pressureless compaction, ceramic moulds – spray deposition - Finishing of sintered parts.

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 composite –Moulding – compression, vacuum bag – contact – resin transfer – transfer / injection. Filament winding.

UNIT V

Rapid prototyping and rapid tooling: 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

REFERENCES

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

Upon completing this course, students will be able to:

1. Understand the state-of-the-art processes in the field of Manufacturing Technology.
2. Gain knowledge on advanced Welding processes and their importance in manufacturing.
3. Understand the concepts of powder metallurgy and advanced shaping processes.
4. Gain knowledge on processing of plastic and different production techniques involved
5. Realize the need and place for rapid prototyping approach.

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	1		
CO2	1	2											2		
CO3	1		3	3								1		1	
CO4		1		3						1		2	3	2	1
CO5	2	2	2	2						2		1	2	3	2

MMPESCN	**NON DESTRUCTIVE TESTING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To introduce the various aspects of destructive testing and Non-destructive testing
- To introduce the fundamentals of advanced materials testing methods
- To introduce the knowledge about inspection of magnetic and non magnetic materials

UNIT I

Liquid penetrant system – Processing cycles –Inspection of surface defects-Generation of Magnetic fields-Magnetic particle inspection equipments – Demagnetization-Applications and limitations.

UNIT II

Production of X-rays – Characteristics rays and white rays- Tube current and voltage – Source of γ ray - Half-life period- Penetrating power – Absorption of x and γ ray – Radiation contrast and film contrast- Exposure charts - penetrameters and sensitivity –Safety.

UNIT III

Eddy current production – Impedance concepts –Inspection of magnetic materials-Inspection of Non magnetic materials –Influences of various parameters-Advantages and limitations.

UNIT IV

Production of ultrasonic waves – Different types of waves-Normal beam inspection – Angle beam inspection-Thickness measurements –Applications.

UNIT V

Principle of acoustic emission- Instrumentation for Non destructive testing- Principles of holography-Applications of holographic techniques Non destructive inspection-Advantages and limitations- Other techniques.

TEXT BOOKS

1. Barry Hull and Vernon John, "Non Destructive Testing", Mac Millan, 1988.

REFERENCES

1. Metals Hand Book, "American Society of Metals", 9th Edition,Volume-11, 1980.
2. Birchand, D., "Non Destructive Testing", Oxford University Press, 1977.
3. Proceedings of the 10th International Acoustic Emission Symposium, Japanese Society for Non Destructive Inspection, Sendai, 1990.
4. Holler, P., "New Procedures in Non Destructive Testing", Springer Verlag, 1983.

COURSE OUTCOMES

Upon completing this course, students should be able to:

1. To provide better understanding of the Liquid penetrant system and Magnetic particle inspection methods
2. To impart knowledge on the Radiogaphic Non desdructive testing methods
3. To understand the Eddy current testing methods
4. To impart knowledge on the ultrasonic waves methods.
5. To impart knowledge on the acoustic emission method for testing of defects

	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	3	1	2										3	3	2
CO3	2	1							1					3	
CO4		2	1	1					2			1	2	1	2
CO5	2		2	2					1			2		2	1

OPEN ELECTIVE COURSES

MMOESCN	OPERATIONS RESEARCH	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce students the use of quantitative methods and techniques for effective decisions–making.
- To provide an understanding of the systematic approach to solve decision making problems.
- To enhance the decision-making skills through the application of appropriate models.

UNIT I

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

UNIT II

Transportation problems - optimal solutions. Assignment problems - Hungarian algorithm - Traveling salesman problem – applications – Problems.

UNIT III

Waiting line Problems - cost of waiting and cost of providing service - single channel - single stage type of problems - Monte Carlo simulation for queue problems.

Network models - Minimal spanning tree problem, shortest route problem and Maximum flow problem.

UNIT IV

PERT and CPM - basic steps - rules for constructing the network - Fulkerson's rule - time estimates - PERT calculations - probability of meeting the time schedule - time - cost trade off (crashing) - difference between PERT and CPM – applications.

UNIT V

Decision Theory - Decision making under risk condition - expected monetary value criteria - Decision trees - Decision making under uncertain conditions - Minimax, maximin, maximax, Hurwitz and Regret criteria.

TEXT BOOKS

1. Gupta and Hira, “Operations Research”, S. Chand & Co., 1998.
2. Vohra, N.D., “Quantitative Techniques in Management”, Tata McGraw-Hill, 1990.

REFERENCES

1. Sharma, S.D., “Operations Research”, Kedarnath Ramnath and Co., Meerut, 1998.
2. Barry Render, Ralph M. Stair Jr., “Quantitative analysis for Management”, Pearson New Delhi, 2010.
3. Ravindran, A., Phillips, D.T., and Solberg, J.J., “Operations Research, Principles and Practice”, John Wiley and Sons, Singapore, 1987.
4. Taha, “Operations Research”, Tata McGraw-Hill, 1998.

5. Bronson, R., "Theory and Problems of Operations Research", Schaum's outline series,1997.

COURSE OUTCOMES

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

1. Formulate and solve linear programming problems
2. Develop solutions for various assignment, transportation problems
3. Apply the concept of waiting line and network models
4. Construct and analyze the project network using project management techniques
5. Select appropriate decision making models for the real life 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	2	2	1									2	2		1
CO2	2	2	1										3		
CO3	2	3										2	2	2	
CO4	2	3	2	1								2		2	1
CO5	1	3	2	1								1	2	2	2

MMOESCN	**MACHINE TOOL DESIGN**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To introduce the various drive systems used in machine tools
- To understand the basic design aspects of various of machine tool components and structures

UNIT I & II

Various driving systems for machine tools - Stepper motors - 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 ssdrive - Meander drive. Various stepless regulation systems - 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 of column 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 Bearing Design 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, 1997.
2. Metha, N.K., "Machine tool Design and Numerical Control", Tata McGraw-Hill, New Delhi, 1999.

REFERENCES

1. Sen and Bhattacharya , "Principles of Machine Tools", Volume- II, New Central Book Agency, Calcutta, 1990.
2. Acherkan, "Machine Tool Design", Volume-I to IV, MIR Publishers, Moscow, 1978.

COURSE OUTCOMES

Upon completing this course, students should be able to:

1. gain knowledge on various drives for machine tools
2. apply the concept of preferred numbers in machine tools
3. design frictionless guideways for CNC machines
4. design bed-ways for various machines tools
5. design and develop frictionless bearings for advanced machine tools

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									3	1	2
CO2	3	2	2										2		
CO3	2		3									1		2	1
CO4		1										1	2	2	
CO5	2	2	3									2	3		2

MMOESCN	NEURAL NETWORKS AND FUZZY LOGIC	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To learn the concepts to increase machine IQ by overlapping the dynamic system, adaptive control, Statistics with probability and mathematical logic.

UNIT I

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 II

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 III

Introduction to 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 IV

Other JANN 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 V

Recent Advances: Fundamentals of Genetic Algorithms - Genetic Modeling - Hybrid systems - Integration of Fuzzy Logic, Neural Networks and Genetic Algorithms - Non Traditional Optimization Techniques like Ant Colony Optimization, Particle -Swam Optimization and Artificial, Immune Systems - Applications in Design and Manufacturing.

TEXT BOOKS

1. S. Rajasekaran, G.A. Vijayalakshimi, " Pai Neural Networks, Fuzzy Logic and Genetic Algorithms", Prentice Hall of India Private limited, 2003.

REFERENCES

1. Klir.G, Yuan.B.B, "Fuzzy sets and Fuzzy Logic", Prentice Hall of India Private limited, 1997.
2. Timothy J.Ross,"Fuzzy Logic with Engineering Applications". N1cGraw Hill, 1995.
3. ZuradaJ .M, "Introduction to Artificial of Neural Systems", Jaico Publishing House, 1994.
4. Laurence Fausett, "Fundamentals of Neural Networks", Prentice Hall. 1992.
5. Gen, M. and R.Cheng," Genetic Algorithm and I I Engineering Design", John Wiley, 1997.

COURSE OUTCOMES

Upon completing this course, students should be able to:

1. gain fundamental knowledge on the principles of fuzzy logic
2. create advanced fuzzy systems
3. gain fundamental knowledge on the principles of artificial neural network
4. apply their knowledge on the development of ANN system
5. deliver their knowledge to develop non-traditional optimization techniques for specific industrial 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	2	2									2	1	2	
CO2	2	2										1	3		
CO3		2	2	1								2	2	2	1
CO4	3		2	2								1	2	2	2
CO5	3	2	2									2	2	1	1

MMOESCN	**ENGINEERING ECONOMICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To introduce the student to the cost implications of the various decisions that may have to be made in a manufacturing environment.

UNIT I

Basic concepts, terms, demand – supply relationship, Role of engineering economics in decision making, Interest calculation (simple & compound), cash (IN/OUT) flows,.

UNIT II

Principle of money – Factors and their uses – single payment factors, uniform series present worth factor - capital recovery factor, sinking fund factor present worth, future worth and equivalent uniform annual worth calculation.

UNIT III

Application of money – time relationships: present worth, capitalized cost evaluation, equivalent uniform annual worth calculation, rate of return components for single projects, rate of return evaluation for multiple alternatives.Minimum attractive rate of return.

UNIT IV

Replacement strategies and Policies: Basic concepts of replacement analysis, economic service life, opportunity costs - cash flow approaches to replacement analysis - Replacement analysis using specified study period - probabilistic replacement models.

UNIT V

Cost volume profit relationship – relevant costs in decision making – profit management analysis - aluation, alternative selection by cost-benefit break-even analysis and its application, payback period. Depreciation methods: straight line, declining balance, sinking fund - Depletion models – cost depletion, percentage depletion methods.

TEXT BOOKS

1. Leland Blank, T., and Anthony J. Tarquin, “Engineering Economy”, McGraw-Hill, Singapore, 4th Edition 1998.
2. Riggs, J.L., Bedworth, J.A., and Randhava, S.U., ”Engineering Economics”, McGarw Hill,1998.

REFERENCES

1. Degarmo, E.P., Sullaivan, W.G., and Bontadelli, J.A., "Engineering Economics", Macmillan Pub. Co., New York, 1993.
2. Stenier, H.M., "Engineering Economics Principle", McGraw-Hill, New York, 1992.
3. Thuesen, G.J., and Fabrycky, W.J., "Engineering Economics", Prentice Hall International, New Jersey, 1993.

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

MMOESCN	SENSORS AND CONTROL SYSTEMS IN MANUFACTURING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To equip the students with concepts of sensor performance, product monitoring and control applications in robotics.
- To acquaint the student with the elements of CIM, FMS and the integration of manufacturing functions.
- To provide students with a sound understanding of the use of advance instrumentation and sensing methods.
- Understand the various components of sensor network architecture, networks in manufacturing and PLC.
- To provide an exposure to 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.- Fibre 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.

REFERENCES

1. Tonshoff, H.K., and Inasaki, I., "Sensor Applications, vol. 1 sensors in Manufacturing", Wileyvch Publications 2001.

COURSE OUTCOMES

Upon completing this course, students should be able to:

1. gain knowledge on the use of various sensors
2. provide the basics of sensor requirement in product monitoring
3. gain knowledge on the condition monitoring procedures and system integration
4. appreciate the importance of sensors in fault finding using remote sensing
5. apply their knowledge in the use of advanced instrumentation and sensing methods

	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	
CO2	2	1		2								2	3		1
CO3	3	1	2										2	2	
CO4		2	2	2								1		2	2
CO5	3	2	2	2								1	3	2	2

MMOESCN	**SURFACE ENGINEERING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

This course will enable the student

- To familiarize the basic concepts of Surface Engineering and Tribology
- To introduce the various aspects of wear, its mechanism and control.

- To introduce the fundamentals of various surface modification processes.
- To introduce the concepts of thick film and thin film coatings.

UNIT I

Mechanisms of wear and metal cleaning: Basic mechanisms of wear - abrasive, adhesive wear, contact fatigue – fretting corrosion – Testing of wear resistance – Practical diagnosis of wear – General cleaning process for ferrous and non ferrous alloys – Selection of cleaning processes – alkaline cleaning, emulsion cleaning abrasive bath cleaning – polishing, buffing and hot peering.

UNIT II

Thermal spraying processes and Electro deposited coatings: Thermal spraying-materials, characteristics of thermal spray process – Designing for thermally sprayed coatings – coating production – spray fused coatings – Principles of electroplating – technology and control – electroplating – Technology and control – electroplating systems – properties and applications of electro deposits - non - aqueous and electroless deposition.

UNIT III

Hot dip coating and diffusion coatings: Principles – surface preparation-batch coating and continuous coating – properties and applications principle of cementation – cladding, vacuum deposition – sprayed metal coating – structure of diffusion coatings – chemical vapor deposition – physical vapor deposition

UNIT IV

Non metallic coatings and conversion coatings: Plating coating – lacquers – rubbers and elastomers – Vitreous enamels – anodizing, Chromating, Phosphating

UNIT V

Weld surfacing: Hard facing, overlaying – Laser cladding – Explosive cladding – Roll bonding - Testing and inspection of coatings: Thickness and porosity measurement – selection of coatings

TEXT BOOKS

1. Stan Grainger, “Engineering Coatings – Design and Applications”, Jaico, 1994.
2. Parthasarathy, N.V., “Electroplating Hand Book”, Prentice Hall, 1992.

REFERENCES

1. Gale, D.R., “Principles of Metal Surface Treatment & Protection”, Pergamon, 1990.
2. Niku-Lavi, “Advances in Surface Treatments”, Pergamon, 1990.
3. “Metals Handbook on Surface Engineering”, 8th Edition, ASM, 1994.

COURSE OUTCOMES

Upon completing this course, students should be able to:

1. Provide engineering knowledge on Mechanisms of wear and Testing of wear resistance
2. Understand the thermally sprayed coatings and Principles of electroplating.
3. Understand the Hot dip coating and diffusion coatings
4. Provide better knowledge on the Non metallic coatings and conversion coatings
5. Understand the weld surfacing and Explosive cladding

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		
CO2	3	2										2		2	
CO3	3		2							1			2	2	1
CO4	2	2	1									2	1	1	2
CO5	1	1	2										3		2

MMOESCN	COMPOSITE MATERIALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To impart an in-depth knowledge on composite materials and types
- To make an understanding of the production processing and the structural development in composite materials.

UNIT I

Introduction: Fundamentals of composites – need for composites – Enhancement of properties – classification of composites - Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC) Reinforcement - Particle reinforced composites, Fibre reinforced composites, Applications of various types of composites.

UNIT II

Classification of Polymers - properties and applications of selective engineering polymers - Polymer Matrix Composites: Polymer matrix resins - Thermosetting resins, thermoplastic resins - Reinforcement fibres - Rovings - Woven fabrics - Non Woven random mats - various types of fibres. PMC processes - 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 III

Metal Matrix Composites: Characteristics of MMC, Various types of Metal matrix composites Alloy vs. MMC, Advantages of MMC. Limitations of MMC, Metal Matrix, Reinforcements particles - fibres. Effect of reinforcement - Volume fraction - Rule of mixtures, Processing of MMC - Powder metallurgy process - diffusion bonding - stir casting, squeeze casting.

UNIT IV

Ceramics Matrix Composites: Engineering ceramic materials - properties - advantages limitations - Monolithic ceramics - Need for CMC Ceramic matrix - Various types of 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

Advances Composites: Carbon/carbon composites - Advantages of carbon matrix - limitations of carbon matrix Carbon fibre - chemical vapour deposition of carbon on carbon fibre perform. Sol gel technique. Composites for aerospace industrial applications.

REFERENCES

1. Composite materials, Engineering and Science, Mathews .F.L. and Rawings .R.D., Chapman
2. Composite materials, Chawla K.K., SpringerVerlag, 1987
3. Engineering Materials, Kenneth G.Budinski, Prentice Pvt. Ltd., 41th Indian Reprint, 2002
4. Introduction to Metal Matrix Composites, T.W.Clyne and P.J. Withers, Cambridge University Press, 1993
5. Fundamentals of Composite Manufacturing, B. Strong, SME, 1989
6. Composite materials, S.C. Sharma, Narosa Publications, 2000
7. "Short Term Course on Advances in Composite Materials", Composite Technology Centre, Department of Metallurgy, lIT - Madras, December 2001
8. Hand Book of Plastic processing, Brydson,
9. FRP Technology (Fibre Reinforced Resin System), Weatherhead, R.G Applied Science Publishers Limited, London, 1990

COURSE OUTCOMES

Upon completing this course, students should be able to:

1. Obtain knowledge on classification of composite materials used in the modern world
2. Obtain knowledge on different types of production technique of Polymer Matrix Composites and their Reinforcements.
3. To understand the basics of Metal Matrix Composites and their Reinforcements
4. To understand the basics of the Ceramics Matrix Composites and their Reinforcements
5. Gain knowledge on the processing methods of carbon matrix / Carbon fibre composites and 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	3	2	2									1	3	1	
CO2	2	3											2		2
CO3	3		2									2		3	1
CO4		2	2									1	3	2	2
CO5	3		1										1	3	

MMOESCN	SUPPLY CHAIN MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Discuss the fundamental concepts of supply chain management;
- impart the knowledge on how to align the management of a supply chain with corporate goals and strategies.
- Expose the issues in international supply chain management

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 sc- 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. SC Strategies: Efficient Vs Responsive strategy- Agile Vs Lean supply chain, postponement strategy- push pull strategy.

UNIT III

Value of Information- Bullwhip effect - information and supply chain technology- Supply chain integration- 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 strategies VAT material flow analysis. Strategic alliances – Make or buy decision – Framework for strategic alliance – outsourcing - Krajalic matrix - core competency – 3PL-4PL – Effect of Demand and supply uncertainty- cross docking- - risk pooling- Square root law - centralized vs decentralized system

UNIT V

Global SC - International Issues in SCM- Introduction- risks and advantages - design for logistics- supplies integration into to new product-development- mass customization - Issues in customer value – Information technology for SCM - Goals – standardization - infrastructure - DSS for supply chain management.

REFERENCES

1. Designing and managing the Supply Chain, Simchi - Levi Davi, Kaminsky Philip and Simchi-Levi Edith, Tata McGraw Hill Publishing Company Ltd, New Delhi, 2003
2. Supply chain management, 2nd edition, Sunil Chopra and Peter Meindl, Pearson Education, New Delhi, 2003.
3. Supply Chain Management: Text and Cases, Janat Shah, Pearson Education India, 2009.
4. Supply Chain Management, Robert B Hand Field and Ernest Nichols, Prentice Hall, New Jersey, 1999.
5. Supply chain management: concepts, techniques and practices, Ling Li, world scientific press, 2011
6. Supply chain management (Theories & practices), R Mohanty andS G Deshmukh, Ist edition, Biztantra innovation in management, 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 management methodologies
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 role of information technology to improve the performance of the 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											2			
CO2	3	2											2	1	2
CO3	3	3	2							1		2	2	2	2
CO4	2	2	2						1	2			1	2	
CO5	2		1						2	2		2	1		

HONOURS ELECTIVE COURSES

MMHESCN	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

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.

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 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.

REFERENCES

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

Upon completing this course, students should be able to:

1. Understand the Tensile behaviour of metals;
2. Understand the Hardness & Toughness behaviour of metals
3. Understand the Fatigue behaviour of metals.
4. Gain knowledge about the Fracture behaviour of metals
5. Understand the environmental factors affecting the mechanical behaviour of 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	1										3		
CO2	3	2	1									1	1	2	
CO3		3	2										2	2	2
CO4	2		2									1	3	3	2
CO5	3	3										1		1	1

MMHESCN	MODERN MANUFACTURING STRATEGIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To provide knowledge and understanding of the modern manufacturing strategies
- Present a broad conceptual framework for the management of the operations function across the supply chain.

UNIT I

Total Productive Maintenance (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)- JIT philosophy – Objectives – Sources of waste – Waste reduction – Value added focus – push system-pull system – push vs pull system – kanban – JIT implementation

UNIT IV

Business Process Re-engineering (BPR)- Basic concepts – TQM and BPR – Traditional IE and BPR- Benchmarking-Types of benchmarking-overview and approaches to Concurrent Engineering - Agile and Lean 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

REFERENCES

1. Advanced Operations Management, Mohanty R.P., and Deshmukh S.G., Pearson Education (Singapore) Pvt. Ltd., New Delhi, India.2003.
2. Competitive Manufacturing Management, Nicholas J.M., TMH, New Delhi. 2001.
3. Introduction to Total Productive Maintenance, Seiichi Nakeiima, Productivity Press (India) Pvt Ltd., Madras, 1988.

COURSE OUTCOMES

Upon completing this course, students should be able to:

1. Apply the concept of Total Productive Maintenance
2. Recognize the roles of supply chain among various business functions and their roles in the organizations' strategic planning and gaining competitive advantage
3. Apply the concept of JIT principles and make use of waste reduction techniques
4. Know and apply Business Process Re-engineering techniques
5. Gain knowledge about Technology Management and Strategic Management 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	1	1										2		
CO2	3		2									2	2		1
CO3	3		2	1				1					1	2	
CO4	3	2	1					1				1	1	1	2
CO5	3	1	1	2				2				2	2	1	1

MMHESCN	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	3	2	2					2				2	3	2	2
CO2	2	2		2				1					3		2
CO3	3		2									2		2	
CO4	1	2	2	2									3		2
CO5	3	2	2	2									3	2	2

MMHESCN	PLANT LAYOUT AND MATERIAL HANDLING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Introduce the concepts of layout planning and the various algorithms used
- 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.

REFERENCES

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, Singapore, 2003

COURSE OUTCOMES

Upon completing this course, students should be able to:

1. Perform load distance analysis and apply different line balancing techniques
2. Demonstrate computer aided plant layout techniques for solving layout problems
3. Apply facilities planning for various layout problems
4. Carryout economics analysis of material handling equipments
5. Utilize the concepts of mechanized assembly

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	1	1	
CO2	3	3	2					1					2	2	
CO3	3	2	2	2								1	1	2	1
CO4	3	3										2		2	2
CO5			1	1									1		2

MMHESCN	**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 – Probability model – expected value model - 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 - 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 – 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.

REFERENCES

1. Chary S.N., "Production and Operations Management" Theory and Problems, TMH, New Delhi, 1990
2. Monks J.G., "Operation Management" Theory & Problems, McGraw Hill, 1987
3. Srinath L.S., "Concepts in Reliability Engineering", East west press Ltd. 1991
4. Bikas Bhadury and S.K. Basu, Terrotechnology: Reliability Engineering and Maintenance Management, Asian Books Pvt., Ltd., New Delhi, 2003
5. Seiichi Nakeiima, "Introduction to Total Productive Maintenance", Productivity Press (India) Pvt Ltd., Madras, 1988
6. Mishra R.C., Pathak K., "Maintenance and Engineering Management", 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. Apply problem solving models to maintenance
3. Utilize the Replacement strategies, Policies and models
4. Have a working knowledge of the techniques of reliability engineering
5. Demonstrate different types of spares and models used for managing spares

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								1		1	
CO2	3	3	2											2	1
CO3	2	2										2	2	1	2
CO4	2	1											2	2	1
CO5	2	2										1	1	3	2

MMHESCN	PRECISION ENGINEERING AND NANO-TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the concept of precision engineering and manufacturing methods
- To introduce the concept of nano technology and scanning instrumentation
- To make an understanding of MEMS

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, 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), Nanoidentation - 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.

TEXT BOOKS

1. Nakazawa H. "Principles of Precision Engineering", Oxford University press, 1994.
2. Mark Ratner and Daniel Ratner, "Nano Technology", Pearson Education, Delhi 2003.
3. Precision engineering in Manufacturing, Murthy.R.L. New Age international Pvt. Limited.

REFERENCES

1. Hand book of Surface and Nano Technology, D.J.White House.
2. Institute of Physics Publishing, Bristol and Philadelphia, Bristol. BSI 6BE U.K.
3. The Science and Engineering of Micro electronic Fabrication, Stephen A. Campbell, Oxford University Press, 1996.
4. Understanding Smart Sensors, Randy Frank, Artech. House, Boston, 1996.

COURSE OUTCOMES

Upon completing this course, students should be able to:

1. Learn the concept of precision engineering and manufacturing methods
2. Understand the principles of Metrology
3. Understand the special casting techniques, micro machining
4. Learn the concept of nano technology and scanning instrumentation
5. Expose to the smart structures, smart materials and principle of MEMS

	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	3		
CO2	2		2										2	3	2
CO3	3	1	2	2								2		1	
CO4			1	1									2	2	2
CO5	3	2	3	2								2	1	3	2

MINOR ENGINEERING COURSES

MMMESCN	MACHINE TOOLS AND METAL CUTTING	L	T	P	C
		3	0	0	4

COURSE OBJECTIVES

- To impart an understating of the principle of metal cutting
- To provide knowledge of various cutting tool materials
- To provide an overview of various machine tools and operations performed
- To focus on the principle of Numerical control of machine tools

UNIT I

Fundamentals of Metal Cutting: Mechanics of chip formation – Types of chips – Shear Zone – Orthogonal Cutting – Shear angles and its relevance – Cutting forces and Power – Merchant's Circle – Numerical examples

UNIT II

Cutting Tool Materials: Requirements – Types Tool wear and tool life: Types of tool Wear – Tool life equations – Numerical examples – Machinability – Cutting fluids – Functions – Properties – Types.

UNIT III

Machine Tools: Classifications – Centre Lathe – Constructional features – Operations performed. Special purpose Lathes: Capstan and Turret Lathes – Automatic Lathes – Tooling design for Automatic lathes.

UNIT IV

Reciprocating Machine tools: Shaper – Planer – Slotter – Constructional features – Operations performed. Milling Machines – Types – Operations performed – Types of cutters. Hole making operations: Drilling – Reaming Boring – Tapping – Other Machine tools: Sawing – Broaching – Gear Cutting.

UNIT V

Grinding – Types of grinding machines – Grindery Wheel – Designation and Selection other Abrasive machining processing – Hoping – Lapping – Surface finishing – Polishing and buffing – Abrasive belt grindery – Barrel tumbling – Barrel rolling – Burnishing

Numerical control of machine tools – Principle – Types of control System – NC tooling – Part Programming fundamentals Manual and Computer aided part programing (CAP) (only concepts)

TEXT BOOKS

1. Suresh Dalela, "Manufacturing Science & Technology", Vol. I & II, Umesh Publications, 1997.
2. Radhakrishnan, P., "Computer Numerical control of Machine Tools", New central Book Agency, 2002.

REFERENCES

1. Kalpakjian, S., “Manufacturing Engineering & Technology”, 3rd Edition, Addition Wesley Inc. 1997.
2. Hajra Choudhry, S.K., “Elements of Workshop Technology”, Media Promoters & Publications Pvt. Ltd, 1994.
3. Krar, S.F., and Check, A.F., “Technology of Machine Tools”, Tata McGraw-Hill, New Delhi, 1998.

COURSE OUTCOMES

Upon completing this course, students should be able to:

1. Understand the principle of metal cutting
2. Gain knowledge of various cutting tool materials
3. Gain knowledge of Rotary type Machine Tools and their classifications
4. Gain knowledge above the various reciprocating machine tools and operations performed
5. Gain the knowledge of abrasive processes and NC machines and 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	3	3	1									1	2		
CO2	2	2	2										1		
CO3	2	1											2	3	2
CO4	2		2	2					1					3	1
CO5	2	3		2					1					2	2

MMMESCN	**METAL CASTING, FORMING AND JOINING PROCESSES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**4**

COURSE OBJECTIVES

- To introduce the principle of metal casting process and various process elements
- To provide an understanding of various metal forming processes
- To give a focus on the various sheet metal forming operations
- To give broad idea on the various metal joining processes

UNIT I

Basic Terminologies – Patterns – Types – Materials, allowances – Cores – Types – Moulding materials: Sand compositions – Indian sands – Other sands – Properties – Sand mould making, Elements of gating system.

UNIT II

Design of gates and risers – simple problems. Melting practice: Cupola – other furnaces – Cleaning of castings and casting defects – causes. Special casting Process: Shell

moulding – Investment casting – Permanent mould casting – Die casting – Centrifugal casting – Continuous casting.

UNIT III

Classification – Hot and Cold working. Rolling load – Defects and causes. Forging – Hand forging operations – Press forging – Forging defects – Drop forging and upset forging. Extrusion: Principle – Formand and Backward – Hot and Cold extrusion – Tube and rod extrusion – Wire drawing – Seamless tubes extrusion.

UNIT IV

Sheet metal forming: Drawing – Redrawing – Stretch forming – Flanging – Spinning – limiting draw ratios – (Bending – Springback) Embossing.
Metal Joining process: Classifications – Gas Welding – Principle – Oxy acetylene – Oxy hydrogen – Gas Cutting.

UNIT V

Electric Arc Welding: Principle – Arc Welding equipments – Electrodes – Manual metal arc welding – Carbon Arc welding – Tungsten Inert gas welding – Gas Metal Arc welding – Submerged arc welding – Atomic hydrogen welding – Solid state welding process.

TEXT BOOKS

1. Parmar, R.S., "Welding Processes and Technology", Khanna Publishers, New Delhi, 2007.
2. Rowe, G.W., "An Introduction to the Principles of Metal Working", Edward Arnold Publication.
3. Campbell, "Casting and Forming Process", McGraw-Hill, 1997.

REFERENCES

1. Nadkarni, S.V., "Modern Arc Welding Technology", Oxford & IBH Publishing Co.Pvt.Ltd, NewDelhi, 1996.
2. Khanna, O.P., "Welding Technology" Dhanpat Rai & Sons Publishers, New Delhi, 1993.
3. George E. Dieter "Mechanical Metallurgy", McGraw-Hill International Edition, Newyork, 1998
6. Robert H. Wagoner and Jean Loup Chenot., "Fundamentals of Metal Forming", John Wiley & Sons Inc., New York, 1992.
7. Heine, R.W., Rosenthal, P.C., & Loper, C.R., "Principles of Metal Casting", Tata McGraw-Hill, 1997.
8. Jain, P.L., "Principles of Foundry Technology", Tata McGraw-Hill, 1997.

COURSE OUTCOMES

Upon completing this course, students should be able to:

1. Understand the basic terminologies in metal casting
2. gain knowledge in the advancement in the casting technology
3. recognize different forming process to manufacture near net-shape product
4. identify various sheet metal forming techniques
5. distinguish between fusion welding processes and solid state welding 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	2		3									1	3		
CO2	2	1	2									1	2		1
CO3	3	1	2											1	2
CO4		2											1	2	2
CO5	3	2	1										3	2	3