B.S. Abdur Rahman Crescent Institute of Science & Technology

Deemed to be University u/s 3 of the UGC Act, 1956

REGULATIONS 2017

CURRICULUM AND SYLLABI

For

B.TECH. PROGRAMMES

UNIVERSITY VISION AND MISSION

VISION

B.S. Abdur Rahman Institute of Science and Technology aspires to be a leader in Education, Training and Research in Engineering, Science, Technology and Management and to play a vital role in the Socio-Economic progress of the Country.

MISSION

- To blossom into an internationally renowned University
- To empower the youth through quality education and to provide professional leadership
- To achieve excellence in all its endeavors to face global challenges
- To provide excellent teaching and research ambience
- To network with global institutions of Excellence, Business, Industry and Research Organizations
- To contribute to the knowledge base through Scientific enquiry, Applied research and Innovation

DEPARTMENT OF MECHANICAL ENGINEERING

VISION AND MISSION

VISION

To excel in providing quality education and training through Undergraduate and Postgraduate programmes and carryout quality research in the field of Mechanical Engineering.

MISSION

- To provide a good learning experience through appropriate design of curriculum and syllabi that facilitates students to gain thorough understanding of the fundamental concepts and applications in Mechanical Engineering
- To equip students to solve challenging problems in Mechanical Engineering and related areas taking in to account their impact on the society
- To facilitate students to develop good communication, leadership and managerial skills through team approach in conducting experiments and projects
- To pursue academic and collaborative research activities with industry and other research institutions ensuring high quality in publications and other research outputs

PROGRAMME EDUCATIONAL OBJECTIVES

- To induce a sense of excitement in learning by adapting a holistic approach through well designed curriculum, pedagogy and evaluation for a successful professional career
- To provide a strong foundation in physical sciences and analytics to enable comprehensive understanding of the basic principles of Mechanical Engineering
- To develop knowledge and skill in applying engineering principles to conceive, design, analyze, manufacture, maintain and recycle engineering systems and components
- To equip the students with essential fundamental knowledge not only in the facets of Mechanical Engineering but also from other relevant disciplines to infuse a multi-disciplinary approach
- To enhance the spirit of inquiry through projects, internships leading to development of creativity, self-confidence and team spirit
- To provide necessary ambience with scope for developing communication and life skills so as to meet the needs of the society in the globalized environment

PROGRAMME OUTCOMES

- Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to

comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

- Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES

- Apply the principles of Engineering to Model, Analyze, Design and realize physical components, processes and systems
- Work professionally in the Mechanical Systems

REGULATIONS - 2017

B.TECH. DEGREE PROGRAMMES

1.0 PRELIMINARY DEFINITIONS & NOMENCLATURE

In these Regulations, unless the context otherwise requires:

i) **"Programme"** means B.Tech. Degree Programme.

ii) **"Branch"** means specialization or discipline of B.Tech. Degree Programme like Civil Engineering, Mechanical Engineering, etc.,

iii) **"Course"** means a theory or practical subject that is normally studied in a semester, like Mathematics, Physics, Engineering Graphics, Computer Practice, etc.,

iv) **"Institution"** means B.S. Abdur Rahman Crescent Institute of Science and Technology.

v) **"Dean (Academic Affairs)"** means the Dean (Academic Affairs) of B.S. Abdur Rahman Crescent Institute of Science and Technology.

vi) **"Dean (Student Affairs**)" means the Dean (Students Affairs) of B.S. Abdur Rahman Crescent Institute of Science and Technology.

vii) **"Controller of Examinations"** means the Controller of Examination of B.S. Abdur Rahman Crescent Institute of Science and Technology who is responsible for conduct of examinations and declaration of results.

2.0 ADMISSION

2.1a) Candidates for admission to the first semester of the eight-semester B.Tech. degree programme shall be required to have passed the Higher Secondary Examination of the (10+2) curriculum (Academic stream) prescribed by the appropriate authority or any other examination of any university or authority accepted by the Institution as equivalent thereto.

2.1b) Candidates for admission to the third semester of the eight-semester B.Tech. programme under lateral entry scheme shall be required to have passed the Diploma examination in Engineering / Technology of the Department of Technical Education, Government of Tamil Nadu or any other examination of any other authority accepted by the Institution as equivalent thereto.

2.2 Notwithstanding the qualifying examination the candidate might have passed, the candidate shall also write an entrance examination prescribed by the Institution for admission. The entrance examination shall test the proficiency of the candidate in Mathematics, Physics and Chemistry on the standards prescribed for Ten plus Two academic stream.

2.3 The eligibility criteria such as marks, number of attempts and physical fitness shall be as prescribed by the Institution from time to time.

3.0 BRANCHES OF STUDY

3.1 Regulations are applicable to the following B.Tech. degree programmes in various branches of Engineering and Technology, each distributed over eight semesters with two semesters per academic year.

B.TECH. DEGREE PROGRAMMES:

1. Aeronautical Engineering
2. Automobile Engineering
3. Civil Engineering
4. Computer Science and Engineering
5. Electrical and Electronics Engineering
6. Electronics and Communication Engineering
7. Electronics and Instrumentation Engineering
8. Information Technology
9. Manufacturing Engineering
10. Mechanical Engineering
11. Biotechnology
12. Cancer Biotechnology
13. Food Biotechnology

4.0 STRUCTURE OF THE PROGRAMME

4.1 Every Programme will have a curriculum with syllabi consisting of theory and practical courses such as,

i) Basic Sciences (BS)

ii) Humanities & Social Sciences (HS)

iii) Management Sciences (MS)

iv) Engineering Sciences Fundamentals (ESF)

v) Engineering Core Courses (EC)

vi) Professional Electives (PE)

vii) General Electives (GE)

viii) Workshop practice, laboratory work, industrial training, seminar presentation, project work, etc.

4.2 Each course is normally assigned certain number of credits:

- one credit per lecture period per week
- one credit per tutorial period per week
- one credit for two to three periods and two credits for four periods of laboratory or practical sessions
- one credit for two periods of seminar / project work per week
- one credit for two weeks of industrial training.

4.3 Each semester curriculum shall normally have a blend of lecture courses, laboratory courses and laboratory integrated theory courses of total not exceeding 26 credits.

4.4 For the award of the degree, a student has to earn a minimum total credits specified in the curriculum of the relevant branch of study. The minimum credits to be earned will be between 174 and 180, depending on the program.

4.5 The medium of instruction, examinations and project report shall be in English, except for courses in languages other than English.

5.0 DURATION OF THE PROGRAMME

5.1 A student is ordinarily expected to complete the B.Tech. programme in eight semesters (six semesters in the case of lateral entry scheme), but in any case not more than 14 continuous semesters reckoned from the date of first admission (12 semesters in the case of lateral entry student).

5.2 Each semester shall consist of a minimum of 90 working days.

5.3 Semester end examination will normally follow within a week after the last working day of the semester.

6.0 CLASS ADVISOR AND FACULTY ADVISOR

6.1 CLASS ADVISOR

A faculty member will be nominated by the HOD as Class Advisor for the class throughout the period of study except first year.

The Class Advisor shall be responsible for maintaining the academic, curricular and co-curricular records of students of the class throughout their period of study.

However, for the first and second semester, the class advisors (First year class advisors) will be nominated by the first year coordinator.

6.2 FACULTY ADVISOR

To help the students in planning their courses of study and for general counseling, the Head of the Department of the students will attach a maximum of 20 students to a faculty member of the department who shall function as faculty advisor for the students throughout their period of study. Such faculty advisor shall guide the students in taking up the elective courses for registration and enrolment in every semester and also offer advice to the students on academic and related personal matters.

7.0 COURSE COMMITTEE

7.1 Each common theory course offered to more than one group of students shall have a “Course Committee” comprising all the teachers teaching the common course with one of them nominated as course coordinator. The nomination of the course coordinator shall be made by the Head of the Department / Dean (Academic Affairs) depending upon whether all the teachers teaching the common course belong to a single department or to several departments. The Course Committee shall meet as often as possible and ensure uniform evaluation of the tests and arrive at a common scheme of evaluation for the tests. Wherever it is feasible, the Course Committee may also prepare a common question paper for the test(s).

8.0 CLASS COMMITTEE

A class committee comprising faculty members handling the classes, student representatives and a senior faculty member not handling the courses as chairman will be constituted branch-wise and semester-wise

8.1 The composition of class committees for first and second semester will be as follows:

i) The first year coordinator shall be the chairman of the class committee

ii) Faculty members of all individual courses of first / second semester

iii) Six student representatives (male and female) of each class nominated by the first year coordinator

iv) The class advisor and faculty advisors of the class.

8.2 The composition of the class committee for each branch from 3rd to 8th semester will be as follows:

i) One senior faculty member preferably not handling courses for the concerned semester, appointed as chairman by the Head of the Department

ii) Faculty members of all courses of the semester

iii) Six student representatives (male and female) of each class nominated by the Head of the Department in consultation with the relevant faculty advisors

iv) All faculty advisors and the class advisors.

v) Head of the Department

8.3 The class committee shall meet at least four times during the semester. The first meeting will be held within two weeks from the date of commencement of classes, in which the nature of continuous assessment for various courses and the weightages for each component of assessment will be decided for the first and second assessment. The second meeting will be held within a week after the date of first assessment report, to review the students' performance and for follow up action. The third meeting will be held within a week after the second assessment report, to review the students' performance and for follow up action.

8.4 During these three meetings the student members representing the entire class, shall meaningfully interact and express opinions and suggestions to improve the effectiveness of the teaching-learning process.

8.5 The fourth meeting of the class committee, excluding the student members, shall meet within 5 days from the last day of the semester end examination to analyze the performance of the students in all the components of assessments and decide their grades in each course. The grades for a common course shall be decided by the concerned course committee and shall be presented to the class committee(s) by the concerned course coordinator.

9.0 REGISTRATION AND ENROLMENT

9.1 Except for the first semester, every student shall register for the ensuing semester during a specified week before the semester end examination of the ongoing semester. Every student shall submit a completed registration form indicating the list of courses intended to be enrolled during the ensuing semester. Late registration with the approval of the Dean (Academic Affairs) along with a late fee will be permitted up to the last working day of the current semester.

9.2 From the second year onwards, all students shall pay the prescribed fees for the year on a specific day at the beginning of the semester confirming the registered courses. Late enrolment along with a late fee will be permitted up to two weeks from the date of commencement of classes. If a student does not enroll, his/her name will be removed from rolls.

9.3 The students of first semester shall register and enroll at the time of admission by paying the prescribed fees.

9.4 A student should have registered for all preceding semesters before registering for a particular semester.

10.0 COURSE CHANGE / WITHDRAWAL

10.1 CHANGE OF A COURSE

A student can change an enrolled course within 10 working days from the commencement of the course, with the approval of the Dean (Academic Affairs), on the recommendation of the Head of the Department of the student.

10.2 WITHDRAWAL FROM A COURSE

A student can withdraw from an enrolled course at any time before the first assessment for genuine reasons, with the approval of the Dean (Academic Affairs), on the recommendation of the Head of the Department of the student.

11.0 TEMPORARY BREAK OF STUDY FROM PROGRAMME

A student may be permitted by the Dean (Academic Affairs) to avail temporary break of study from the programme up to a maximum of two semesters for reasons of ill health or other valid grounds. A student can avail the break of study before the start of first assessment of the ongoing semester. However the total duration for completion of the programme shall not exceed the prescribed maximum number of semesters (vide clause 5.1).If any student is debarred for want of attendance or suspended due to any act of indiscipline, it will not be considered as break of study. A student who has availed break of study has to rejoin in the same semester only.

12.0 CREDIT LIMIT FOR ENROLMENT & MOVEMENT TO HIGHER SEMESTER

12.1 A student can enroll for a maximum of 32 credits during a semester including Redo /Pre do Courses

12.2 The minimum earned credit required to move to the higher semester shall be

- Not less than 20 credits, to move to the 3rd semester
- Not less than 40 credits, (20 for lateral entry) to move to the 5th semester
- Not less than 60 credits, (40 for lateral entry) to move to the 7th semester

13.0 ASSESSMENT PROCEDURE AND PERCENTAGE WEIGHTAGE OF MARKS

13.1 Every theory course shall have a total of three assessments during a semesteras given below:

Assessment No.	Course Coverage in Weeks	Duration	Weightage of Marks
Assessment 1	1 to 6	1.5 hours	25%
Assessment 2	7 to 12	1.5 hours	25%
Semester End Exam	Full course	3 hours	50%

13.2 Appearing for semester end theory examination for each course is mandatory and a student should secure a minimum of 40% marks in each course in semester end examination for the successful completion of the course.

13.3 Every practical course will have 60% weightage for continuous assessments and 40% for semester end examination. However a student should have secured a minimum of 50% marks in the semester end practical examination.

13.4 For laboratory integrated theory courses, the theory and practical components shall be assessed separately for 100 marks each and consolidated by assigning a weightage of 75% for theory component and 25% for practical component. Grading shall be done for this consolidated mark. Assessment of theory component shall have a total of three assessments with two continuous assessments carrying 25% weightage each and semester end examination carrying 50% weightage. The student shall secure a separate minimum of 40% in the semester end theory examination. The evaluation of practical component shall be through continuous assessment.

13.5 The components of continuous assessment for theory/practical/laboratory integrated theory courses shall be finalized in the first class committee meeting.

13.6 In the case of Industrial training, the student shall submit a report, which will be evaluated along with an oral examination by a committee of faculty

members, constituted by the Head of the Department. A progress report from the industry will also be taken into account for evaluation. The weightage for report shall be 60% and 40% for Viva Voce examination.

13.7 In the case of project work, a committee of faculty members constituted by the Head of the Department will carry out three periodic reviews. Based on the project report submitted by the student(s), an oral examination (viva-voce) will be conducted as the semester end examination, for which one external examiner, approved by the Controller of Examinations, will be included. The weightage for periodic review will be 50%. Of the remaining 50%, 20% will be for the project report and 30% for the Viva Voce examination.

13.8 Assessment of seminars and comprehension will be carried out by a committee of faculty members constituted by the Head of the Department.

13.9 For the first attempt of the arrear theory examination, the internal assessment marks scored for a course during first appearance will be used for grading along with the marks scored in the arrear examination. From the subsequent appearance onwards, full weightage shall be assigned to the marks scored in the semester end examination and the internal assessment marks secured during the course of study shall be ignored.

In case of laboratory integrated theory courses, after one regular and one arrear appearance, the internal mark of theory component is invalid and full weightage shall be assigned to the marks scored in the semester end examination for theory component. There shall be no arrear or improvement examination for lab component.

14.0 SUBSTITUTE EXAMINATIONS

14.1 A student who has missed, for genuine reasons, a maximum of one of the two continuous assessments of a course may be permitted to write a substitute examination paying the prescribed substitute examination fees. However, permission to take up a substitute examination will be given under exceptional circumstances, such as accidents, admission to a hospital due to illness, etc. by a committee constituted by the Dean of School for that purpose. However there is no Substitute Examination for Semester End examination.

14.2 A student who misses any continuous assessment test in a course shall apply for substitute exam in the prescribed form to the Head of the Department /

Dean of School within a week from the date of missed assessment test. However the Substitute Examination will be conducted after the last working day of the semester and before Semester End Examination.

15.0 ATTENDANCE REQUIREMENT AND SEMESTER / COURSE REPETITION

15.1 A student shall earn 100% attendance in the contact periods of every course, subject to a maximum relaxation of 25% (for genuine reasons such as medical grounds or representing the Institution in approved events etc.) to become eligible to appear for the semester-end examination in that course, failing which the student shall be awarded "I" grade in that course. The cases in which the student is awarded "I" grade, shall register and repeat the course when it is offered next.

15.2 The faculty member of each course shall cumulate the attendance details for the semester and furnish the names of the students who have not earned the required attendance in that course to the Class Advisor. The Class Advisor will consolidate and furnish the list of students who have earned less that 75% attendance, in various courses, to the Dean (Academic Affairs) through the Head of the Department/ Dean of School. Thereupon, the Dean (Academic Affairs) shall announce the names of such students prevented from writing the semester end examination in each course.

15.3 A student who has obtained 'I' grade in all the courses in a semester is not permitted to move to next higher semester. Such student shall repeat all the courses of the semester in the subsequent academic year.

15.4 A student should register to re-do a core course wherein "I" or "W" grade is awarded. If the student is awarded, "I" or "W" grade in an elective course either the same elective course may be repeated or a new elective course may be taken with the approval of Head of the Department / Dean of School.

15.5 A student who is awarded "U" grade in a course will have the option to either write the semester end arrear examination at the end of the subsequent semesters, or to redo the course in the evening when the course is offered by the department. Marks scored in the continuous assessment during the redo classes shall be considered for grading along with the marks scored in the semester-end (redo) examination. If any student obtained "U" grade in the redo course, the marks scored in the continuous assessment test (redo) for

that course will be considered as internal mark for further appearance of arrear examination.

15.6 If a student with "U" grade, who prefers to redo any particular course, fails to earn the minimum 75% attendance while doing that course, then he / she will not be permitted to write the semester end examination and his / her earlier "U" grade and continuous assessment marks shall continue.

16.0 REDO COURSES

16.1 A student can register for a maximum of two redo courses per semester in the evening after regular college hours, if such courses are offered by the concerned department. Students may also opt to redo the courses offered during regular semesters.

16.2 The Head of the Department with the approval of Dean Academic Affairs may arrange for the conduct of a few courses during the evening, depending on the availability of faculty members and subject to a specified minimum number of students registering for each of such courses.

16.3 The number of contact hours and the assessment procedure for any redocourse will be the same as those during regular semesters except that there is no provision for any substitute examination and withdrawal from an evening redo course.

17.0 PASSING AND DECLARATION OF RESULTS AND GRADE SHEET

17.1 All assessments of a course will be made on absolute marks basis. However, the Class Committee without the student members shall meet within 5 days after the semester-end examination and analyze the performance of students in all assessments of a course and award letter grades. The letter grades and the corresponding grade points are as follows:

Letter Grade	Grade Points
S	10
A	9
B	8
C	7
D	6
E	5
U	0
W	0
I	0
AB	0

"W" denotes withdrawal from the course.

"I" denotes inadequate attendance and hence prevention from semester-end examination

"U" denotes unsuccessful performance in the course.

"AB" denotes absence for the semester-end examination.

17.2 A student who earns a minimum of five grade points ('E' grade) in a course is declared to have successfully completed the course. Such a course cannot be repeated by the student for improvement of grade.

17.3 The results, after awarding of grades, shall be signed by the Chairman of the Class Committee and Head of the Department/Dean of Schools and it shall be declared by the Controller of Examinations.

17.4 Within one week from the date of declaration of result, a student can apply for revaluation of his / her semester-end theory examination answer scripts of one or more courses, on payment of prescribed fee, through proper application to Controller of Examination. Subsequently the Head of the Department/ Dean of School offered the course shall constitute a revaluation committee consisting of Chairman of the Class Committee as Convener, the faculty member of the course and a senior member of faculty knowledgeable in that course. The committee shall meet within a week to revalue the answer scripts and submit its report to the Controller of Examinations for consideration and decision.

17.5 After results are declared, grade sheets shall be issued to each student, which will contain the following details. The list of courses enrolled during the semester including redo courses, if any, and the grade scored, the Grade Point Average (GPA) for the semester and the Cumulative Grade Point Average (CGPA) of all courses enrolled from first semester onwards. GPA is the ratio of the sum of the products of the number of credits of courses registered and the grade points corresponding to the grades scored in those courses, taken for all the courses, to the sum of the number of credits of all the courses in the semester.

If Ci, is the number of credits assigned for the i^{th} course and GPI is the Grade Point in the i^{th} course

$$GPA = \frac{\sum_{i=1}^{n}(C_i)(GPi)}{\sum_{i=1}^{n} C_i}$$

Where n = number of courses

The Cumulative Grade Point Average CGPA shall be calculated in a similar manner, considering all the courses enrolled from first semester. **“I” and "W"** grades will be excluded for calculating GPA .**"U", “I”, "AB"** and **"W"** grades will be excluded for calculating CGPA. The formula for the conversion of CGPA to equivalent percentage of marks shall be as follows: Percentage Equivalent of Marks = CGPA X 10

17.6 After successful completion of the programme, the Degree will be awarded with the following classifications based on CGPA.

Classification	CGPA
First Class with Distinction	8.50 and above and passing all the courses in first appearance and completing the programme within the Prescribed period of 8 semester for normal entry and 6 semesters for lateral entry
First Class	6.50 and above and completing the programme within a maximum of 10 semester for normal entry and 8 semesters for lateral entry
Second Class	Others

However, to be eligible for First Class with Distinction, a student should not have obtained ‘U’ or ‘I’ grade in any course during his/her study and should have completed the U.G. programme within a minimum period (except break of study). To be eligible for First Class, a student should have passed the examination in all the courses within the specified minimum number of semesters reckoned from his/her commencement of study. For this purpose, the authorized break of study will not be counted. The students who do not satisfy the above two conditions will be classified as second class. For the purpose of classification, the CGPA will be rounded to two decimal places. For the purpose of comparison of performance of students and ranking, CGPA will be considered up to three decimal places.

18.0 ELECTIVE CHOICE:

18.1 Apart from the various elective courses listed in the curriculum for each branch of specialization, the student can choose a maximum of two electives from any other specialization under any department, during the entire period of study, with the approval of the Head of the parent department and the Head of the other department offering the course.

18.2 ONLINE / SELF STUDY COURSES

Students are permitted to undergo department approved online/ self study courses not exceeding a total of six credits with the recommendation of the Head of the Department / Dean of School and with the prior approval of Dean Academic Affairs during his/ her period of study. In case of credits earned through online mode ratified by the respective Board of Studies, the credits may be transferred following the due approval procedures. The students shall undergo self-study courses on their own with the mentoring of a member of the faculty. The online/ self-study courses can be considered in lieu of elective courses.

19.0 SUPPLEMENTARY EXAMINATION

Final Year students can apply for supplementary examination for a maximum of two courses thus providing an opportunity to complete their degree programme. Likewise students with less credits can also apply for supplementary examination for a maximum of two courses to enable them to earn minimum credits to move to higher semester. The students can apply for supplementary examination within three weeks of the declaration of results.

20.0 PERSONALITY AND CHARACTER DEVELOPMENT

20.1 All students shall enroll, on admission, in any of the personality and character development programmes, NCC / NSS / NSO / YRC / Rotaract and undergo practical training.

- **National Cadet Corps (NCC)** will have to undergo specified number of parades.

- **National Service Scheme (NSS)** will have social service activities in and around Chennai.
- **National Sports Organization (NSO)** will have sports, games, drills and physical exercises.
- **Youth Red Cross (YRC)** will have social service activities in and around Chennai.
- **Rotaract** will have social service activities in and around Chennai.

21.0 DISCIPLINE

21.1 Every student is required to observe disciplined and decorous behavior both inside and outside the campus and not to indulge in any activity which will tend to affect the prestige of the Institution.

21.2 Any act of indiscipline of a student, reported to the Dean (Student Affairs), through the HOD / Dean will be referred to a Discipline and Welfare Committee nominated by the Vice-Chancellor, for taking appropriate action.

22.0 ELIGIBILITY FOR THE AWARD OF DEGREE

22.1 A student shall be declared to be eligible for the award of B.Tech. degree provided the student has:

i) successfully completed all the required courses specified in the programme curriculum and earned the number of credits prescribed for the specialization, within a maximum period of 14 semester (12 semesters for lateral entry) from the date of admission, including break of study

ii) no dues to the Institution, Library, Hostels

iii) no disciplinary action pending against him/her.

22.2 The award of the degree must have been approved by the Institution.

23.0 POWER TO MODIFY

Notwithstanding all that has been stated above, the Academic Council has the right to modify the above regulations from time to time.

B.S. ABDUR RAHMAN CRESCENT INSTITUTE OF SCIENCE AND TECHNOLOGY

B.TECH. MECHANICAL ENGINEERING

CURRICULUM& SYLLABUS, REGULATIONS 2017

SEMESTER I

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1.	BS	MAC 1181	Differential Calculus and Geometry	3	1	0	4	
2.	HS	ENC 1181/ ISC 1181/ LNC 1181/ LNC 1182 / LNC 1183	English / Arabic / Mandarin / German / Japanese	3	0	0	3	
3.	BS	PHC 1181	Physics	3	0	2	4	
4.	BS	CHC 1181	Chemistry	3	0	2	4	
5.	ESF	GEC 1101	Engineering Graphics	2	0	2	3	
6.	ESF	GEC 1102	Engineering Design	2	0	0	2	
7.	ESF	GEC 1103	Basic Engineering Practices Laboratory	0	0	2	1	
8.	ESF	GEC 1104	Computer Programming I	1	0	2	2	**23**

SEMESTER II

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	BS	MAC 1281	Advanced Calculus	3	1	0	4
2.	BS	-	Physics Elective	2	0	2	3
3.	BS	-	Chemistry Elective	2	0	2	3
4.	ESF	GEC1211	Basic Engineering Mechanics	3	1	0	4
5.	BS	GEC 1212	Environmental Studies	2	0	0	2

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
6.	ESF	GEC 1213	Computer Programming II	1	0	2	2	
7.	EC	MEC1211	Material Science	3	0	0	3	
8.	EC	MEC1212	Design Appreciation Lab	0	0	3	1	
9.	ESF	EEC 1283	Basic Electrical Engineering	2	0	0	2	
10.	ESF	EEC 1284	Electrical Engineering Laboratory	0	0	3	1	**25**

SEMESTER III

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1.	BS	MAC2181	Partial Differential Equations and Transforms	3	1	0	4	
2.	HS	-	Humanities Elective I	2	0	0	2	
3.	HS	ENC 2181	Oral Communication	0	0	2	1	
4.	EC	MEC2101	Manufacturing Processes	3	0	0	3	
5.	EC	MEC2102	Engineering Metallurgy	3	0	0	3	
6.	EC	MEC2103	Engineering Thermodynamics	3	1	0	4	
7.	EC	MEC2104	Solid Mechanics	3	1	0	4	
8.	EC	MEC2105	Manufacturing Processes Lab	0	0	3	1	
9.	EC	MEC2106	Material Testing and Metallurgy Lab	0	0	3	1	
10.	EC	MEC2107	Part Modeling Lab	0	0	3	1	**24**

SEMESTER IV

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1.	BS	-	Mathematics Elective I	3	1	0	4	
2.	HS	-	Humanities Elective II	2	0	0	2	
3.	HS	ENC2282	Written Communication	0	0	2	1	
4.	EC	MEC2211	Kinematics of Machinery	3	0	0	3	
5.	EC	MEC2212	Fluid Mechanics and Machinery	3	1	0	4	
6.	EC	MEC2213	Metal Cutting and Machine Tools	3	0	0	3	
7.	EC	MEC2214	Machining Lab	0	0	3	1	
8.	EC	MEC2215	Product Modelling Lab	0	0	3	1	
9.	EC	MEC2216	Fluid Mechanics and Machinery Lab	0	0	3	1	**20**

SEMESTER V

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	MS	MSC 3181/ MSC 3182	Leadership and CEO Training/ Social Entrepreneurship	3	0	0	3
2.	GE	-	General Elective I	3	0	0	3
3.	HS	ENC3181	Soft Skill for Career	0	0	2	1
4.	EC	MEC3101	Dynamics of Machinery	3	1	0	4
5.	EC	ECC3181	Electronics for Mechanical Systems	2	0	0	2
6.	EC	MEC3102	Thermal Engineering (Integrated Lab)	3	0	3	4
7.	EC	MEC3103	Mechanics Lab	0	0	3	1

8.	EC	ECC3182	Electronics Lab	0	0	3	1	
9.	PE		Programme Elective ##				6**	**25**

SEMESTER VI

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1.	MS	MSC 3181/ MSC 3182	Leadership and CEO Training/ Social Entrepreneurship	3	0	0	3	
2.	BS	-	Mathematics Elective II	2	0	0	2	
3.	HS	ENC3281	English for Workplace	0	0	2	1	
4.	EC	MEC3211	Machine Design	3	1	0	4	
5.	EC	MEC3212	Metrology and Mechanical Measurements (Integrated Lab)	3	0	3	4	
6.	EC	MEC3213	Heat and Mass Transfer	3	0	0	3	
7.	EC	MEC3214	Heat and Mass Transfer Lab	0	0	3	1	
8.	EC	MEC3215	CNC Lab	0	0	3	1	
9.	PE		Programme Elective ##				6**	**25**

SEMESTER VII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	GE	-	General Elective II	3	0	0	3
2.	EC	MEC4101	Finite Element Analysis (Integrated Lab)	3	0	3	4
3.	EC	MEC4102	Mechatronics (Integrated Lab)	3	0	3	4
4.	EC	MEC4103	Design of Transmission Systems	3	0	0	3
5.	EC	MEC4104	Simulation Lab	0	0	3	1
6.	EC	MEC4105	Automobile Lab	0	0	3	1

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
7.	PE		Programme Elective ##				6**	
8.	EC	MEC4106	Internship				1	**23**

SEMESTER VIII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1.	EC	MEC4211	Project Work	0	0	24	12	12

Total credits – 177

* Industrial training will be undertaken during Third year summer vacation. The credit will be awarded in the 7th Semester.

PROGRAMME ELECTIVES

ELECTIVES FOR DESIGN

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PE	MECX01	Advanced Strength of Materials	3	0	0	3
2.	PE	MECX02	Composite Materials for Manufacture	3	0	0	3
3.	PE	MECX03	Design of Hydraulics and Pneumatics	3	0	0	3
4.	PE	MECX04	Noise, Vibration and Harshness	3	0	0	3
5.	PE	MECX05	Design of Jigs, Fixtures and Press Tools	3	0	0	3
6.	PE	MECX06	Industrial Problem Solving Techniques	3	0	0	3
7.	PE	MECX07	Geometric Modelling	2	0	0	2
8.	PE	MECX08	Reverse Engineering	2	0	0	2
9.	PE	MECX09	Reliability Engineering	2	0	0	2
10	PE	MECX10	Micro Electro Mechanical Systems (MEMS)	2	0	0	2
11	PE	MECX11	Geometric Dimensioning and Tolerancing	1	0	0	1
12	PE	MECX12	Tool and Die Design	1	0	0	1
13	PE	MECX13	Product Design and Manufacturing	3	0	0	3

ELECTIVES FOR THERMAL

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PE	MECX21	Refrigeration and Air Conditioning	3	0	0	3
2.	PE	MECX22	Advanced I.C. Engines	3	0	0	3
3.	PE	MECX23	Nuclear Engineering	3	0	0	3
4.	PE	MECX24	Gas Dynamics and Jet Propulsion	3	0	0	3
5.	PE	MECX25	Energy Conversion	3	0	0	3
6.	PE	MECX26	Turbomachinery	3	0	0	3
7.	PE	MECX27	Energy Conservation and Management	3	0	0	3
8.	PE	MECX28	Computational Flow and Heat Transfer	3	0	0	3
9.	PE	MECX29	Renewable Sources of Energy	3	0	0	3
10	PE	MECX30	Solar Engineering	3	0	0	3
11	PE	MECX31	Design of Thermal Systems	3	0	0	3
12	PE	MECX32	Automobile Engineering	3	0	0	3
13	PE	MECX33	Automotive Pollution and Control	2	0	0	2
14	PE	MECX34	Fuels and Combustion	2	0	0	2
15	PE	MECX35	Alternate Fuels	1	0	0	1

ELECTIVES FOR MANUFACTURING AND MATERIAL SCIENCE

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PE	MECX41	Modern Manufacturing Systems	3	0	0	3
2.	PE	MECX42	Process Planning and Cost Estimation	3	0	0	3
3.	PE	MECX43	Production Planning and Control	3	0	0	3
4.	PE	MECX44	Statistics and Quality Control	3	0	0	3
5.	PE	MECX45	Modern Production Management	3	0	0	3
6.	PE	MECX46	Advanced Optimisation Techniques	3	0	0	3
7.	PE	MECX47	Mechanical Maintenance	2	0	0	2
8.	PE	MECX48	Robotics and Automation	2	0	0	2
9.	PE	MECX49	Advanced Production Process for Automotive Components	2	0	0	2
10	PE	MECX50	Plant Layout and Material Handling	2	0	0	2
11	PE	MECX51	Industrial Safety Engineering	2	0	0	2
12	PE	MECX52	Operations Research & System Analysis	2	0	0	2
13	PE	MECX53	Nano Materials & Fabrications	2	0	0	2
14	PE	MECX54	Advanced materials	2	0	0	2
15	PE	MECX55	Prototyping Techniques	2	0	0	2
16	PE	MECX56	Industrial Marketing	1	0	0	1
17	PE	MECX57	Entrepreneurial Development	1	0	0	1

18	PE	MECX58	Digital Manufacturing	1	0	0	1
19	PE	MECX59	Additive Manufacturing	1	0	0	1
20	PE	MECX60	Failure Analysis and techniques	1	0	0	1
21	PE	MECX61	Advanced System Simulation (1D Modelling)	1	0	0	1
22	PE	MECX62	Project Management	1	0	0	1
23	PE	MECX63	Internet of Things for Manufacturing	1	0	0	1

Physics Elective Courses

(To be offered in II Semester)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	PHCX 01	Fundamentals of Engineering Materials	2	0	2	3
2.	PHCX 02	Heat and Thermodynamics	2	0	2	3
3.	PHCX 03	Introduction to Nanoscience and Technology	2	0	2	3
4.	PHCX 04	Lasers and their applications	2	0	2	3
5.	PHCX 05	Materials Science	2	0	2	3
6.	PHCX 06	Non-Destructive Testing	2	0	2	3
7.	PHCX 07	Properties of Matter and Acoustics	2	0	2	3
8.	PHCX 08	Properties of Matter and Nondestructive Testing	2	0	2	3
9.	PHCX 09	Semiconductor Physics and Optoelectronics	2	0	2	3

Chemistry Elective Courses

(To be offered in II Semester)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	CHCX01	Analytical Instrumentation	2	0	2	3
2.	CHCX02	Corrosion and its Control	2	0	2	3
3.	CHCX03	Electrical Materials and Batteries	2	0	2	3
4.	CHCX04	Engineering Materials	2	0	2	3
5.	CHCX05	Fuels and Combustion	2	0	2	3
6.	CHCX06	Fundamentals of Physical Chemistry	2	0	2	3
7.	CHCX07	Green Technology	2	0	2	3
8.	CHCX08	Organic Chemistry of Biomolecules	2	0	2	3

9.	CHCX09	Polymer Science and Technology	2	0	2	3

Maths Elective Courses

(To be offered in IV Semester)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	MACX 01	Discrete Mathematics And Graph Theory	3	1	0	4
2.	MACX 02	Probability And Statistics	3	1	0	4
3.	MACX 03	Random Processes	3	1	0	4
4.	MACX 04	Applied Numerical Methods	3	1	0	4

Maths Elective Courses

(To be offered in VI Semester)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	MACX 05	Mathematical Programming	2	0	0	2
2.	MACX 06	Statistical Methods for Data Analysis	2	0	0	2
3.	MACX 07	Numerical Methods for Integral and Differential Equations	2	0	0	2
4.	MACX 08	Mathematical Modelling	2	0	0	2
5.	MACX 09	Graph Theory	2	0	0	2

Humanities Elective I

(To be offered in III Semester)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	SSCX01	Fundamentals of Economics	2	0	0	2
2.	SSCX02	Principles of Sociology	2	0	0	2
3.	SSCX03	Sociology of Indian Society	2	0	0	2

Humanities Elective II

(To be offered in IV Semester)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	SSCX04	Economics of Sustainable Development	2	0	0	2
2.	SSCX05	Industrial Sociology	2	0	0	2
3.	SSCX06	Law for Engineers	2	0	0	2

General Elective

Group I Courses

(To be offered in V semester)

Sl. No.	Course Code	Course Title	Offering Department
1.	GECX101	Disaster Management	Civil
2.	GECX102	Total Quality Management	Mechanical
3.	GECX103	Energy Studies	Mechanical
4.	GECX104	Robotics	Mechanical
5.	GECX105	Transport Management	Automobile
6.	GECX106	Control Systems	EEE
7.	GECX107	Introduction to VLSI Design	ECE
8.	GECX108	Plant Engineering	EIE
9.	GECX109	Network Security	CSE
10.	GECX110	Knowledge management	CSE
11.	GECX111	Cyber security	IT
12.	GECX112	Genetic Engineering	LS
13.	GECX113	Fundamentals of Project Management	CBS
14.	GECX114	Operations Research	Mathematics
15.	GECX115	Nano Technology	Physics / Chemistry
16.	GECX116	Vehicle Maintenance	Automobile
17.	GECX117	Fundamentals of Digital Image Processing	ECE

Group II Courses

(To be offered in VII semester)

Sl. No.	Course Code	Course Title	Offering Department
1.	GECX201	Green Design and Sustainability	Civil
2.	GECX202	Appropriate Technology	Civil / Mechanical
3.	GECX203	Engineering System Modelling and Simulation	Mechanical
4.	GECX204	Value Analysis and Engineering	Mechanical
5.	GECX205	Industrial Safety	Mechanical
6.	GECX206	Advanced Optimization Techniques	Mechanical
7.	GECX207	Mat Lab Simulation	EEE
8.	GECX208	Embedded SystemsHand its Applications	ECE
9.	GECX209	Usability Engineering	CSE
10.	GECX210	Supply Chain Management	CBS
11.	GECX211	System Analysis and Design	CA
12.	GECX212	Advanced Materials	Physics & Chemistry
13.	GECX213	National Service Scheme	School of Humanities
14.	GECX214	Automotive Pollution and Control	Automobile
15.	GECX215	Motor Vehicle Act, Insurance and Policy	Automobile
16.	GECX216	Principles of Communication Systems	ECE
17.	GECX217	Lean Management	Civil
18.	GECX218	Spatial Data Modeling & Analysis	Civil

SEMESTER I

MAC 1181	DIFFERENTIAL CALCULUS AND GEOMETRY	L	T	P	C
		3	1	0	4

OBJECTIVES:

The aims of this course are to

- Introduce eigen values and eigenvectors of matrix algebra
- Make the student knowledgeable in the area of Three Dimensional Analytical Geometry
- Demonstrate the application of Differential Calculus
- Familiarize the student with the functions of several variables
- Develop the use of ODE solvable techniques necessary for engineering applications
- Motivate the students with some basic engineering application problems in ODE

MODULE I MATRICES 8+2

Characteristic Equation- Eigenvalues and Eigenvectors of a real matrix – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton Theorem (without proof) – Orthogonal matrices – orthogonal transformations of a symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by orthogonal transformation.

MODULE II THREE DIMENSIONAL ANALYTICAL GEOMETRY 7+3

Direction cosines and ratios – angle between two lines – equations of a plane – equations of a straight line, coplanar lines - shortest distance between skew lines - sphere – tangent plane – plane section of a sphere – orthogonal spheres.

MODULE III DIFFERENTIAL GEOMETRY 7+3

Curvature – Cartesian and polar coordinates – centre and radius of curvature – circle of curvature – involutes and evolutes – envelopes.

MODULE IV DIFFERENTIAL CALCULUS OF SEVERAL VARIABLES 8+2

Functions of two variables – partial derivatives – total differential – Implicit Functions – Jacobian - Taylor's series expansion – Optima of two variables – Lagrange's multiplier method.

MODULE V ORDINARY DIFFERENTIAL EQUATIONS 8+2

Linear equations of second order with constant and variable coefficients – Simultaneous first order linear equations with constant coefficients – homogeneous equations of Euler's type – method of undetermined coefficients, method of variation of parameters

MODULE VI APPLICATIONS OF ORDINARY DIFFERENTIAL EQUATIONS 7+3

Solution of Ordinary Differential Equation Related to Electric Circuits – Bending of Beams- Motion of a Particle in a resisting medium – Simple harmonic motion.

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1. Ramana, B.V, "Higher Engineering Mathematics" Tata McGraw Hill Publishing Co. New Delhi, 2006.
2. Grewal B.S., "Higher Engineering Mathematics" (43rd edition), Khanna Publishers, New Delhi, 2012.
3. John W. Cell "Engineering Problems Illustrating Mathematics" Mc Graw Hill Publishing Co., New York 1943.

REFERENCES:

1. Veerarajan.T., "Engineering Mathematics" (5th edition) Tata Mc Graw Hill Publishing Co. New Delhi, 2012
2. Kreyszig, E., "Advanced Engineering Mathematics", 10th edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2001.
3. Peter V. O'Neil, "Advanced Engineering Mathematics", 7th edition, Cengage Learning, 2011.
4. Dennis G. Zill, Warren S. Wright, "Advanced Engineering Mathematics", 4th edition, Jones and Bartlett publishers, Sudbury, 2011.
5. Alan Jeffrey, "Advanced Engineering Mathematics", Academic Press, USA, 2002.
6. Venkataraman, M.K., "Engineering Mathematics", Volume I, 2nd edition, National Publishing Co., Chennai, 2003.
7. James Stewart ".Calculus" (7th edition),Brooks/Cole cengage learning, UK

OUTCOMES:

After completing the course, student will be able to

- Understand the matrix techniques and compute eigen values and eigenvectors of a given matrix.
- Do the problems based on three dimensional analytic geometry.
- Apply differential calculus in engineering problems.
- Differentiate more than one variable and their applications.
- Solve the differential equations with constant coefficient and variable coefficient.
- Form and solve differential equations.

ENC 1181	ENGLISH	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To train students to use appropriate vocabulary in academic and technical contexts.
- To facilitate students to speak effectively while exchanging ideas and making presentations.
- To develop students' listening skill for comprehending and analyzing information.
- To develop their reading skill through sub skills like skimming, scanning and critical reading of a text.
- To sharpen their academic writing skills.
- To expose them to the correct usage of language and help them to apply that knowledge appropriately.

MODULE I **8**

L: Listening for general information

S : Self Introduction, Introducing one another.

R: Predicting the content

W: Paragraph Writing

Language Focus: Affixes, Simple Present tense, Connective & Prepositions.

MODULE II **8**

L: Listening for specific information (from dialogues)

S:Exchanging opinion.

R: Skimming technical Passages

W: Argumentative Writing (using the concept of Flipped Learning), Letter to the Editor.

Language Focus: Idioms, use of Modals, Simple Past tense &use of "Wh" and question tags.

MODULE III **7**

L: Learning the ways of describing images and presenting specific information (focusing on note making)

S: Making Presentations using visuals.

R : Scanning short texts for gist of information

W: Letter of Invitation, Expository Writing

Language Focus: Homophones, Homographs, Simple Future & Collocations.

MODULE IV **7**

L: Understanding prepared presentation techniques through videos

S: Short Presentations.

R: Reading for coherence and cohesion

W: Letter seeking permission for Industrial Visit

Language Focus: S-V agreement, Euphemism

MODULE V **8**

L : Understanding Non- Verbal Communications while listening to narration of incidents.

S: Narrating an expereince

R: Inferential Reading

W: Process Description – Transcoding a Flow chart.

Language Focus: Interchange of Active & passive voice, Impersonal Passive voice.

MODULE VI **7**

L: Learning Story telling techniques (stories & visuals) through audio files

S: Discussion in groups

R: Reading for critical appreciation

W: Developing an idea, Slogan writing, Interpreting a Bar Chart.

Language Focus: If clause and phrasal verbs.

Total Hours:45

REFERENCES:

1. Carol Rosenblun perry (2011). The Fine Art of Technical Writing. Create Space Independent Publishing Platform, New Delhi.
2. Dutt, P.K. Rajeevan. G and Prakash, C.L.N. (2007) A course in Communication Skills. Cambridge Univesity Press, India.
3. Kala, Abdul & Arun Tiwari (2004). Wings of Fire: An Autobiography (Simplified and A bridged by Mukul Chowdhri). Hyderabad Univeristy Press.
4. Sen, Leena. (2004) Communication Skills. Prentice Hall, New Delhi.
5. Matt Firth, Chris Sowton et.al. (2012). Academic English: An Integrated Skills Course for EAP. Cambridge University Press, Cambridge.

OUTCOMES:

After completion of the course, students will have the ability to

- Demonstrate their range of vocabulary in academic and technical contexts
- Exchange ideas and make presentations
- Comprehend and respond appropriately to listening tasks.
- Read a text efficiently and process information.
- Create and draft different kinds of academic documents
- Communicate effectively using grammatically correct expressions.

ISC1181	ARABIC	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To read and write in Arabic language.
- To learn vocabulary of different fields
- To develop situational communication skills.

MODULE I PREPARATORY ARABIC **7**

Introducing Arabic Alphabets.

Listening and Reading.

Audio & Video aided listening, Tajweed listening,

Writing Arabic Alphabets (connected & unconnected).

Introducing words.

Reading simple sentences.

Learning names of the things in and around the class room.

Exercises.

MODULE II FUNCTIONAL ARABIC **7**

Listening Arabic texts, stories and action verbs

Communicating Simple sentences.

Jumla' Ismiyya and Jumla' Fi'liyya

Situational Conversation:

Greetings, Introduction.

Classroom, College, Picnic.

Dining and Kitchen.

Reading skills.

Exercises

MODULE III FUNCTIONAL ARABIC **8**

Implication of effective listening.

Audio aids.

Writing Simple sentences.

Communicating ordinal and cardinal numbers.

Situational communication:

Playground, library.

Forms of plural – Sample sentences.

Introduction to tenses.

Exercises.

MODULE IV FUNCTIONAL ARABIC 8

Communication:

Family, travel

Market, Prayer hall

Writing skills:

Note making.

Sequencing of sentences.

Developing answers from the questions.

Exercises.

MODULE V TECHNICAL ARABIC 8

Importance of technical communication.

Reading and writing skills.

Audio & Video aided listening.

Introduction to Arabic terms related to administration.

Situation communication:

Air travel, Office administration, passport, visa.

Exercises

MODULE VI TECHNICAL ARABIC 7

Situation communication:

Contractual work, machineries and equipment.

Computer, internet browsing.

Banking,

Exercises.

Total Hours:45

TEXT BOOKS:

1. Arabic for professionals and employees, Kilakarai Bukhari Aalim Arabic College, Chennai, India, 2013.

REFERENCES:

1. Arabic Reader for Non Arabs (Ummul Qura University, Makkah), Kilakarai Bukhari Aalim Arabic College, 2005.

OUTCOMES:

On successful completion of the course, the student will be able to:

- Write correct sentences in Arabic.
- Communicate in Arabic at primary level in working situations in the fields of engineering and administration.

LNC1181	MANDARIN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To improve the proficiency of students in Mandarin language.
- To develop their knowledge of vocabulary.
- To train them in using appropriate grammatical forms during communications.
- To empower them for successful communication in social and academic contexts.
- To make them appreciate the language usage in real life situations.

MODULE I **8**

General Introduction to Chinese • Pinyin and Tones • Introduction to the Writing System: basic strokes and stroke order Numbers 1-100, song Days of the Week Months of the Year

MODULE II **8**

Chinese names and related culture Chinese family structures and values Greetings Introducing Yourself Family members Occupations

MODULE III **7**

Languages and Nationalities Daily Routine Chinese breakfast Negative Sentences and Interrogative Sentences Asking for Personal Information The Verb *shi* and Basic Sentence Structures

MODULE IV **7**

Answering an Affirmative-negative Question · Food and drinks Transportation Likes and dislikes Adverbs *bu*, *jiu* and *dou* Verb-absent Sentences

MODULE V **8**

Jisui and *duoda* Questions S+V+O Construction Routines and Daily Activities·*Haishi* Questions Modal Verbs Hobbies and Habits

MODULE VI **7**

Making Suggestions with *haoma* Colors Clothing Body parts Talking about Likes and Dislikes Measurement Words in Chinese

Total Hours:45

TEXT BOOKS:

1. Ma, Yanmin, and Li, Xinying. Easy Steps to Chinese, Vol. 1 Textbook. Beijing: Beijing Language and Culture University Press, 2006. Print.
2. Ma, Yanmin, and Li, Xinying. *Easy Steps to Chinese, Vol. 1 Workbook*. Beijing: Beijing Language and Culture University Press, 2006. Print.

OUTCOMES:

On completion of the course, students will be able to

- Exhibit proficiency in Chinese Language.
- Use vocabulary in appropriate contexts.
- Use appropriate grammatical forms effectively.
- Use the language in social and academic contexts.
- Appreciate the use of language forms.

LNC1182	GERMAN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To improve the proficiency of students in German language.
- To create awareness of using vocabulary among students.
- To expose them to correct grammatical forms of the language.
- To empower them for successful communication in social and academic contexts.

MODULE I **8**

Introduction to German alphabets, phonetics and pronunciation- Introducing themselves and others using simple sentences and answer to some basic personal questions-: Introduction to different types of articles and verbs, Nouns

MODULE II **8**

Understanding and responding to everyday queries like instruction, questions, - number & gender, pronouns, present and past tense.

MODULE III **7**

Short telephone messages, requests etc., if spoken slowly and clearly-- Detailed overview of articles, adjectives with/without articles, Prepositions

MODULE IV **7**

Ask and giving directions using simple prepositions- Ability to fill basic information on forms while registering for courses / classes.

MODULE V **8**

Ability to extract and understand relevant information in a public announcement, broadcast, newspaper, radio etc-- dative & accusative

MODULE VI **7**

Ability to describe about people, work, immediate environment, education and other topics related to personal needs in a concise manner- Understanding of matters that are familiar and are encountered regularly like instances at school, work, at public places, places of leisure etc.

Total Hours:45

TEXT BOOKS:

1. Course book :Tangram aktuell 1 – Lektion 1–4 (Kursbuch + Arbeitsbuch mit Audio-CD zum Arbeitsbuch), Rosa-Maria Dallapiazza, Eduard von Jan, Til Schönherr, Hueber Publisher, ISBN 978-3-19-001801-7
2. Practice book: Tangram aktuell 1 – Lektion 1–4 (Kursbuch + Arbeitsbuch mit Audio-CD zum Arbeitsbuch), Rosa-Maria Dallapiazza, Eduard von Jan, Til Schönherr, Hueber Publisher, ISBN 978-3-19-001801-7.

REFERENCES:

1. NETZWERK A1 TEXTBOOK, Deutsch als Fremdsprache, Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, Langenscheidt and Klett, ISBN : 9788183076968
2. STUDIO D A1 (SET OF 3 BOOKS + CD), Hermann Funk. Cornelsen, ISBN: 9788183073509
3. Willkommen! Beginner's course. Paul Coggle, Heiner Schenke. 2nd edition. (chapter 1 - 6) ISBN: 9781444165159 –
4. Willkommen! Beginner's course. Paul Coggle, Heiner Schenke. ISBN: 978-1-444-16518-0
5. An Introduction to the German Language and Culture for Communication, Updated Edition Lovik, Thomas A., J. Douglas Guy & Monika Chavez. Vorsprung -. New York, Houghton Mifflin Company, 1997/2002. ISBN 0-618-14249-5.

OUTCOMES:

On completion of the course, students will be able to

- Show their proficiency in German Language.
- Use appropriate vocabulary in real life contexts.
- Use appropriate grammatical forms while communicating with people.
- Effectively use the language in social and academic contexts.

LNC1183	JAPANESE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To train students to use appropriate vocabulary in academic and technical contexts.
- To facilitate students to speak effectively while exchanging ideas and making presentations.
- To develop their reading skill through sub skills like skimming, scanning and critical reading of a text.
- To sharpen their academic writing skills.
- To expose them to the correct usage of language and help them to apply that knowledge appropriately.

MODULE I **7**

Introduction of the Japanese writing system, i.e. *Hiragana*, *Katakana* and *Kanji*, word-building, writing foreign names and loan words in Katakana.

MODULE II **8**

Oral practice of pronunciation and intonation of Japanese sounds, Japanese greetings, self introduction, identifying things, time of the day, calendar; counting using Japanese numerical classifiers; describing things;

MODULE III **7**

Making comparisons; talking of daily activities, kinship terms used for address and reference, seasons, giving and receiving, shopping; making requests, talking of one's likes and dislikes.

MODULE IV **8**

Extensive practice of basic patterns at the lower intermediate level through drills and exercises.

MODULE V **7**

Comprehension of passages in simple Japanese and writing of composition in Japanese applying lower intermediate grammatical patterns.

MODULE VI **8**

Diverse texts based on Japanese culture, customs, history, food habits, and science etc, for the development of communicative competence of students; skimming, scanning of texts with emphasis on advanced sentence patterns,

grammatical structures and idiomatic phrases, reading and writing of approximately

Total Hours:45

REFERENCES:

1. Nihongo I, Kokusaigakuyukai, and other supplementary material
2. Exersice book 1of Nihongo 1, and other supplementary material
3. Nippon, the Land and its People & Encyclopedia of Contemporary Japanese
4. Japani: Japanese Conversation for Improving Spoken Proficiency, By P.A. George, Inoue Yoriko and Itsuko Nandi, Books Plus.
5. Chukyu Nihongo, Tokyo Gaikokugo Daigaku; Nihongo II, Kokusaigakuyukai, and other supplementary material.

OUTCOMES:

After completion of the course, students will have the ability to

- Demonstrate their range of vocabulary in academic and technical contexts
- Exchange ideas and make presentations
- Comprehend and respond appropriately to listening tasks.
- Read a text efficiently and process information.
- Create and draft different kinds of academic documents
- Communicate effectively using grammatically correct expressions.

PHC 1181	PHYSICS	L	T	P	C
		3	0	2	4

OBJECTIVES:

To make students conversant with the

- basic concepts of crystal physics and its structures
- production and applications of ultrasonic waves
- study of thermal conductivities of good and bad conductors
- phenomenon of wave optics and its applications
- principle of fibre optic communication and its applications to sensors
- wave mechanics principle and its applications in electron microscopy
- green energy physics and its environmental impacts to society

MODULE I CRYSTAL PHYSICS 8

Crystalline and amorphous solids – Unit Cell – Seven Crystal Systems – Bravais Lattice – Miller Indices – Interplanar Spacing – Characteristics of Unit Cell - Calculation of Number of atoms per unit cell, Atomic Radius, Coordination Number and Packing Factor for SC, BCC, FCC and HCP and Diamond structures –Defects in crystals-Point defects –Edge and screw dislocations and their significance - Surface Defects.

MODULE II ULTRASONICS AND THERMAL PHYSICS 8

Introduction to Ultrasonics - Properties - Production methods - Magnetostriction Oscillator method- Piezoelectric Oscillator method – Detection of Ultrasonics – Thermal method – Piezoelectric method – Kundt's tube method – Applications of Ultrasonics – Acoustic Grating – SONAR – Depth of sea – Velocity of blood flow, Ultrasonic Flaw detector (qualitative).

Transmission of heat – Conduction, Convection and Radiation – Thermal Conductivity of good Conductor – Forbe's method- Thermal Conductivity of bad Conductor – Lee's Disc method.

MODULE III APPLIED OPTICS 8

Interference – Air Wedge – Michelson's Interferometer – Determination of wavelength of light and thickness of thin transparent sheet.

Introduction to Laser – Characteristics of Laser – Spontaneous and Stimulated Emissions – Einstein's Coefficients - Population inversion – Pumping Mechanism – Laser Action – Types of Laser: He-Ne laser, CO2 laser and Nd: YAG laser - Applications : Laser Materials Processing .

MODULE IV FIBRE OPTICS 7

Optical fibre – Principle and propagation of light in optical fibre – Numerical aperture and acceptance angle – Types of optical fibres – Attenuation – Absorption, Scattering losses, Bending losses and Dispersion in Optical fibres – Fiber Connectors and Couplers - Applications – Fibre optic communication system (block diagram only)- Fibre optic sensors - displacement and pressure sensors (qualitative) - Medical endoscope.

MODULE V QUANTUM MECHANICS 7

Black body radiation – Planck's theory of radiation – Deduction of Wien's displacement law and Rayleigh – Jean's law from Planck's theory –Dual nature of matter – de Broglie's wavelength- Physical significance of wave function – Schrodinger wave equation – Time independent and time dependent wave equation – Particle in one dimensional box – Harmonic oscillator(qualitative).

MODULE VI RENEWABLE ENERGY SOURCES 7

Present Energy sources and sustainability - Solar energy - Solar photovoltaics - Solar cells – Bioenergy - Biomass – production of liquid fuels from biomass – Wind energy – Wind turbines – energy and power from wind turbines - Geothermal energy - Ocean energy: Wave energy – Wave energy conversion devices – Tidal energy – Tidal power basics – power generation –Tidal energy potential – Environmental benefits and impacts of renewable energy sources

PRACTICALS **Total Hours** :45

1. Determination of Velocity of Ultrasonic waves in a given liquid using Ultrasonic Interferometer.
2. Determination of wavelength of ultrasonic waves using Kundt's tube method.
3. Determination of thickness of a thin wire using Air Wedge method.
4. Determination of wavelength of light using spectrometer diffraction grating.
5. Determination of angle of divergence of a laser beam using He-Ne laser.
6. Determination of particle size of lycopodium powder using semiconductor laser.
7. Determination of wavelength of laser light using semiconductor laser diffraction.

8. Determination of Acceptance angle and Numerical Aperture using fiber optic cable.
9. Determination of thermal conductivity of a good conductor by Forbe's method.
10. Determination of thermal conductivity of a bad conductor by Lee's disc method.
11. Determination of solar cell characteristics.

L – 45; P – 15; Total Hours : 60

REFERENCES :

1. Gaur R.K. and Gupta S.L., "Engineering Physics'', 8th edition, Dhanpat Rai Publications (P) Ltd., New Delhi, 2013.
2. Palanisamy P.K., Physics for Engineers, Vol1 & Vol2, 2nd Edition, Scitech Publications, 2003.
3. Serway R.A. and Jewett, J.W. "Physics for Scientists and Engineers with Modern Physics". Brooks/cole Publishing Co., 2010.
4. Tipler P.A. and Mosca, G.P., "Physics for Scientists and Engineers with Modern Physics", W.H. Freeman, 2007.
5. Markert J.T., Ohanian. H. and Ohanian, M. "Physics for Engineers and Scientists". W.W. Norton & Co. 2007.
6. Godfrey Boyle, "Renewable Energy: Power for sustainable future", 2nd edition, Oxford University Press, UK, 2009.

OUTCOMES:

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

- Understand the different types of crystal structures
- Apply the concept of ultrasonic principle in engineering and medical field
- Calculate thermal conductivities of good and bad conductors
- Differentiate the various laser systems and its applications in engineering and medical field
- Apply the principle of fibre optics for communication and sensor applications
- Formulate wave mechanics principle for applications in electron microscopy
- Correlate the different renewable energy sources for societal needs.

- To complement the knowledge acquired in the theory class.
- To correlate the experimental results for application.

CHC1181	CHEMISTRY	L	T	P	C
		3	0	2	4

OBJECTIVES:

The students should be conversant with

- The basic problems like hardness, alkalinity, dissolved oxygen associated with the water used for domestic and industrial purpose and treatment process involved.
- The synthesis, properties and applications of nanomaterials.
- The importance of renewable energy sources like solar, wind, biogas, biomass, geothermal, ocean and their limitations.
- The basic analytical techniques like uv-visible, ft-ir, nmr, aas, aes, circular dichroism and xrd etc.
- Photochemistry concepts related to physical processes and chemical reactions induced by photon absorption and their applications.
- Basic principles of electrochemistry, cell construction and evaluation and to understand general methodologies for construction & design of electrochemical cell

MODULE I WATER TECHNOLOGY 9

Impurities present in water, hardness : types of hardness, demerits of hard water in boilers, estimation of hardness by EDTA method (problems) – alkalinity : estimation of alkalinity (problems) – dissolved oxygen: estimation of dissolved oxygen – conditioning methods : external treatment method: – lime soda and zeolite process (principle only), Ion exchange process – Internal treatment : colloidal, carbonate, phosphate and calgon methods – drinking water: standards (BIS), treatment of domestic water {screening, sedimentation, coagulation, filtration, disinfection }– desalination: electrodialysis, reverse osmosis.

MODULE II NANOCHEMISTRY 6

Introduction – distinction between molecules, bulk materials and nanoparticles – classification based on dimension with examples – synthesis (top-down and bottom-up approach): sol-gel, thermolysis (hydrothermal and solvothermal), electrodeposition, chemical vapour deposition, laser ablation – properties and applications (electronic, magnetic and catalytic) – risk factors and future perspectives.

MODULE III ENERGY SOURCES 8

Energy: past, today, and future – a brief history of energy consumption – present energy scenario of conventional and renewable energy sources – renewable energy : needs of renewable energy, advantages and limitations of renewable energy – solar energy: basics, solar energy in the past , photovoltaic, advantages and disadvantages – bioenergy: conversion, bio degradation, biogas generation, biomass gasifier, factors affecting biogas generation, advantages and disadvantages – geothermal energy: geothermal resources (hot dry rock and magma resources, natural and artificial), advantages and disadvantages – wind energy: wind resources, wind turbines, advantages and disadvantages – ocean energy: wave energy, wave energy conversion devices, ocean thermal energy, advantages and disadvantages.

MODULE IV PHOTOCHEMISTRY 7

Introduction: absorption and emission, chromophores, auxochromes – laws of photochemistry: Grotthus-Draper law, Stark Einstein law – quantum yield (problems) –photo physical processes: fluorescence and phosphorescence - Jablonski diagram (electronic states and transitions) – quenching, annihilation – photosensitization: principle and applications – chemiluminescence, bioluminescence.

MODULE V ANALYTICAL TECHNIQUES 7

Spectroscopy: electromagnetic radiation and spectrum – types of transitions – types of spectra (atomic and molecular with their chemical usefulness) – Beer-Lamberts law (problems) – principles, instrumentation and applications of: Colourimetry – UV-Vis spectrophotometer – atomic absorption spectroscopy – atomic emission spectroscopy – principles and applications of: IR, NMR, mass and X-ray diffraction analysis.

MODULE VI ELECTROCHEMISTRY 8

Electrochemistry - types of electrodes (principle and working) : gas (SHE), metal/metal ion electrode, metal-metal insoluble salt (calomel electrode), ion-selective (glass electrode and fluoride ion selective electrode) – Electrolytic and galvanic cells, construction of cell, EMF measurement and applications (problems), standard cell (Weston-cadmium), reversible and irreversible cell, concentration cell. Determination of fluoride ion using fluoride ion selective

electrode – Chemically modified electrodes (CMEs): concept, approaches and applications.

PRACTICALS

1. Estimation of hardness in given water sample.
2. Estimation of the alkalinity of the given water sample.
3. Estimation of strong acid by conductometry.
4. Estimation of Fe^{2+} present in the given sample by potentiometry.
5. Verification of Beer-Lamberts law and estimation of Cu^{2+} present in unknown sample.
6. Estimation of sodium and potassium present in the given sample by flame photometry.
7. Determination of molecular weight and degree of polymerisation of a polymer by viscosity method.
8. Synthesis of thermosetting polymer.

L – 45; P – 15; Total Hours : 60

REFERENCES:

1. S. Vairam, P. Kalyani and Suba Ramesh, “Engineering Chemistry”, Wiley India Ltd., New Delhi, 2011.
2. G.A. Ozin and A.C. Arsenault, “Nanochemistry: A Chemical Approach to Nanomaterials”, RSC Publishing, Thomas Graham House, Cambridge, 2005.
3. P.C Jain & Monica Jain, Engineering Chemistry Dhanpatrai Publishing Company (P) Ltd., New Delhi (2013).
4. S S Umare & S S Dara, A text Book of Engineering Chemistry, S. Chand& Company Ltd, New Delhi, 2014.
5. G.D.Rai, “Non conventional energy sources,” Khanna Publishers, New Delhi, 2011.
6. John Twidell and Tony Weir, “Renewable Energy Resources, Taylor & Francis Ltd, London, United Kingdom, 2005
7. Principles of molecular photochemistry: An introduction, Nicholas J. Turro, V.Ramamurthy and Juan C. Scaiano, University Science Books, Sausalito, CA, 2009.

OUTCOMES:

The students will be able to

- Solve problems related to hardness, alkalinity, dissolved oxygen associated with the water and describe the treatment processes.
- Classify nanomaterials and apply the nanochemistry approach to synthesize the nanomaterials.
- Explain the principle and enumerate the advantages and disadvantages of various renewable energy sources.
- State the principle and illustrate the instrumentation of various analytical techniques.
- Apply the concepts of photochemistry to elaborate various photo-physical and photochemical reactions.
- Construct a electrochemical cell and describe the various types of electrodes and determine the fluoride content.

GEC 1101	ENGINEERING GRAPHICS	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To introduce the students of all engineering programs, the basic concepts of engineering drawing, which is the basic communication medium for all engineers
- To provide practical exposure on important aspects like drawing analytic curves, orthographic projections, section of solids, development of surfaces, isometric projection, perspective projection and free hand drawing.
- To introduce computerized drafting.

MODULE I BASICS AND ENGINEERING CURVES 10

Drawing instruments, dimensioning, BIS conventions, types of lines, simple geometric constructions.

Conic sections: ellipse, parabola, hyperbola.

Special curves: cycloid, epicycloid, hypocycloid and involutes.

MODULE II ORTHOGRAPHIC PROJECTION 8

Orthographic projection – first angle, second angle, third angle and fourth angle projections –setup - assumptions, principle. Free hand sketching of orthographic views of simple machine parts as per first angle projection. Orthographic projection of points in all quadrants. Some commands and demonstration of drafting packages.

MODULE III PROJECTION OF STRAIGHT LINES AND PLANES 10

Projection of straight lines in first quadrant – true length and true inclinations – Rotating line and trapezoidal methods –traces of straight line.

Projection of plane lamina in first quadrant and its traces

MODULE IV PROJECTION OF SOLIDS 10

Projection of solids in first quadrant: Axis inclined to one reference plane only-prism, pyramid, cone, cylinder – change of position and auxiliary projection methods.

MODULE V SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES 12

Section of solids: prism, pyramid, cone, cylinder, and sphere – sectional view – true shape of section Solids in simple position and cutting plane inclined to one reference plane only.

Development of surface of truncated solids: prism, pyramid, cone cylinder – frustum of cone, pyramid and simple sheet metal parts.

MODULE VI PICTORIAL PROJECTIONS 10

Isometric projection: Isometric scale – isometric axes- iso sheet - Isometric projection and view of prism, pyramid, cylinder, cone, frustums, truncated solids and simple products

Perspective projection: station point – vanishing point – Perspective projection and views of prism, pyramid, cylinder and frustums by Visual ray method.

L – 30; P – 30; Total Hours :60

TEXT BOOKS:

1. N.D. Bhatt, 'Engineering Drawing' Charotar Publishing house, 53rd Edtion, (2014)

REFERENCES:

1. K.V. Natarajan, 'A text book of Engineering Graphics', Dhanalakshmi publishers, Chennai. (2009)
2. Venugopal. K, and V. Prabhu Raja, Engineering Graphics, New Age International (P) Ltd., Publication, Chennai. (2011)

OUTCOMES:

- Students should be able to read the specifications and standards of technical drawing and able to draw conic sections and special curves.
- Students should be able to understand the insight of orthographic projection and to draw the various views of orthographic projection of a point and various components.
- Students should be able to draw the orthographic views of straight lines and plane figures.
- Students should be able to draw the orthographic views of simple solids.
- Students should be able to draw the sections of solids and development of solid surfaces.

- Students should be able to draw the isometric and perspective projection of simple solids and components.

GEC 1102	ENGINEERING DESIGN	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To understand the role of design in Engineering
- To understand the basic design concepts
- To understand the role of innovation in design

MODULE I DESIGN AS A CENTRAL ACTIVITY IN ENGINEERING 08

Product design – products and processes – product design methodology Design of systems; Software design

MODULE II NEED ANALYSIS AND CONCEPT DEVELOPMENT 07

Voice of customers – product specification - need analysis Bench marking Product architecture – concept generation and evaluation;

MODULE III CASE STUDIES IN ENGINEERING DESIGN 08

Product design – process design; system design; software design -Ergonomics – usability

MODULE IV INNOVATION AND DESIGN 07

Role of innovation in Engineering – incremental changes and systemic changes; scientific approach to driving innovation – case studies.

Total Hours : 30

REFERENCES:

1. Clive L. Dym and David C. Brown, “Engineering Design: Representation and Reasoning”, 2nd Edition, Cambridge University Press, New Delhi, 2011.
2. Daniel G. Dorner, G. E. Gorman and Philip J. Calvert, “Information Needs Analysis: Principles and practice in information organizations”, Published by Faced Publishing, London. 2015.
3. Cliff Matthews, “Case Studies in Engineering Design”, John Wiley & Sons Pvt. Ltd, New York, 1998.
4. Bengt-Arne Vedin, “The Design-Inspired Innovation Workbook”, World Scientific, 2011.

5. Navi Radjou, Jaideep Prabhu and Simone Ahuja, “Jugaad Innovation”, Published by Random House India, 2012.

OUTCOMES:

The students will be able to

- Apply the basic knowledge of design in engineering products / process / service.
- Analyse the problems and give innovative solutions.
- Correlate the basic knowledge of design in the real world problems.
- Apply innovative approaches to engineering design.

GEC1103	BASIC ENGINEERING PRACTICES LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To provide a practical exposure to basic engineering practices like carpentry, fitting, plumbing, welding and making of simple electrical and electronic circuits
- To have an understanding on the use of various tools, instruments and methods
- To enable the students to appreciate the practical difficulties and safety issues

CIVIL ENGINEERING PRACTICE

1. Study of plumbing in general household and industrial systems
2. Making a small window frame with Lap and Mortise & Tenon Joints
3. Introduction to power tools

MECHANICAL ENGINEERING PRACTICE

1. Fabrication of a small Table frame with Butt, Lap and Fillet Joints
2. Machining of a simple component like a table weight using lathe
3. Mold preparation for simple component

ELECTRICAL ENGINEERING PRACTICE

1. Comparison of incandescent, Fluorescent, CFL and LED lamps.
2. Study of Protection Circuits (small relay, fuse, MCB, HRC, MCCB, ECCB).
3. Familiarization of households Electrical Gadgets (Iron Box, Wet Grinder).
4. Understanding of Domestic and Industrial wiring.
5. Earthing and its significance.
6. Troubleshooting in Electrical Circuits.
7. Study of inverter fed UPS/Emergency lamp

ELECTRONICS ENGINEERING PRACTICE

1. Identifications symbolic representation of active and passive electronic components
2. Soldering and tracing of electronic circuits and checking its continuity
3. Assembling of A.C. to D.C, D.C to A.C. Circuits in bread Board and Mini project.

Total Hours : 30

OUTCOMES:

Upon the completion of the course, students should be able to

- Appreciate the practical skills needed even in making of simple objects, assemblies and circuits
- Attend minor defects especially in items used in day to day life
- Aware of the safety aspects involved in using tools and instruments

GEC 1104	COMPUTER PROGRAMMING I	L	T	P	C
		1	0	2	2

OBJECTIVES:

- To identify the hardware and software components of the computer.
- To know the basic concept of operating system and get knowledge about different operating systems.
- To learn various database concepts and operations
- To develop efficient algorithms for solving a problem.
- To implement the algorithms in C language.
- To use arrays in solving problems.

MODULE I COMPUTER FUNDAMENTALS 7

Introduction -. Number System - Planning the computer program - Computer Software - Basic operating system concepts - Database Operations

MODULE II PROGRAMMING IN C 8

Introduction to C Programming Language – Operators - Control statements - Iterative statements - Arrays.

LIST OF EXPERIMENTS:

1. Computer organization –Hardware in a typical computer Identification – Booting- error messages and what it means
2. Types of Operating systems – Windows and Linux
3. Structure of a basic program - Hello world program – Debugging it
4. Data types: Type conversions
5. Input / Output: Formatted functions – Unformatted functions – Library functions
6. Properties of operators – Priority of operators – Arithmetic relational logical and bitwise operators
7. If – if else- nested if else- goto- switch case – nested switch case – for loops– nested for loops – while loop – do-while loop – break and continue statement
8. Arrays – Operation with arrays
9. Sorting and searching.

L – 15; P – 15; Total Hours :30

REFERENCES:

1. Ashok N Kamthane, “Computer Programming”, Pearson Education, 2nd Edition, ISBN 13: 9788131704370, 2012
2. Paul J. Deitel, Deitel & Associates, “C How to Program”, Pearson Education, 7th Edition, ISBN-13: 978-0132990448, 2012

OUTCOMES:

Students who complete this course will be able to

- Recognize Modular design, logic flow, data abstraction
- Analyze the working of the programming constructs, functions, and I/O.
- Write down programs for sorting and searching algorithms
- Write down programs developing cycle for different applications
- Debug the programs and solve some practical problems in programming
- Develop programs using arrays.

SEMESTER II

MAC 1281	ADVANCED CALCULUS	L	T	P	C
		3	1	0	4

OBJECTIVES:

The aims of this course are to

- Train the students in solving problems using multiple integration.
- Provide knowledge in using special functions to find out the area and volume of a region.
- Acquire knowledge in tangent and normal vectors.
- Gain knowledge in finding the areas of a curve and surface using vector integration.
- Learn about the analytic functions and their properties along with bilinear transformation.
- Know complex integration using Cauchy's theorems.

MODULE I MULTIPLE INTEGRATION AND ITS APPLICATIONS 8+2

Multiple integrals– Cartesian and Polar coordinates – change of order of integration – Multiple integral to compute area and volume.

MODULE II TRANSFORMATION OF COORDINATES AND SPECIAL FUNCTIONS 7+3

Change of variables between Cartesian, polar, cylindrical and spherical coordinates - Beta and Gamma functions – Properties and applications.

MODULE III VECTOR DIFFERENTIATION 7+3

Operations on vectors – Scalar Product, Vector Product, Projection of Vectors - Angle between two vectors - Gradient, divergence and curl

MODULE IV VECTOR INTEGRATION 8+2

Line, surface and volume integrals – Green's Theorem, Gauss Divergence Theorem and Stokes Theorem (statement only) – verification and evaluation of integrals.

MODULE V ANALYTIC FUNCTION 8+2

Analytic function - Necessary and Sufficient condition (statement only) – Cauchy-Riemann equations in polar coordinates - properties of analytic

function – determination of analytic function – conformal mapping (w = z+a,az and 1/z) and bilinear transformation.

MODULE VI COMPLEX INTEGRATION 7+3

Statement and application of Cauchy's integral theorem – Cauchy's integral formula – Taylor's series and Laurent's series expansion – singularities - classification – residues - Cauchy's residue theorem – contour integration – Unit circle and semi circular contours (excluding poles on the real axis).

L – 45; T – 15; TOTAL HOURS – 60

TEXT BOOKS:

1. Veerarajan.T., "Engineering Mathematics "(5th edition) Tata Mc Graw Hill Publishing Co. New Delhi, 2012
2. Grewal B.S., "Higher Engineering Mathematics" (43rd edition), Khanna Publishers, New Delhi, 2012.
3. John W. Cell "Engineering Problems Illustrating Mathematics" Mc Graw Hill Publishing Co., New York 1943

REFERENCES:

1. Kreyszig, E., "Advanced Engineering Mathematics", 10th edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2001.
2. Peter V. O'Neil, "Advanced Engineering Mathematics", 7th edition, Cengage Learning, 2011.
3. Dennis G. Zill, Warren S. Wright, "Advanced Engineering Mathematics", 4th edition, Jones and Bartlett publishers, Sudbury, 2011.
4. Alan Jeffrey, "Advanced Engineering Mathematics", Academic Press, USA, 2002.
5. Ramana, B.V., "Higher Engineering Mathematics" Tata Mc Graw Hill Publishing Co. New Delhi, 2006.
6. Venkataraman, M.K., "Engineering Mathematics", Volume 2, 2nd edition, National Publishing Co., Chennai, 2003.
7. James Stewart ".Calculus" (7th edition), Brooks/Cole cengage learning, UK.

OUTCOMES:

After completing the course, student will be able to

- Compute the area and volume using multiple integrals.
- Apply special functions to solve integration problems.
- Apply differentiation in scalar and vector fields.
- Find area and volume of a region using vector integration.
- Verify analyticity, conformity and bilinearity of complex functions.
- Evaluate complex integrals.

GEC 1211 BASIC ENGINEERING MECHANICS L T P C
3 1 0 4

OBJECTIVES:

- To impart knowledge about the basic laws of statics and dynamics and their applications in problem solving
- To acquaint both with scalar and vector approaches for representing forces and moments acting on particles and rigid bodies and their equilibrium
- To give on exposure on inertial properties of surfaces and solids
- To provide an understanding on the concept of work energy principle, friction, kinematics of motion and their relationship

MODULE I VECTOR APPROACH TO MECHANICS 9

Introduction - Units and Dimensions- Vectors – Vectorial representation of forces and moments –Vector Algebra and its Physical relevance in Mechanics - Laws of Mechanics – Parallelogram and triangular Law of forces -Lame's theorem, Coplanar Forces – Resolution and Composition of forces- Equilibrium of a particle.

MODULE II EQUILIBRIUM OF PARTICLE 10

Forces in space - Equilibrium of a particle in space - Equivalent systems of forces – Principle of transmissibility – Single equivalent force

MODULE III EQUILIBRIUM OF RIGID BODY 12

Free body diagram – Types of supports and their reactions – requirements of stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis –Vectorial representation of moments and couples – Scalar components of a moment –Varignon's theorem - Equilibrium of Rigid bodies in two dimensions -Examples

MODULE IV PROPERTIES OF SURFACES 12

Determination of Areas – First moment of area and the Centroid of sections – Rectangle, circle, triangle from integration – T section, I section, Angle section, Hollow section by using standard formula – second and product moments of plane area – Physical relevance - Rectangle, triangle, circle from integration - T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Polar moment of inertia- Mass moment of Area

MODULE V FRICTION 08

Introduction to friction- types of friction- Laws of Coloumb friction- Frictional force – simple contact friction – Rolling resistance –ladder friction

MODULE VI LAWS OF MOTION 09

Review of laws of motion – Newton's law – Work Energy Equation of particles– Impulse and Momentum – Impact of elastic bodies.

L – 45; T – 15; Total Hours :60

REFERENCES:

1. Beer, F.P and Johnston Jr. E.R, "Vector Mechanics for Engineers, Dynamics & Statics", Third SI Metric Edition, Tata McGraw-Hill International Edition, 2001.
2. Hibbeller, R.C., Engineering Mechanics, Vol. 1 Statics, Vol. 2 Dynamics, Pearson Education Asia Pvt. Ltd., 2000.
3. Irving H. Shames, Engineering Mechanics – Statics and Dynamics, IV Edition Pearson Education Asia Pvt. Ltd., 2003.

OUTCOMES:

On completion of this course students should be able

- Analyse and resolve forces, moments and solve problems using various principles and laws of Mechanics
- Apply the concept of equilibrium to particles and solve problems
- Apply the concept of equilibrium to rigid bodies and solve problems
- Analyse and determine the properties of surfaces
- Analyse and evaluate the fractional forces between the bodies
- Apply the laws of motion in solving dynamics problems

GEC 1212	ENVIRONMENTAL STUDIES	L	T	P	C
		2	0	0	2

OBJECTIVES:

The student will be conversant with the

- Various natural resources, availability, utilisation and its current scenario
- Different ecosystems, energy transfer, values, threats and conservation of biodiversity
- Levels of different pollutants and its impact and the causes and effects of natural disasters
- Impacts of human population, impact assessment, human rights and environmental acts and sustainable development

MODULE I NATURAL RESOURCES 8

Land resources: land degradation, soil erosion and desertification - Forest resources: use and over-exploitation, deforestation - Water resources: use and over-utilisation of surface and ground water, conflicts over water (inter-state and international), dams (benefits and problems), water conservation (rainwater harvesting and watershed management) - Mineral resources: use and exploitation, environmental effects of extracting and using mineral resources, mining - Food resources: world food problems, changes in land use by agriculture and overgrazing, modern agriculture and its effects, fertilizer and pesticide problems, water logging and salinity - Energy resources: increasing energy needs, renewable and non-renewable, use of alternate energy sources.

MODULE II ECOSYSTEM AND BIODIVERSITY 8

Ecosystem- energy flow in the ecosystem - food chains, food webs and ecological pyramids - characteristics, structure and function of (a) Terrestrial ecosystems (forest, grassland, desert) and (b) Aquatic fresh water ecosystems (pond, lake, river) (c) Aquatic salt water ecosystems (ocean, estuary) - ecological succession.

Biodiversity - genetic, species and ecosystem diversity – hot-spots of biodiversity –biogeographic classification of India - endangered, endemic, extinct and invasive species of India - red data book - values of biodiversity: consumptive, productive, social, ethical, aesthetic and option values - threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts - conservation of biodiversity: in-situ and ex-situ conservation of biodiversity

MODULE III ENVIRONMENTAL POLLUTION AND NATURAL DISASTER **8**

Definition, cause, effects and control measures of (a) air pollution (b) water pollution (c) soil pollution (d) marine pollution (e) noise pollution (f) thermal pollution (g) nuclear hazards - ill-effects of fireworks and upkeep of clean environment - solid waste management: types (urban, industrial, biomedical and electronic wastes), collection, processing and disposal (incineration, composting and land-fill) - natural disaster and management: flood, cyclone, drought, landslide, avalanche, volcanic eruptions, earthquake and tsunami.

MODULE IV HUMAN POPULATION, HEALTH AND SOCIAL ISSUES **6**

Population and population growth, population variation among nations, population explosion, family welfare programme.

Human health: air-borne, water borne diseases, infectious diseases, risks due to chemicals in food and environment.

Sustainable development - environmental legislation and laws: water act, air act, wildlife protection act, forest conservation act, environment protection act - environmental impact assessment, steps in EIA - human rights - women and child welfare.

Case studies related to current situation

Total Hours :30

TEXT BOOKS:

1. Erach Bharucha, Textbook for Environmental Studies For Undergraduate Courses of all Branches of Higher Education for University Grants Commission, Orient Blackswan Pvt Ltd, Hyderabad, India, 2013.
2. Benny Joseph, Environmental Studies, Tata McGraw-Hill Education, India, 2009.
3. Ravikrishnan A, Environmental Science and Engineering, Sri Krishna Publications, Tamil Nadu, India, 2015.
4. Raman Sivakumar, Introduction to Environmental Science and Engineering, McGraw Hill Education, India, 2009.
5. Venugopala Rao P, Principles of Environmental Science and Engineering, Prentice Hall India Learning Private Limited; India, 2006.

6. Anubha Kaushik and Kaushik C.P., Environmental Science and Engineering, New Age International Pvt Ltd., New Delhi, India, 2009.

REFERENCES:

1. Masters G.M., Introduction to Environmental Engineering and Science, Prentice Hall, New Delhi, 1997.
2. Henry J.G. and Heike G.W., Environmental Science and Engineering, Prentice Hall International Inc., New Jersy, 1996.
3. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co. Boston, USA, 2016.

OUTCOMES:

The student will be able to

- Predict the scenario of various natural resources and suggest remedies to curb the exploitation of these resources.
- Identify food chain and web and its role in various ecosystems, assess the impacts on biodiversity and provide solutions to conserve it.
- Analyse the impacts of pollutants in the environment and propose suitable method to alleviate the pollutants and the natural disasters.
- Assess on the impact of human population and the health related issues and the ethics to be followed for sustainable life.

GEC 1213 COMPUTER PROGRAMMING II

L	T	P	C
1	0	2	2

OBJECTIVES:

- To provide knowledge about the benefits of Object Oriented Programming over Procedure oriented programming.
- To learn various File operations
- To expose fundamental concepts of object-oriented programming in classes, invoking methods and functions.
- To prepare students to get full use of code reusability using object oriented programming.
- To implement the basic concepts of object oriented programming using C++concepts.
- To focus on solving problems based on analyzing, designing and implementing programs in C and C++.

MODULE I PROGRAMMING IN C 7

Functions - Storage Classes - Structures and Unions – Pointers -Self Referential Structures and Linked Lists - File Processing.

MODULE II PROGRAMMING IN C++ 8

Programming in C++ - Overview of OOP in C – Inheritance - Polymorphism - Type Casting – Exceptions.

LIST OF EXPERIMENTS:

1. Functions
2. One dimensional arrays, Pointers
3. Recursion
4. Multi dimensional arrays, Linked lists.
5. Operating on Files.
6. Simple C++ program with Control statements.
7. Getting input from user console.
8. Classes, Object and Constructors.
9. Method overloading.
10. Inheritance

L – 15; P – 15; Total Hours :30

REFERENCES:

1. Bjarne Stroustrup," The C++ Programming Language", Addison Wesley, 4th edition, ISBN-13: 978-0321563842, 2013.
2. Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", Prentice Hall, ISBN 0-13-110362-8, 2015.
3. Bjarne Stroustrup, "Programming: Principles and Practice Using C++ ", Addison Wesley, 2nd edition, ISBN-13: 978-0321992789, 2014.
4. Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language (Ansi C Version)", Prentice Hall India Learning Private Limited, 2nd edition, ISBN-13: 978-8120305960, 1990.

OUTCOMES:

Students who complete this course will be able to

- Develop efficient algorithms for solving problems
- Handle files in C
- Use simple data structures like arrays and linked lists in solving problems.
- Write simple programs using concepts of object oriented programming.
- Implement algorithms in C++ Language.
- Demonstrate the Object Oriented Programming concepts applied in networking, web development and Database applications.

MEC1211	MATERIAL SCIENCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To integrate the materials science, manufacturing, and mechanics knowledge that students have from previous courses and apply it to engineering design.
- To impart knowledge on properties, testing and applications of materials so as to identify and select suitable materials for various engineering applications.
- To Impart knowledge on the various modes of failures and newer materials for engineering uses.

MODULE I CLASSIFICATION OF MATERIALS 10

Historical perspective, Material properties and qualities, Classification of materials: Ferrous (steel) and Non-ferrous (Aluminium, copper) metals, Polymers (PC, PP, PE, PVC, PTFE, Acrylic), Engineering Ceramics (Aliumina, SiC), Composites–Types, Properties and Applications.

MODULE II NEWER/ADVANCED MATERIALS 5

Smart materials, Nano crystalline Materials, Superalloys ,Intermetallics, Biomaterials – Properties and applications

MODULE III TESTING OFMATERIALS 9

Testing of materials under tension, compression and shear loads. Hardness tests (Brinnell, Vickers and Rockwell).Impacttest-Izodand Charpy. Tests for Creep and Fatigue.

MODULE IV FAILUREANALYSIS 6

Wear and Corrosion Failures– Factors influencing failures, Failure analysis techniques, Analysis of failures, Simple case studies.

MODULE V FRACTURE AND ITS PREVENTION 9

Fundamentals, Mechanism of plastic deformation, Slip and Twinning, Types of fracture, Ductile fracture: mechanism and prevention. Brittle fracture: principles of fracture mechanics, Griffith's theory on fracture, stress intensity factor and fracture toughness. Creep and Fatigue fracture: Mechanism, Factors affecting fracture, Prevention.

MODULE VI MATERIALSELECTION 6

Steps in materials selection process, Factors influencing materials selection, Case studies

Total Hours :45

TEXT BOOKS:

1. Williams D Callister, “Material Science and Engineering” Wiley India Pvt Ltd, Revised, Indianedition2007.
2. KennethG.Budinski,MichaelK.Budinski,“EngineeringMaterials,PropertiesandSelection”, Pearson Education, 8thEdition,2005

REFERENCES:

1. Elements of Material Science and Engineering: VanVlack, Wesley Pub. Comp.
2. Materials Selection in Mechanical Design Fourth Edition Michael F. Ashby Butterworth – Heinemann 2011.
3. EngineeringMaterials1anIntroductiontotheirPropertiesand Applications Second Edition by Michael F.Ashby and David R.H.Jones Butterworth- Heinemann Reprint 2002.
4. Introduction to Physical Metallurgy by Sydney Avner, McGrawHill Ltd

OUTCOMES:

Students will be able to

- Classify commonly used engineering materials and to describe the key properties and applications.
- Identify newer materials for engineering applications.
- Evaluate the mechanical properties of materials under different loading conditions using standard testing practices.
- Evaluate failures arising from wear and corrosion.
- Analyze and provide solution for fracture in engineering components.
- Know how to use information sources to select materials for engineering uses.

MEC 1212	DESIGN APPRECIATION LAB	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To disassemble products and understand the interactions between its subsystems and their functionality.
- To appreciate the use of various mechanisms involved in engineering products.
- To gain knowledge through experience in handling of engineering products.
- To kindle own creativity, ideation and realize the importance of team working.

STUDY EXERCISE:

1. Study of Standard Components (Threaded fasteners, Gears, Bearings, Belt / chain drives, etc)
2. Mechanical components in electronic devices (CDD, HDD and Printer)
3. Front axle with Steering and Rear axle with Differential

TEAR DOWN EXERCISE:

Dismantle and assemble the following engineering products to identify the components and its functions

1. Reciprocating pump, axial piston pump and radial piston pump
2. Gear pump and vane pump
3. Centrifugal pump and submersible pump
4. Reciprocating compressor / Blower / Rotary compressor
5. Different type of valves
6. Work holding devices
7. Fixed reduction gear box
8. Internal combustion engine (2 Stroke and 4 Stroke)
9. Fuel feed pump and carburetor
10. Transmission system for diesel engine
11. Braking systems
12. Motors and generators

PROJECT:

Student groups will identify a product and perform a complete tear down and present it to the class.

Total Hours :45

REFERENCES:

1. Things Come Apart: A Teardown Manual for Modern Living by Todd McLellan, Thames & Hudson Ltd, London, United Kingdom, 2013.
2. Reverse Engineering: Mechanisms, Structures, Systems & Materials by Robert W. Messler, McGraw Hill Professional, 2013.
3. Kevin Otto, Kristin wood, Product Design, Pearson Publishers, 2013.

OUTCOMES:

On completion of the course, the students would be able to

- Understand of engineering systems and their mechanisms
- Understand the importance of design features in various engineering components.
- Develop awareness about single product meets multiple functions.
- Gain interest and ability to dismantle products by preparing tear down plan.
- Enhance team working and technical report writing skills.

EEC1283	BASIC ELECTRICAL ENGINEERING	L	T	P	C
		2	0	0	2

OBJECTIVES:

To impart knowledge on

- Basic concepts of electrical circuits and their solutions
- Principle of operation and applications of various D.C. and A.C. Machines
- Usage of the machines as drives
- Concepts of Basic Electronics and Devices.

MODULE I DC AND AC CIRCUITS 9

Ohm's law and its limitations. Kirchhoff's laws and its applications. Analysis of series, parallel and series-parallel resistive circuits. Power and Energy in such circuits. Generation of sinusoidal AC voltage-Phase and phase difference of sinusoidal varying voltage and current. Definition of real power, reactive power, apparent power and power factor -. The relationship between line and phase voltage & currents in balanced 3phase Star and Delta connections - Illustrative Examples

MODULE II DC MOTORS AND SPECIAL ELECTRICAL MOTORS 6

Working principle of motor.-Types and constructional feature - DC motor - Characteristics and applications. Principle of operation and constructional features of BLDC motor, Stepper and servo motors.

MODULE III TRANSFORMER AND INDUCTION MOTORS 8

Principle of operation and construction and types of single phase transformers. E.M.F equation, - voltage regulation. Three Phase Induction Motor: Principle of operation, constructional features, types, slip and its significance. Applications of squirrel- cage and slip-ring motors, Star Delta starter. Single phase Induction Motor: Principle of operation and applications.

MODULE IV ELECTRONICS 7

Semiconductor Diode: Operation, characteristics and its applications –Rectifiers and Filters, Zener diode Operation, characteristics and its applications - Regulated power supply using 78XX regulator ICs - Transistor, characteristics, operation and Applications- Transistor based Relay Driver Circuits – opto - isolators and its applications - Basics of Thyristors and applications.

Total Hours :30

REFERENCES:

1. Edward Hughes, “Electrical and Electronics Technology”, Pearson India, 9th Edition, 2007.
2. D P Kothari and I J Nagrath, “Basic Electrical Engineering”, McGraw Hill Publishing Co. Ltd., 2nd Edition, 2002.
3. Cotton H, Electrical Technology, Pitman, 2004.
4. B L Theraja and A K Theraja, “A textbook of Electrical Technology”, S.Chand, 2005.
5. Tom Denton “Automobile Electrical and Electronic Systems” Elsevier Butterworth- Heinemann, Third edition, 2004

OUTCOMES:

On completion of this course, the student will be familiar with

- Demonstrate the basics of Electrical circuits and their solution methods.
- Understand the working of Thyristors.
- Explain the structure of DC Motors systems.
- Understand the working of Special machines system.
- Demonstrate working of AC DC conversion.
- Explain the operation of Transformers and Induction motors

EEC1284	ELECTRICAL ENGINEERING LAB	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To understand, simulate and verify Ohm's Law and Kirchhoff's Laws theorem.
- To understand and verify the characteristics of various Electrical Machines
- To fabricate the interfacing and power supply circuits.
- To understand the battery chargers.

LIST OF EXPERIMENTS:

1. Verification of Ohm's Law and Kirchhoff's Laws using MATLAB.
2. Power and power factor measurement using two wattmeter method.
3. Load Test on DC Shunt Motor.
4. Load Test on DC Series Motor
5. Load Test on Single Phase Transformer
6. Load Test on Three Phase Induction Motor.
7. Three phase transformer connections.
8. Fabrication of IC78XX based Regulated power supply.
9. Fabrication of opto - Isolator based transistor - relay driver circuit.
10. Fabrication of Transistor based Amplifier.
11. Study of battery chargers.

Total Hours: 45

REFERENCES:

1. Mr. M. Ramkumar, Mr. S. Suresh Electrical Workshop Manual, , Department of EEE, BSACU

OUTCOMES:

At the end of the course, the student should be able to

- Construct and simulate any given simple electric circuits and verify theorems using MATLAB.
- Study and understand the performance of Electrical Machines.
- Fabricate the power supplies.
- Design the relay driver stage.
- Implement the amplifier circuits.
- Analyse the battery charging system.

SEMESTER III

MAC 2181	PARTIAL DIFFERENTIAL EQUATIONS AND TRANSFORMS	L	T	P	C
		3	1	0	4

OBJECTIVES:

The aims of this course are to

- Familiarize in solving partial differential equation of first, second and higher orders.
- Introduce basics and engineering applications of Fourier series, Laplace Transform, Fourier Transform and Z- Transform.

MODULE I PARTIAL DIFFERENTIAL EQUATIONS 8 + 2

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solution of standard types of first order partial differential equations – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients.

MODULE II FOURIER SERIES 8+2

Fourier Series and Dirichlet's conditions - General Fourier series - Half range Fourier series - Parseval's identity - Harmonic Analysis.

MODULE III FOURIER TRANSFORMS 7+3

Fourier integral theorem (without proof) - Fourier transform pair - Fourier Inverse Transform – Properties - Convolution theorem - Parseval's identity.

MODULE IV APPLICATIONS OF FOURIER SERIES AND FOURIER TRANSFORMS 7+3

Applications of Fourier series and Fourier Transform to solution of PDEs having constant coefficients with special reference to Heat & Wave equations, Discrete & point Spectrum and Single pulse.

MODULE V LAPLACE TRANSFORM 8+2

Introduction to Laplace transform - Existence of Laplace Transform - Properties of Laplace Transforms - Initial & Final Value Theorems - Inverse Laplace Transform - Convolution Theorem – Circuits to signal square wave: Integral equations with unrepeated complex factors – Damped forced vibrations: repeated complex factors – Resonance - Solution of differential equations

MODULE VI Z – TRANSFORM 7+3

Introduction and Definition of Z-transform - Properties of Z- Transform - Convolution Theorem of Z-Transform - Inverse Z–transform - Convolution

Theorem of Inverse Z-Transform - Formation of difference equations - Solving Difference Equations using Z-Transform.

L – 45; T – 15; Total Hours: 60

TEXT BOOKS:

1. Kreyszig .E., “Advanced Engineering Mathematics“, 10th edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2001.
2. Grewal B.S., “Higher Engineering Mathematics”, 42nd edition, Khanna Publishers, New Delhi, 2012.
3. Ramana, B.V, “Higher Engineering Mathematics” Tata Mc Graw Hill Publishing Co. New Delhi, 2006.

REFERENCES:

1. Veerarajan.T., “Engineering Mathematics“, 5th edition, Tata Mc Graw Hill Publishing Co. New Delhi, 2012.
2. Peter V. O'Neil, “Advanced Engineering Mathematics”, 7th edition, Cengage Learning, 2011.
3. Dennis G. Zill, Warren S. Wright, “Advanced Engineering Mathematics”, 4th edition, Jones and Bartlett publishers, Sudbury, 2011.
4. Alan Jeffrey, “Advanced Engineering Mathematics”, Academic Press, USA, 2002.

OUTCOMES:

After completing the course, student will be able to

- Solve the partial differential equations.
- Derive a fourier series of a given periodic function by evaluating fourier coefficients.
- Apply integral expressions for the forward and inverse fourier transform to a range of non-periodic waveforms.
- Solve wave equation and heat flow equation.
- Solve ordinary differential equations using laplace transform.
- Solve difference equation using Z-transform.

ENC 2181	ORAL COMMUNICATION	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To expose students to a range of professional contexts through podcasts for learning appropriate expressions.
- To train them in making poster presentations.
- To enable them to make effective business presentations.
- To help them learn persuasive and negotiation skills.
- To train them to debate on issues of current relevance
- To train them to participate in group discussions on current affairs

MODULE I **4**

Orientation to the Importance of Oral Communication -– Verbal and non-verbal communication -Paralinguistic features.

One-minute presentations (using Audacity / Voice thread) – Just a minute (JAM) on random topics

MODULE II **4**

Negotiating and persuading through effective arguments – to arrive at a conclusion (pair-work)

Understanding Negotiation, persuasion and marketing skills through Podcasts

Listening to short conversations and monologues for understanding real life conversations

MODULE III **4**

Making Poster presentations on current issues

Understanding nuances of making effective presentations (TED Videos)

MODULE IV **6**

Deliberation on social and scientific issues – Debates (focus on rebuttal skills and deconstructing arguments)

Viewing videos on debates (NDTV Discussions)

MODULE V **6**

Discussing social issues or current affairs in groups

Viewing group discussions and listening for specific information

MODULE VI **6**

Making full length presentation (through Voice thread) with the focus on one's career plans and prospects (discipline specific)

Listening to interviews for understanding speakers' perception (on industry related issues)

Total Hours: 30

REFERENCES:

1. Hancock, Mark (2012). *English Pronunciation in Use*. Cambridge University Press, UK.
2. Anderson, Kenneth & et.al (2007). *Study Speaking: A Course in Spoken English for Academic Purposes* (Second Edition). Cambridge University Press, UK.
3. Hurlock, B.Elizabeth (2011). *Personality Development*. Tata McGraw Hill, New York.
4. Dhanavel,S.P (2015). *English and Soft Skills*. Orient Blackswan, Chennai.
5. Whitby, Norman (2014). *Business Benchmark: Pre-Intermediate to Intermediate.* Cambridge University Press, UK.

OUTCOMES:

On completion of the course, students will be able to

- Listen to business conversations and do related tasks.
- Deliver effective poster presentations.
- Make effective business presentations.
- Use persuasive and negotiating skills for justifying arguments.
- Participate effectively in debates.
- Speak English intelligibly, fluently and accurately in group discussions.

MEC2101	MANUFACTURING PROCESSES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the principles of various casting processes and their applications
- To learn the features of various types of welding processes
- To study the applications of various metal forming processes
- To describe various types of sheet metal forming process and its application
- To know the various steps required in powder metallurgy for making different components
- To understand the methods used for making plastic components

MODULE I CASTING PROCESSES 8

Sand casting process: Principle, Types of patterns- Pattern materials- Pattern allowance - Moulding sand –moulding sand properties and testing – Core making- Moulding machine types: Jolt and Squeeze- Cupola and Crucible furnace -Steps involved in sand casting-- Sand casting defects –Sand casting inspection methods- Moulding sand –Principle of special casting processes: Shell, Lost wax process, Centrifugal casting, Pressure die casting and Stir casting

MODULE II METAL JOINING PROCESSES 8

Gas welding: Principle, Equipment and types of flames- Arc Welding process: Principle, Equipment- Resistance welding: Principle, Spot, Seam, Percussion- MIG and TIG welding process- Submerged arc welding- Electro slag – Electron beam welding – Brazing and Soldering- Welding defects

MODULE III METAL FORMING PROCESSES 7

Hot and cold working of metals- Forging processes: Principle, Open and closed die forging, Forging operations, Forging machine types- Rolling : Principle, Types of rolling mills, Shape rolling operations, Flat strip rolling- Extrusion: Principle and types- Drawing process: Principle and rod , wire and tube drawing

MODULE IV SHEET METAL FORMING PROCESSES 7

Sheet metal forming operations: Shearing, bending, drawing and Stretching operations- Evaluation of formability of sheet metal: Forming limit diagram and Erichsen cupping tester-Hydro forming – Rubber pad forming- Metal spinning- Explosive forming- Magnetic pulse forming- Peen forming- Super Plastic forming

MODULE V POWDER METALLURGY 7

Principle- Methods of production of metal powders- Mixing of powders – Compaction of metal powders- Sintering- Secondary operations- Selective laser sintering- Applications, Advantages and limitations

MODULE VI MANUFACTURE OF PLASTIC COMPONENTS 8

Types of Plastics: Thermosetting plastics and Thermo plastic – Injection Moulding: Plunger and Screw machines- Blow moulding- Rotational moulding- Film blowing- Extrusion moulding- Compression moulding- Thermoforming- Transfer moulding- Bonding of thermoplsatics

Total Hours: 45

REFERENCES:

1. Hajra Choudhury , Elements of Workshop Technology, Vol I and Vol II, Media Promoters Pvt.Ltd, Mumbai 2007
2. Serope kalpakjian, Steven R. Schmid, Manufacturing Engineering and Technology, Pearson Education, Inc.2006.
3. Elements of Manufacturing Processes, B.S.Magendran Parashar & R.K. Mittal, Prentice Hall of India, 2003
4. Manufacturing Technology, P.N. Rao, Tata McGraw- Hill Publishing Limited, II Edition, 2009
5. A text book of production technology, P.C. Sharma, S.Chand and Company, X Edition, 2008
6. Manufacturing Process- Begman, John Wilely & Sons, VIII Edition, 1999.
7. Manufacturing Science, G.S. Sawhney, Vol I & II, I.K. International Publishing House Pvt. Ltd, New Delhi

OUTCOMES:

Students will be able to

- Identify a suitable casting process for making a component
- Select an appropriate welding process for joining of metals
- Choose proper equipment for making components by metal forming processes
- Pick appropriate sheet metal forming process to make a desired shape of component
- Apply the various steps involved in powder metallurgy for making various components
- Elite the process required to fabricate plastic products

MEC2102	ENGINEERING METALLURGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the fundamentals of crystallographic structures
- To learn the different phases of an alloy through phase diagrams
- To educate on different types of ferrous materials, properties and their applications
- To discuss different heat treatment processes and phase transformations
- To instruct the various processing of materials
- To describe the various strengthening mechanisms of materials

MODULE I CRYSTALLOGRAPHY 5

Crystal structures fundamentals, Crystallographic points, directions and planes, Structure of crystalline solids, Imperfection in metal crystals: Crystal imperfections and their classifications, point defects, line defects, edge & screw dislocations, surface defects, volume defects. Effects of imperfections on metal properties.

MODULE II PHASE DIAGRAM 10

Alloys constitution, Solid solutions: Substitutional and Interstitial, Solubility limit, phase, Importance and interpretation of phase diagram, Cooling curves, Unary & binary phase diagrams, Gibbs's phase rule, eutectic, eutectoid, peritectic and peritectoid systems, iron-Iron carbide phase diagram. Grain size determination. Diffusion Mechanisms, Steady-State and Non-steady-State Diffusion, Factors That Influence Diffusion.

MODULE III FERROUS MATERIALS 8

Ferrous materials, Classification, Specification of steel, Effect of alloying elements in steel (Mn, Si, Cr, Mo, V Ti & W), Stainless steel, Tool steel, Dual phase steels, High strength low alloy (HSLA) Steel, Transformation included plasticity (TRIP) steel, Maraging steel – properties and applications. Cast Irons - Gray, White malleable, Spheroidal graphite – properties and applications.

MODULE IV HEATTREATMENT PROCESSES AND PHASE TRANSFORMATIONS 9

Principles, purpose, Classification of heat treatment processes: Annealing, Normalizing, Hardening, Tempering. Case hardening: Carburizing, Nitriding, Cyaniding, Flame and induction hardening. Phase transformations: basic concepts, Isothermal and Continuous cooling transformation diagrams. Austempering, Martempering, Hardenability: Jominy end quench test.

MODULE V PROCESSING OF MATERIALS 5

Processing of engineering materials – Primary and Secondary processes – Castability, Weldability, Forgeability and Malleability Criteria – Process induced defects – Monitoring and control.

MODULE VI STRENGTHENING MECHANISM 8

Basic concepts: Dislocations and plastic deformations - Solid solution strengthening, strengthening by grain size reduction, Precipitation hardening, Particle and fiber dispersion strengthening, Strain hardening, Recovery, Recrystallisation and grain growth.

Total Hours: 45

TEXT BOOKS:

1. Williams D Callister, “Material Science and Engineering” Wiley India Pvt Ltd, Revised, Indian edition 2007.
2. Kenneth G.Budinski, Michael K.Budinski, “Engineering Materials, Properties and Selection”, Pearson Education, 8thEdition,2005

REFERENCES:

1. Raghavan.V. “Materials Science and Engineering”, Prentice Hall of India Pvt. Ltd,5th edition, 2007.
2. George.E. Dieter, “Mechanical Metallurgy”, McGraw Hill, 2007.
3. SyndneyHAvner,“IntroductiontoPhysicalMetallurgy”,2/ETata McGraw Hill Book Company, 2007.

OUTCOMES:

Students will be able to

- Express the different crystallographic structures
- Interpret the different phases in the phase diagram
- Identify suitable ferrous material for a specific application
- Use a relevant heat treatment process and recognize its transformation
- Categorize the different processing of materials
- Select a suitable strengthening mechanism for various applications

MEC2103	ENGINEERING THERMODYNAMICS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To study the fundamental concept of thermodynamic systems and energy transfer
- To study and understand zeroth and first laws of thermodynamics
- To analyze second law of thermodynamics
- To learn the principle of steam power cycle and its improvement
- To understand thermodynamic relations and their significance
- To gain knowledge on the properties of moist air and psychrometric processes

MODULE I BASIC CONCEPTS AND PROPERTIES 12

Thermodynamic systems and control volume, Property- pressure, temperature (Zeroth law of thermodynamics),volume, internal energy, specific heat capacities, enthalpy. Concept of Energy- modes of work and heat- P- dV work, Path function - work and its illustrations for simple processes- Quasi-static process -thermal equilibrium, thermodynamic cycle.

Properties of pure substances -vapour, liquid and dryness fraction – Use of Steam Tables Phase rule, P-V, P-T, T-V, PVT surfaces

MODULE II FIRST LAW OF THERMODYNAMICS 10

Cyclic & Non-cyclic processes - Calculations of work done and heat transfer for an ideal gases and pure substances for various processes.

Derivation of Steady Flow Energy Equation (SFEE) for control volume - Steady flow processes including throttling- Examples of steady flow devices- Problems in SFEE for ideal gases and pure substances.

MODULE III SECOND LAW, ENTROPY AND AVAILABILITY 12

Second law of thermodynamics – Kelvin’s and Clausius’s statements of second law- Reversibility and irreversibility- Carnot cycle, reversed Carnot cycle, efficiency, COP- Thermodynamic temperature scale.

Clausius inequality, concept of entropy, entropy of ideal gases and pure substances-principle of increase in entropy – Carnot theorem, absolute entropy, availability, Concept of Exergy analysis.

MODULE IV STEAM POWER CYCLES 8

Illustration of processes in T-S and H-S diagrams for pure substances - Standard Rankine's cycle, Modified Rankine's cycle, cycle improvements - reheat cycle and regenerative cycle - Simple problems.

MODULE V GAS MIXTURES AND THERMODYNAMIC RELATIONS 8

Gas mixtures – properties of ideal and real gases, equation of state, Vander Waal's equation of state, compressibility factor, compressibility chart – Dalton's law of partial pressure, Amagut's law, T-ds equations, Maxwell's relations, Clausius Clapeyron equation, Joule – Thomson experiment.

MODULE VI PSYCHROMETRY 10

Psychrometry and psychrometric charts, property calculation of air vapour mixtures- Psychrometric process – Sensible heat exchange processes - Latent heat exchange processes - Adiabatic mixing, evaporative cooling - simple problems.

L-45;T-15; Total Hours: 60

REFERENCES:

1. Nag.P.K., "Engineering Thermodynamics", 4th Edition, Tata McGraw-Hill, New Delhi, 2008.
2. Rajput. R.K., "Thermal Engineering", Laxmi publications.
3. Cengel, "Thermodynamics" An Engineering Approach, Third Edition – 2003, Tata Mc Graw Hill, New Delhi.
4. Venwylen and Sontag, "Classical Thermodynamics", Wiley Eastern, 5th edition 2000
5. Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.
6. Holman.J.P., "Thermodynamics", 3rd Ed. McGraw-Hill, 1995.
7. D.B. Spalding and E.H. Cole, "Engineering Thermodynamics", 3rd edition, ELBS 1973.

OUTCOMES:

Students will be able to

- Apply the concept of thermodynamic properties to quantify energy transfer
- Apply and analyse zeroth and first laws of thermodynamics
- Evaluate the second law of thermodynamics applied to heat engines and refrigerators
- Analyse and evaluate vapour power cycles
- Evaluate properties of gas mixtures
- Demonstrate various Psychrometric processes and their relations

MEC2104	SOLID MECHANICS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To study about stress, strain and deformation of solids
- To learn various loads and stresses in different types of beams
- To educate about torsional effects in different types of shafts
- To study about application of torsion in springs and columns
- To describe the different mathematical models for beam deflection
- To discuss analysis of stresses in two dimensions

MODULE I STRESS, STRAIN AND DEFORMATION OF SOLIDS 10

Rigid and Deformable bodies – Strength, Stiffness and Stability – Stresses - Tensile, Compressive and Shear – Deformation of simple and compound bars under axial load – Thermal stress – Elastic constants – Strain energy and unit strain energy – Strain energy in uniaxial loads.

MODULE II BEAMS - LOADS AND STRESSES 12

Types of beams: Supports and Loads – Shear force and Bending Moment in beams : Cantilever, Simply supported and Overhanging beams – Stresses in beams – Theory of simple bending – Stress variation along the length and in the beam section – Effect of beam section on stress induced – Shear stresses in beams – Shear flow.

MODULE III TORSION 10

Analysis of torsion in circular bars – Shear stress distribution – Bars of Solid and hollow circular section – Stepped shaft – Twist and torsion stiffness – Compound shafts – Fixed and simply supported shafts.

MODULE IV SPRINGS AND COLUMNS 10

Application to close-coiled helical springs – Maximum shear stress in spring section including Wahl Factor – Deflection of helical coil springs under axial loads – Design of helical coil springs – stresses in helical coil springs under torsion loads. Columns – End conditions – Equivalent length of a column – Euler equation – Slenderness ratio – Rankine formula for columns.

MODULE V BEAM DEFLECTION 8

Elastic curve of Neutral axis of the beam under normal loads – Evaluation of beam deflection and slope: Double integration method and Macaulay Method.

MODULE VI ANALYSIS OF STRESSES IN TWO DIMENSIONS 10

Biaxial state of stresses – Thin cylindrical and spherical shells – Deformation in thin cylindrical and spherical shells – Biaxial stresses at a point – Stresses on inclined plane – Principal planes and stresses – Mohr's circle for biaxial stresses – Maximum shear stress - Strain energy in bending and torsion.

L-45; T-15; Total Hours: 60

TEXT BOOKS:

1. Bansal, R.K, "A text book of strenth of material", Laxmi Pulication (P) Ltd., 2010.
2. Ramamrutham, S, strenth of materials, 14th Edition, Dhanth Rai Publication, 2011.

REFERENCES:

1. Popov E.P, "Engineering Mechanics of Solids", Prentice-Hall of India, New Delhi, 1997.
2. Beer F. P. and Johnston R, "Mechanics of Materials", 3rd Edition, McGraw-Hill Book Co, 2002.
3. Nash W.A, "Theory and problems in Strength of Materials", Schaum Outline Series, McGraw-Hill Book Co, New York, 1995.
4. Timoshenko S.P, "Elements of Strength of Materials", Tata McGraw-Hill, New Delhi 1997.
5. Singh D.K "Mechanics of Solids" Pearson Education, 2002.
6. Kazimi S.M.A, "Solid Mechanics", Tata McGraw-Hill Publishing Co, New Delhi, 1981.

OUTCOMES:

The students will be able to

- Demonstrate stress, strain and deformation of solids
- Recognise the various loads and analyse stresses in different types of beams
- Evaluate the torsional effects in different types shafts
- Calculate the various design parameters for springs and columns
- Estimate the beam deflection using various mathematical models
- Express the stresses in two dimensions

MEC2105	MANUFACTURING PROCESSES LAB	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To provide the basic knowledge on different manufacturing techniques
- To experience the various operational activities of basic manufacturing processes including metal casting, metal joining, metal forming and machining
- To enable the students to fabricate simple components through the acquired skills

LIST OF EXPERIMENTS:

- CASTING PROCESS
  - Preparation of green sand mould for dumble and flange
- JOINING PROCESS
  - Preparation of weldments by arc welding and TIG welding
- FORMING PROCESS
  - Forming of hexagonal rod from the round rod
- SHEET METAL OPERATIONS
  - Making of tray and funnel from sheet metal
- OPERATIONS ON PLASTICS
  - Injection moulding by plastics
  - Extrusion / Blow moulding
- BASIC MACHINING
  - Facing, Plain turning, step turning and taper turning on lathe
  - Grooving, external chamfering, single start ‘V’ thread cutting and knurling on lathe
  - Drilling, boring, internal thread cutting, internal chamfering on lathe
  - Square cut shaping and key way cut by shaper
  - Internal slot / key way cut by slotter
  - Five holes at a given pitch circle on a plate (Boring center hole, drilling and tapping in five holes)
- PROJECT WORK
  - Combined Skill (Each team has to make an engineering component)

Total Hours: 45

REFERENCES:

1. A course manual for the laboratory (prepared by SMS, BSACU)http://home.iitk.ac.in/~vkjain/manual.pdf
2. Hajra Choudhury, Elements of Workshop Technology, Vol. I and II, Media Promotors Pvt. Ltd., Mumbai, 2007.

OUTCOMES:

Students should be able to

- Describe various basic manufacturing processes
- Make the components using moulding, welding, forging and basic machine tools
- Produce a simple component using different manufacturing process

MEC2106	MATERIAL TESTING AND METALLURGY LAB	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To observe the microstructure of various materials
- To study and record the various destructive test methods
- To understand the importance of various metallurgical and mechanical tests

EXPERIMENT

- MATERIALTESTINGLABEXPERIMENTS
  - Tension test. 1
  - Compression test. 1
  - Torsion test. 1
  - Deflection test. 1
  - Impact test. 1
  - Double Shear test 1
  - Fatigue test 1
- METALLURGYLABEXPERIMENTS
  - Metallographic Examination-Demonstration and Practice 2
  - Study of metallurgical microscope.
  - Specimen preparation for microstructural examination-cutting, grinding, polishing, etching.
  - Selections of etchants for various metals and alloys.
  - Identification of microstructures of Ferrous and Non-ferrous materials. 2
  - Heat treatment: Annealing, normalizing, hardening and tempering of steel- Hardness and its microstructure. 2
  - Study of microstructure of welded (HAZ) and cast component. 1
  - Hardenability test -Jominy End quench test. 1

Total Hours: 45

REFERENCES:

1. ASTME3-01(2007) e1 Standard Guide for Preparation of Metallographic Specimens.
2. ASTM E407- 07Standard Practice for Microetching Metals and Alloys.

3. ASTM E7 – 03(2009) Standard Terminology Relating to Metallography.

OUTCOMES:

Students should be able to

- Interpret and analyse the microstructure of various materials
- Test the various mechanical properties of materials
- Correlate the results for applications

MEC2107	PART MODELING LAB	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To familiarize with the codes and specifications of BIS,limits, fits and tolerances
- To learn and draw assembly drawing of various machine components using drafting packages
- To generate part and assembly drawings of actual mechanical products

DRAWING STANDARDS & FITS AND TOLERANCES

Introduction – Need of Graphical Language – Importance of Machine Drawing – Tools – Projections – Designation – Relative position of views – Classification of Machine Drawings – Scales as per ISO standards – Importance of Title Block and Part list – Lines types – Sectioning – Principle of Dimensioning – Limits, Fits and Tolerance – Definitions – Classifications of Fits – Method of Indicating Fits on Drawings – Tolerance Grade – Shaft and Hole Terminology – Conventional Representations – Surface finishing & Machining Symbols – Abbreviations and Symbols – Screwed Fastenings – Designation of Bolted Joints – Special Types of Bolts and Nuts – Key Joints – Types of Key joints – Introduction to Rivets and Riveting – Welded Joints – Pipes and Pipe Joints – Pulleys – Couplings.

INTRODUCTION TO 2D DRAFTING

Assembly Drawings – Introduction – Types of Assembly – Importance of BOM – Assembly procedures – Assembly Drawings (Examples) – Assembly of Engine Parts: Assembly of Machine Tools Parts – Production Drawings – Difference with Normal Drawings – Method of amendment of Corrections.

INTRODUCTION TO 3D MODELLING AND ASSEMBLY

Introduction of Solid 3D Modelling – Sketcher – Datum planes – Protrusion – Holes – Part modelling – Extrusion – Revolve – Sweep – Loft – Blend – Fillet – Pattern – Chamfer – Round – Mirror – Section – Assembly

Couplings – Flange, Universal, Oldham's, Muff, Gear couplings

Joints – Knuckle, Gib & cotter, strap, sleeve & cotter joints

Engine parts – Piston, connecting rod, cross-head (vertical and horizontal), stuffing box, multi-plate clutch

Miscellaneous machine components – Screw jack, machine vice, tail stock, chuck, vane and gear pumps

Total Hours: 45

TEXT BOOKS:

1. N. D. Bhatt and V.M. Panchal, “Machine Drawing”, 48th Edition, Charotar Publishers,2013
2. Gopalakrishna K.R., “Machine Drawing”, 22 Edition, Subhas Stores Books Corner, Bangalore, 2013.

REFERENCES:

1. Bertoline, Wiebe, Miller, Nasma., Technical Graphics Communication, IRWIN Graphic Series
2. William P. Spence, Engineering Graphics, Printice - Hall Inc, Engle Wood Cliff
3. S. Bogolyubov. A. Voinov., Engineering Drawing, Van Nostr and Reinhold Company
4. Brain Griffiths., Engineering Drawing for Manufacture, Kogan Page Science, USA
5. Hart. K R, Engineering Drawing with Problems and Solutions, Hodder and Stoughton, London Sydney Auckland
6. David L., Goetsch Williams Chaulk John A., Nelson, Technical Drawing (Drafting and Design) Savee Informatics.
7. D.E. Hewitt., Engineering Drawing and Design for Mechanical Technicians, The Macmillan Press Ltd, London

OUTCOMES:

Students should be able to

- State the codes, standards of BIS, limits, fits and tolerances
- Interpret complex drawings of machine parts and assembly
- Generate components and assembly drawings of actual products

SEMESTER IV

ENC 2282	WRITTEN COMMUNICATION	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To help students identify content specific vocabulary and learn its usage.
- To expose them to reading for specific purposes, especially in professional contexts.
- To expose them to the process of different kinds of formal writing.
- To help them learn corporate correspondence for different purposes.
- To train them in preparing effective applications with résumé
- To make them write different types of reports.

MODULE I **4**

Introduction - process of writing – Fundamentals of academic and professional writing – Understanding short, real world notices, messages, etc.

MODULE II **4**

Reading industry related texts (ex. Manufacturing, textile, hospitality sector etc.) for specific information.

Writing Instructions and recommendations

MODULE III **6**

Understanding format and conventions of writing email, memo, fax, agenda and minutes of the meeting.

Writing email, memo, fax, agenda and minutes of the meeting for various purposes (industry specific)

MODULE IV **6**

Viewing letter of application and Résumé, letter calling for an interview, letter of inquiry and Promotional letter

Writing Functional résumé and letter of application using Edmodo,

MODULE V **6**

Viewing a Video and reading a case study (industry specific) – collaborative writing using Edmodo –reading and information transfer

Writing reports- Survey, feasibility and progress – exposure to discipline specific reports

MODULE VI **4**

Writing Statement of purpose (Higher Education)-- Justifying and writing about one's preparedness for job (Statement of Purpose highlighting strengths and weaknesses) – Peer evaluation skills through Edmodo.

Total Hours: 30

REFERENCES:

1. Riordan,D (2013). *Technical Report Writing Today*. Cengage Learning, 10th edition. USA.
2. Oliu, W. E., Brusaw, C.T., & Alred, G.J. (2012). *Writing that Works: Communicating Effectively on the Job*. Bedford/St. Martin's. Eleventh Edition.
3. Garner, B.A. (2013). *HBR Guide to Better Business Writing (HBR Guide Series)*. Harvard Business Review Press. USA.
4. Sharma, R.C. & Krishna M. (2002). *Business Correspondence and Report Writing*. Tata MacGraw – Hill Publishing Company Limited, New Delhi.
5. Macknish, C. (2010). *Academic and Professional Writing for Teachers*. McGraw-Hill Education. USA.
6. Whitby, Norman (2014). *Business Benchmark: Pre-Intermediate to Intermediate.* Cambridge University Press, UK.

OUTCOMES:

On completion of the course, the students will have the ability to

- Identify content specific vocabulary and also use them in appropriate contexts.
- Demonstrate reading skills with reference to business related texts.
- Draft professional documents by using the three stages of writing.
- Create different types of documents for various corporate correspondences.
- Write effective letter of applications, résumé and statement of purpose.
- Write business related reports efficiently.

MEC2211	KINEMATICS OF MACHINERY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the various simple mechanisms
- To analyse the velocity of different mechanisms
- To acquire knowledge on acceleration analysis of different mechanisms
- To educate the kinematics of cams
- To study the different types of gears and gear trains
- To understand the various friction drives

MODULE I BASICS OF MECHANISMS 7

Terminology and Definitions- Description of common Mechanisms-Four Bar Mechanism-Single and double slider crank mechanisms - Kinematic Inversions of 4-bar and slider crank chains-– Indexing Mechanisms - Rocking Mechanisms - Straight line generators- Ratchets and escapements - Design of Mechanisms – Mobility - Grubler's criterion - Grashoff's law- Mechanical Advantage-Transmission angle.

MODULE II VELOCITY ANALYSIS OF MECHANISMS 7

Displacement and velocity analysis in mechanisms - Graphical Method – Velocity polygons – Kinematic analysis by Complex Algebra methods - Vector Approach - Instantaneous Centre method - Kennedys Theorem.

MODULE III ACCELERATION ANALYSIS OF MECHANISMS 7

Acceleration analysis in simple mechanisms - Graphical Method- acceleration polygons - Kinematic analysis by Complex Algebra methods - Vector Approach, Computer applications in the kinematic analysis of simple mechanisms- Coriolis component of acceleration.

MODULE IV KINEMATICS OF CAM 7

Classifications - Displacement diagrams - Simple harmonic, parabolic, and cycloidal motions - Layout of plate cam profiles - Derivatives of Follower motion - High speed cams - Circular arc and tangent cams - Standard cam motion - Pressure angle and undercutting.

MODULE V KINEMATICS OF GEARS 10

Spur gear Terminology and definitions - Fundamental Law of toothed gearing and involute gearing - Inter changeable gears - gear tooth action – Terminology - Interference and undercutting – Non standard gear teeth- Helical, Bevel, Worm,

Rack and Pinion gears (Basics only) - Gear trains - Parallel axis gear trains - Epicyclic gear trains – Differential mechanism.

MODULE VI FRICTION IN MACHINERY 7

Friction drives - Belt and rope drives, Friction in clutches - Friction aspects in Brakes – Friction in vehicle propulsion and braking.

Total Hours: 45

REFERENCES:

1. Rattan S.S, “Theory of Machines”, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1998.
2. Shigley J.E and Uicker J.J, “Theory of Machines and Mechanisms”, McGraw- Hill, Inc. 1995.
3. Thomas Bevan, “Theory of Machines”, CBS Publishers and Distributors, 1984.
4. Ghosh A and A.K. Mallick, “Theory of Mechanisms and Machines”, Affiliated East-West Pvt. Ltd., New Delhi, 1988.
5. Rao J.S and Dukkipati R.V, “Mechanism and Machine Theory”, Wiley-Eastern Ltd., New Delhi, 1992.
6. John Hannah and Stephens R.C, “Mechanics of Machines”, Viva Low-Prices Student Edition, 1999.

OUTCOMES:

The students will be able to

- Describe various simple mechanisms
- Construct the velocity diagram and predict the velocities of mechanisms
- Draw the acceleration diagram and predict the acceleration of mechanisms
- Create various types of cam profiles with different follower motions
- Analyse the kinematics of gears and gear trains
- Solve simple application problems on frictional drives

MEC2212 FLUID MECHANICS AND MACHINERY

L	T	P	C
3	1	0	4

OBJECTIVES:

- o learn the fundamental concepts and properties of fluids
- To study the governing equations for fluid flow
- To educate different types of flow and its losses
- To understand boundary layer concepts and dimensional analysis
- To impart knowledge on hydraulic turbines
- To acquire knowledge on hydraulic pumps

MODULE I FUNDAMENTALS OF FLUID MECHANICS 10

Fluid Properties- Definition, distinction between solid and fluid – Units and Dimensions- Properties of fluid - Density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapour pressure, capillary and surface tension. Fluid statics: concept of fluid static pressure, absolute and gauge pressure- pressure measurements by manometers pressure gauges

MODULE II FLUID KINEMATICS AND FLUID DYNAMICS 12

Fluid Kinematics – Flow visualization – Lines of flow – types of flow – velocity field and acceleration–continuity equation (one and three dimensional forms) Equation of stream line-stream function-velocity potential function–circulation–flow net – fluid dynamics – equation of motion – Euler's equation along streamline – Bernoulli's equation – applications - Venturimeter, Orificemeter, Pitot tube

MODULE III INCOMPRESSIBLE FLUID FLOW 10

Viscous flow - Navier's Stoke equation (statement only)–Shear stress ,pressure gradient relationship- Laminar flow between parallel plates- Laminar flow through circular tubes (Hagen poiseulle's law)–Hydraulic and energy gradient – Flow through pipes–Darcy's Weisback's equation–Pipe roughness–friction factor – Moody's diagram minor losses- Flow through pipes in series and in parallel power transmission.

MODULE IV BOUNDARY LAYER & DIMENSIONAL ANALYSIS 10

Boundary Layer theory, Boundary layer separation – drags and lifts coefficients. Buckingham's pi-Theorem – applications - similarity laws and models

MODULE V HYDRAULIC TURBINES 8

Hydraulic machines: Definition and classification- exchange of energy- Euler's equation for turbo machines–Construction of velocity vector diagrams head and specific work–components of energy transfer–degree of reaction. Hydro turbines: Pelton turbine – Francis turbines – working principles – velocity triangle – work done–specific speed–efficiencies–performance curve for turbines

MODULE VI HYDRAULIC PUMPS 10

Pumps, definition and classifications: - Centrifugal pump: classifications and velocity triangles, specific speed, efficiency and performance curves. Reciprocating pumps: Classification, working principle, indicator diagram, work saved by air vessels and performance curves.

L-45; T-15; Total Hours: 60

REFERENCES:

1. Bansal.R.K "Fluid Mechanics and hydraulics Machines", (5thedition), Laxmi Publications (P) Ltd, New Delhi, 1995.
2. Kumar.K.L., "Engineering Fluid Mechanics ", Eurasia Publishing House(P) Ltd, New delhi, (7thedition), 1995.
3. Vasandani. V.P "Hydraulic Machines–Theory and design", Khanna Publishers
4. Kumar DS, "Fluid Mechanics and Fluid Power Engineering", Kataria SK and Sons, NewDelhi, 1997.
5. Streeter V. Land Wylie, E.B "Fluid Mechanics", Mc. Grath-Hill, 1983.
6. White, F.M., Fluid Mechanics", Tata McGrawhill, 5th Edition, NewDelhi.-2003.
7. John.D. Anderson, "Computational Fluid Dynamics–The Basics with Applications", Mc Graw Hill, New Delhi, 1995.
8. Robert W Fox, "Introduction to Fluid Mechanics", Fourth Edition, John Wiley and sons, Singapore, 1994.

OUTCOMES:

Students will be able to

- Apply the fundamental concepts in the design of flow measuring devices
- Apply the governing equation in flow through conduits
- Analyze incompressible fluid flow through pipes

- Measure Boundary layer friction and establish expression for any measurable parameter from the dependent variables
- Demonstrate and analyze the performance of hydraulic turbines
- Describe and analyze the performance of hydraulic pumps

MEC2213	METAL CUTTING AND MACHINE TOOLS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the various material removal process
- To learn the functions of centre lathe and special purpose lathes
- To acquire knowledge about reciprocating machines and milling machines
- To understand the principle of drilling, broaching and gear cutting
- To gain knowledge about finishing and super finishing processes
- To educate the working principle of CNC machine tools and non-traditional machining processes

MODULE I THEORY OF METAL CUTTING 7

Introduction: material removal processes, types of machine tools – theory of metal cutting, geometry of single point cutting tool, mechanism of chip formation, types of chips, orthogonal metal cutting, machining forces and Merchant's Circle Diagram - cutting tool materials, tool wear, tool life, cutting fluids.

MODULE II CENTRE LATHE AND SPECIAL PURPOSE LATHES 7

Centre lathe, constructional features, cutting tools, various operations, special attachments, machining time and power estimation - Capstan and turret lathes – automatic lathes: semiautomatic, automats – kinematics – single spindle : cutting off, swiss type, automatic screw type – multi spindle; cutting off, bar type

MODULE III RECIPROCATING MACHINES AND MILLING MACHINES 7

Reciprocating machine tools: shaper, planer, slotter - milling: types, milling cutters, plain milling cutter- nomenclature - operations.

MODULE IV DRILLING, BROACHING AND GEAR CUTTING 7

Hole making: drilling, reaming, boring, tapping – Deep hole Drilling – Broaching machines: broach construction – push, pull, surface and continuous broaching machines - Gear cutting: forming, generation, shaping, hobbing – Mechanics of processes.

MODULE V FINISHING AND SUPER FINISHING PROCESSES 10

Abrasive processes – Mechanics: grinding wheel – specifications and selection, types of grinding process – centreless grinding, cylindrical grinding, surface grinding– honing, lapping, super finishing, polishing and buffing

MODULE VI CNC MACHINE TOOLS AND MODERN MACHINING METHODS 7

Numerical control (NC) machine tools – CNC: types, construction details, special features - Advantages and limitations : Abrasive Jet Machining- Ultrasonic Machining - Electron Beam and Laser Beam Machining

Total Hours: 45

REFERENCES:

1. Rao, P.N. “Manufacturing Technology”, Metal Cutting and Machine Tools, Tata McGraw–Hill, New Delhi, 2008
2. Richerd R. Kibbe, John E. Neely, Roland O. Merges and Warren J. White, “Machine Tool Practices”, Prentice Hall of India, 2003
3. HMT – “Production Technology”, Tata McGraw-Hill, 2001
4. P.C. Sharma, “A Text Book of Production Engineering”, S. Chand and Co. Ltd, X edition, 2008
5. Hajra Choudry, “Elements of Work Shop Technology – Vol. II”, Media Promoters. 2007
6. Geofrey Boothroyd, “Fundamentals of Metal Machining and Machine Tools”, McGraw Hill, 2006

OUTCOMES:

Students will be able to

- Describe the various material removal process
- Discuss the various types of lathe and its operations
- Illustrate the operations in reciprocating machines and milling machines
- Explain drilling, broaching and gear cutting operations
- Exhibit the various finishing and super finishing processes
- Deliberate the functions of CNC machine tools and non-traditional machining processes

MEC2214	MACHINING LAB	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To gain knowledge in various mechanisms of special machine tools
- To learn the functions of various machines such as milling, shaping and grinding
- To acquire knowledge on producing various assembly components such as bushes, shafts, bolts and nuts

LIST OF EXPERIMENTS:

- SPECIAL MACHINES
  - Milling machines
  - Spur gear milling
  - Milling polygon surfaces
  - Reciprocating machines
  - Making of 'V' Block for work holding device
  - Super finishing machine
  - Surface grinding
  - Cylindrical grinding
- MACHINING IN LATHE
  - Bush and shaft
  - Bolt and nut
  - Double start 'V' thread
  - Eccentric turning and coupling
- MACHINING IN SEMI-AUTOMATIC LATHE
  - Machining in capstan and turret lathes
- PROJECT WORK
  - Combined Skill (Each team has to make a working model)

Total Hours: 45

REFERENCES:

1. A course manual for the laboratory (prepared by SMS,BSACU)
2. http://home.iitk.ac.in/~vkjain/manual.pdf
3. HMT – "Production Technology", Tata McGraw-Hill, 2001.

OUTCOMES:
Students will be able to

- Demonstrate the different mechanisms involved in special machine tools
- Perform operations in various machines such as in milling, shaping and grinding
- Produce various assembly components such as bushes, shafts, bolts and nuts

MEC2215	PRODUCT MODELLING LAB	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To understand the fundamentals of CAD systems
- To create a 3D model of the component given
- To familiarize students with the assembly of various machine components

OVERVIEW OF CAD SOFTWARE

Create 3D models of standard machine components by reading orthographic views of Brackets, V Blocks, Stop Block.

ASSEMBLY DRAWING

Create part model, assembly, exploded view, sectional views and detail drawings of Joints: Cotter joints, knuckle joints, Hook's joint.

Shaft Couplings: rigid, flexible.

Bearings: Journal, footstep, thrust or collar bearing, Plummer block.

Engine parts: Stuffing box, connecting rod.

Machine tool components: Drill jig, tool post, machine vice, screw jack.

Valves: Safety valve, relief valve, non-return valve.

PARAMETRIC MODELLING

Modelling of screw threads, threaded fasteners, gears & pulleys.

PROJECT

Create CAD models of real time components.

Total Hours: 45

TEXT BOOKS:

1. N. D. Bhatt and V.M. Panchal, "Machine Drawing", 48th Edition, Charotar Publishers,2013
2. Gopalakrishna K.R., "Machine Drawing", 22 Edition, Subhas Stores Books Corner, Bangalore, 2013.

REFERENCES:

1. Bertoline, Wiebe, Miller, Nasma., Technical Graphics Communication, IRWIN Graphic Series
2. William P. Spence, Engineering Graphics, Printice - Hall Inc, Engle Wood Cliff
3. S. Bogolyubov. A. Voinov., Engineering Drawing, Van Nostr and Reinhold Company

4. Brain Griffiths., Engineering Drawing for Manufacture, Kogan Page Science, USA
5. Hart. K R, Engineering Drawing with Problems and Solutions, Hodder and Stoughton, London Sydney Auckland
6. David L., Goetsch Williams Chaulk John A., Nelson, Technical Drawing (Drafting and Design) Savee Informatics.
7. D.E. Hewitt., Engineering Drawing and Design for Mechanical Technicians, The Macmillan Press Ltd, London

OUTCOMES:

Students should be able to

- Describe the fundamentals of CAD systems
- Create a 3D model of the given component
- Perform virtual assembly of various machine components

MEC2216 FLUID MECHANICS AND MACHINERY LAB

L	T	P	C
0	0	3	1

OBJECTIVES:

- To learn about the flow measuring instruments.
- To verify the laws of fluid mechanics.
- To study the performance of various pumps and turbines.

LIST OF EXPERIMENTS:

1. Comparison of coefficient of discharge of given orifice meter and Venturi meter.
2. Calibration of Rotameter.
3. Determination of various losses for the given set of pipes.
4. Performance study of centrifugal pumps / Submersible pumps.
5. Determination of maximum efficiency for the given reciprocating pump.
6. Characteristic curves for Gear pump / Vane pump.
7. Determination of maximum power at constant speed / constant load for an impulse turbine.
8. Performance characteristic of reaction turbine.
9. Impact of jet on flat and curved vanes.
10. Verification of Bernoulli's theorem.
11. Performance test on a jet pump.
12. Flow visualization: Laminar and Turbulent flows.

Total Hours: 45

REFERENCES:

1. Bansal.R.K "Fluid Mechanics and hydraulics Machines", (5thedition), Laxmi Publications (P) Ltd, New Delhi, 1995.
2. Kumar.K.L., "Engineering Fluid Mechanics", Eurasia Publishing House(P) Ltd, New delhi, (7thedition), 1995.
3. Vasandani. V.P "Hydraulic Machines–Theory and design", Khanna Publishers
4. Kumar DS, "Fluid Mechanics and Fluid Power Engineering", Kataria SK and Sons, NewDelhi, 1997.
5. Streeter V. Land Wylie, E.B "Fluid Mechanics", Mc. Grath-Hill, 1983.
6. White, F.M., Fluid Mechanics", Tata McGrawhill, 5th Edition, NewDelhi.-2003.

7. John.D. Anderson, “Computational Fluid Dynamics–The Basics with Applications”, Mc Graw Hill, New Delhi, 1995.
8. Robert W Fox, "Introduction to Fluid Mechanics", Fourth Edition, John Wiley and sons, Singapore, 1994.

OUTCOMES:

Students should be able to

- Apply the laws of fluid mechanics and measure parameters of fluid flow
- Analyse the performance of Hydraulic turbines and pumps
- Evaluate performance of Impinging jet on vanes

SEMESTER V

MSC3181 LEADERSHIP AND CEO TRAINING

L	T	P	C
3	0	0	3

OBJECTIVES:

The course aims at

- Bringing about positive transformation in students' attitude.
- Building unique leadership competencies that would ensure successful transition of students across all career stages.
- Sensitizing students to identify their strengths & weakness and training them to deal with it
- Assisting students in enhancing their expressive ability and inducing a high level of self-confidence to manage both business and emotions
- Training students to become more adaptable and flexible to changing business environment

MODULE I INTRODUCTION TO LEADERSHIP 12

Leadership concept - meaning, definitions, importance of leadership, leadership traits. Leadership functions- general functions, listening, observing, managing and decision making. Components of leadership - leaders, followers and situation. Leadership theories – Trait theory, Skills theory, Style theory, Situational theory, Transformational theory, Transactional theory, Path Goal Theory and LMX. Assessing emotional intelligence and exploring the capabilities and inherent traits. through psychometric tests - Multi factor leadership questionnaire and personal reflections

MODULE II LEADERSHIP STYLE AND COMMUNICATION 8

Leadership styles-visionary, Coaching, Affiliative, Democratic, Pacesetting Commanding, Transformational, Transactional. Autocratic, Participative, Laissez-Faire Leader versus Managers. Leadership communication - Rationale, tactic, assertive, formal, informal, communication in crisis- leadership and negotiations, Leadership Presentations-convincing and impressive style

MODULE III LEADERSHIP ROLES 8

Facets of leadership- Leader as an individual – personality and leadership, values, attitudes and ethics of a leader. Leader as a relationship builder- empowering people to meet higher order needs, initiating organization wide motivational programs, involvement with all stakeholders- focusing on organization growth. Leader as an inspirer- motivation and leadership, recognizing and appreciating contributions, empowering others to lead Leader as an innovator –leader's role in shaping culture and values in an organization. Leader as a Liaison- Leader as team player

MODULE IV LEADERSHIP CHALLENGES AND STRATEGIES 9

Challenges in leadership: Perception of organization culture and values, interpreting the power dynamics in the organization, establishing work life balance. Bad leadership – Reasons and impact.-Case Study of Marissa Mayer-Yahoo. Inc Organizational transformation through efficient leaders-Case study of Apple Inc. Blue Ocean Leadership-Steps to Blue ocean Leadership-Four Pillars of Blue Ocean leadership-Blue Ocean leadership grid

MODULE V LEADERSHIP AND CEO TRAINING 8

Leader as a CEO: Traits of a successful CEO, Key responsibilities of a CEO, the path to be a CEO ,Training on Board Room Discussions, Meeting the CEO – Live sessions with industry CEO's. Requirements of Leadership: - Cognitive skills, Interpersonal skills, Business skills, Strategic skills. Role of Emotional Intelligence in taking up key-positions in the organization.

Teaching Pedagogy:

Nurturing – Based on the identified strengths and weaknesses, training will be given to enhance the strengths and overcome the weakness.

Assessment - Continuous evaluation will be effected through group discussions, oratory assignments and situational enactments. Pre-and post-training assessment through peer reviews and faculty feedback.

Sustained development – Training will be imparted for self-development and monitoring of leadership skills to ensure sustained applicability of the skills learnt.

Total Hours: 45

REFERENCES:

1. Andrew J DuBrin. “Leadership: Research Findings, Practice, and Skills”, 8th Edition, South-Western College Pub, 2015.
2. Yukl G, “Leadership in Organisations”, 8th Edition, Pearson Education, 2013.
3. Richard L Daft, “Leadership”, 5th Edition, South Western Cengage Learning 2012.
4. Stephen P. Robbins and Timothy A. Judge. “Organizational Behaviour”, 15th Edition, New Delhi: Pearson, 2013.
5. Fred Luthans, “Organizational Behavior, an Evidence Based Approach”, 12th Edition, New Delhi: McGraw Hill Education, 2013.
6. Emotional Intelligence, Why it can matter no more than IQ by Daniel Goleman (include a book) Publisher: Bloomsbury Publishing India Private Limited; Latest edition (2017)
7. Primal Leadership: Unleashing the Power of Emotional Intelligence by Prof Daniel Goleman , Richard Boyatzis and McKee, Harvard Business Review Press

RECOMMENDED READINGS:

1. Jim Collins, (2001). “Good To Great: Why Some Companies Make the Leap...And Others Don't”, Random House Publishers India Pvt. Ltd, New Delhi
2. George, B. with Sims, P. True North: Discover Your Authentic Leadership, The Times Group Books; First edition (1 October 2015)
3. Kim, W. C., & Mauborgne, R. A. (2014). Blue ocean strategy, expanded edition: How to create uncontested market space and make the competition irrelevant. Harvard business review Press
4. Leadership Wisdom by Robin Sharma Jaico Publishing House;

OUTCOMES:

The students will be able to

- Explore through self-introspection one’s own leadership style, their strength and weakness
- Gain self-confidence to lead a team in the organization
- Realize the role of leadership in making or breaking of an organization

- Acquire the practice of self-introspection and development of leadership competencies thorough continuous efforts
- Manage their own emotions as well as other resulting in successful relationship building with all stakeholders

MSC3182 SOCIAL ENTREPRENEURSHIP

L	T	P	C
3	0	0	3

OBJECTIVES:

- To be able to understand the field of social entrepreneurship and Social problems
- To be able to describe and understand the traits of social entrepreneurs
- To recognize the social business opportunities
- To synthesize the resource mobilization ways for social entrepreneurship
- To understand the social entrepreneurship models
- To recognize the impact of social entrepreneurship on societies

MODULE I INTRODUCTION TO SOCIAL ENTREPRENEURSHIP 7

Introduction - Emergence and Development of Social Entrepreneurship. Social Problems in India: An Overview. Social Development: The Indian Scenario. Emergence of Social Entrepreneurs and Sustainable Solutions to Social Problem. Characteristics and Context of Social Entrepreneurship .The Role of Social Entrepreneurship in Societies & Economies.

MODULE II SOCIAL ENTREPRENEURSHIP: DRIVERS AND CHALLENGES 7

The Drivers of Social Entrepreneurship. Elements of the Social Entrepreneurial Personality. Challenges of financial constraints. Challenge to attract and cultivate talented workers. Challenge of evaluation of social entrepreneur impact. Challenge of scaling and its impact. Cases

MODULE III SOCIAL ENTREPRENEURSHIP: OPPORTUNITY RECOGNITION 7

Opportunity Recognition and Planning Process. Opportunities for Social Entrepreneurs. The Nature of Social Entrepreneurial Opportunities. Social Problems into Opportunities. Idea development and conceptualization of social problem. Cases

MODULE IV RESOURCE MOBILIZATION FOR SOCIAL VENTURE 8

Resources at Initial Stage. Social Network as a role of Social Capital. Team and Collective Efforts. Need and Determination of Important Resources. Resource of

Knowledge, Skills and Abilities. Overview of venture capital and angel investment. Cases

MODULE V BUSINESS MODELS AND BUSINESS PLAN FOR SOCIAL ENTERPRISES **8**

Design Principles of Social Entrepreneurship Business Models, Evaluation of the Root Cause of a Societal Problem. Developing business plan for social ventures. Developing an investor presentation. Feasibility study and report. How to start a business - Procedures for registration of small scale industry

MODULE VI THE IMPACT OF SOCIAL ENTREPRENEURSHIP ON SOCIETIES AND CASES **8**

Static Impact of Social Entrepreneurship. Impact of Charitable NGOs vs. Social Entrepreneurship, Impact of For-Profit Companies vs. Social Entrepreneurship. Social entrepreneurship report preparation by students. Case Study of Social Entrepreneurs

Total Hours: 45

REFERENCES:

1. "Social Entrepreneurship: New models of sustainable social change" Alex Nicholls, Oxford University Press 2006
2. The Process of social value creation: A multiple case study on Social Entrepreneurship in India , Archana Singh Springer 2016
3. "Social Entrepreneurship and social business" Christine K Volkmann, Springer Gabler 2012
4. "Social Entrepreneurship" Manuel London ,Routlege, 2010

OUTCOMES:

The students can able to

- Conceptualize social entrepreneurship in terms of a theoretical framework between changing social values and institutions
- Think and communicate about social values
- Learn about practical models of social change to launch, lead, manage, and evaluate a social venture
- Analyze funding needs and sources for the social venture
- Experience the ideas can be critically and collaboratively examined prior to commitment.

ENC3181 SOFT SKILLS FOR CAREER

L	T	P	C
0	0	2	1

OBJECTIVES:

- To enable students to gain knowledge about industries, work culture and ethics.
- To develop students' critical reading and writing skills.
- To develop students' problem solving , analytical and leadership skills.
- To train them in presentation, group discussion and team building skills

MODULE I **6**

Brief about industries- Analyzing work culture and ethics of multinational companies and SME(Small and Medium Enterprises) - Knowledge about etiquette (different types)

MODULE II **6**

Visiting industries and writing reports based on their visit.

MODULE III **4**

Analysing industry related problems - case studies.

MODULE IV **6**

Developing Leadership skills - various aspects of leadership - time management -people skills.

MODULE V **8**

Team building skills-- group discussions -- preparing for interviews- interpersonal skills.

Total Hours: 30

REFERENCES:

1. Covey,S.R. (2004). The 7Habits of Highly Effective People: Powerful Lessons in Personal Change. Free Press.UK
2. Fine, P.M. & Alice Olins. (2016).Step up: Confidence, Success and Your Stellar Career in 10 Minutes a Day. Vermilion.UK
3. Pai, A. (1993).How to Develop Self-Confidence. Soma Books Ltd.
4. Wentz, F.H. (2012). Soft skills training: A Workbook to Develop Skills for Employment. Createspace Independent Pub; Large Print edition (14 May 2012)

OUTCOMES:

After the completion of the course, students would be able to

- Demonstrate knowledge about industries/workplace.
- Write reports in simple and clear language.
- Exhibit problem solving and leadership skills.
- Make presentations and take part in discussions

MEC3101 DYNAMICSOFMACHINERY

L	T	P	C
3	1	0	4

OBJECTIVES:

- To study the basics of static and dynamic forces in mechanisms
- To learn about the engine dynamics
- To educate the significance of imbalance inmachineries
- To study the basics of undamped free vibrations
- To acquire knowledge on damped free and forced vibrations
- To comprehend the dynamics of control mechanisms

MODULE I FUNDAMENTALS OF DYNAMICS 9

Introduction on static force analysis, Static Equilibrium, Equilibrium of Two force and three-force members, Member with Two force and a torque, Force convention, free body diagrams, Principle of Superposition. D-Alembert's Principle- Inertia Force Analysis of Mechanisms.

MODULE II ENGINE DYNAMICS 9

Velocity and acceleration of piston-Torque exerted on the crank shaft when friction and inertia of moving parts are neglected- Forces on the reciprocating parts of an engine considering friction and inertia of moving parts, Dynamically equivalent system, Turning moment diagrams-Fly wheels Engine shaking Forces.

MODULE III BALANCING OF MASSES 10

Introduction to balancing, Static balancing, dynamic balancing, balancing of several masses in same planes, balancing of several masses in different planes, Balancing of Reciprocating masses, balancing of locomotives, balancing of inline engines, balancing of V-engines.

MODULE IV UN-DAMPED FREE VIBRATIONS 10

Natural frequencies of free longitudinal vibrations of systems having single degree of freedom- Equilibrium method-Energy method and Rayleigh's method- Natural of free transverse vibrations due to point load and UDL acting over a simply supported shaft, dunkerley's method, critical speed of a shaft- Natural frequency of free torsional vibrations of a single rotor system, two rotor and three rotor system.

MODULE V DAMPED FREE AND FORCED VIBRATIONS 10

Damping factor and Logarithmic Decrement in free vibration- Forced Vibration- Steady state amplitude –Vibration due to Imbalance- Vibration isolation and transmissibility ratio for the systems subjected to forced vibrations.

MODULE VI CONTROL MECHANISMS 12

Introduction to Governors, types of Governor, Watt Governor, Porter governor, Proell Governor, Hartnell Governor, Sensitivity, Stability, Isochronism, Hunting, Governor Effort and Power, controlling force. Introduction, Precessional angular motion, gyroscopic couple, effect of gyroscopic couple on an aero plane, effect of gyroscopic couple on a naval ship -stability of a four wheel drive moving in a curved path- stability of a two wheel vehicle taking a turn.

L – 45; T – 15; Total Hours: 60

REFERENCES:

1. S.S.Rattan, 'Theory of Machines', Tata McGraw Hill Publishing Company Ltd., New Delhi, 1994.
2. Design of Machinery by R.L. Norton, Mc Graw Hill Publications.
3. J.E.Shigley and J.J.Uicker, Theory of machines and Mechanisms, McGraw Hill, Inc., 1995.
4. Theory of Machines by Thomas Bevan, Pearson education publications.
5. A.Ghosh and A.K. Mallick, 'Theory of Mechanisms and Machines', Affiliated East-West Press Pvt. Ltd., New Delhi, 1988.
6. Theory of Machines by P.L. Ballaney, Khanna Publications.
7. Theory of Machines by R.S. Khurmi & J.K.Gupta, S. Chand Publications.

OUTCOMES:

Student should be able to

- Identify the static and dynamic forces in mechanisms
- Analyse the dynamics of engine
- Determine the level of imbalance in machineries
- Solve problems on undamped free vibrations in mechanisms
- Analyse damped free and forced vibrations in machines
- Illustrate the dynamics of control mechanisms

ECC3181	ELECTRONICSFORMECHANICAL SYSTEMS	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To study the characteristics of semiconductor devices such as diodes, transistors and their applications.
- To study fundamentals of digital logic circuits.
- To study 8085 microprocessors and its interfacing with other peripheral devices.

MODULE I SEMICONDUCTORS AND RECTIFIERS 8

Classification of solids based on energy band theory-Intrinsic semiconductors-Extrinsic semiconductors-P type and N type-PN junction and its application – Zener diode. Bipolar junction transistor- CB, CE, CC configuration and characteristics- Field effect transistor: Configuration and characteristic-SCR, DIAC, TRIAC, UJT Characteristics and simple applications.

MODULE II DIGITAL ELECTRONICS 7

Number systems- Binary Arithmetic Operations-Boolean Algebra-Logic gates-Karnaugh map: SOP, POS.

MODULE III COMBINATIONAL AND SEQUENTIAL CIRCUITS 8

Combinational Circuits: Half and full adders- Magnitude Comparator- Multiplexer/ Demultiplexer- encoder / decoder Sequential circuits: Flip Flops: SR, JK, D and T FF- Truth tables and circuits-Shift Registers-Ripple Counters.

MODULE IV 8085 MICROPROCESSOR AND APPLICATIONS OF MICROPROCESSOR 7

Architecture of 8085-Pin configuration - Instruction set-Addressing modes- Simple programs using arithmetic and logical operations. Applications - printed boards-Arduino / Raspberry Pi

Total Hours: 30

TEXT BOOKS:

1. Milman and Halkias, "Integrated Electronics", Tata McGraw-Hill publishers, 1995.

2. Ramesh Goankar, "Microprocessor Architecture", Programming and Applications with 8085, Wiley Eastern, 1998.

REFERENCES:

1. Malvino and Leach, "Digital Principles and Applications", Tata McGraw- Hill,1996
2. Mehta V.K, "Principles of Electronics", S. Chand and Company Ltd, 1994
3. Dougles V.Hall, "Microprocessor and Interfacing", Programming and Hardware, Tata McGraw-Hill, 1999.
4. Salivahanan S, Suresh Kumar N, Vallavaraj A, "Electronic Devices and Circuits" First Edition, Tata McGraw-Hill, 1999.

OUTCOMES:

The student should be able to understand

- Working principles and characteristics of various semiconductor devices.
- Different digital logic circuits: Combinational and sequential circuits.
- Architecture of 8085, its features and programming for specific application.

MEC3102	THERMALENGINEERING (INTEGRATEDLAB)	L	T	P	C
		3	0	3	4

(Use of Steam Tables, Mollier Diagram, Psychrometric chart and Refrigeration property Tables are permitted in the University examination)

OBJECTIVES:

- To impart knowledge on working and performance of IC engines, steam nozzles, turbines and air compressors.
- To comprehend the cycles and systems of refrigeration and air conditioning
- To learn the working principle of IC engines
- To study the performance of various engines under different loadings
- To learn the various heat transactions within and outside the engines
- To acquire knowledge on the properties of fuels and exhaust gases

MODULE I I.C. ENGINES 10

Classification of IC engine - components and functions. Two stroke and Four stroke engines - working principle, actual and theoretical valve timing diagrams, port timing diagrams and PV diagrams. Comparison - two stroke and four stroke engines- petrol and diesel engines. Fuel supply systems and ignition systems, Lubrication system and cooling system

MODULE II AIR STANDARD CYCLES AND IC ENGINE PERFROMANCE 10

Otto, Diesel, Dual, Brayton cycles - Calculation of mean effective pressure and air standard efficiency, Actual and theoretical PV diagram of two stroke and four stroke engines. Performance test on IC engine and Heat balance calculation. Knocking and Detonation. Exhaust gas analysis, pollution control norms.

MODULE III STEAM NOZZLES AND TURBINES 10

Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ratio, super saturated flow. Impulse and reaction principles, compounding, velocity diagrams for simple and multistage turbines, speed regulations - governors and nozzle governors.

MODULE IV AIR COMPRESSORS 10

Classification and working principle, work of compression with and without clearance. Volumetric efficiency, Isothermal efficiency and isentropic efficiency of reciprocating air compressors. Multistage air compressor and inter cooling – working of multistage air compressor, Problems in single and two stage air compressors. Various types of compressors (Descriptive treatment only)

MODULE V REFRIGERATION SYSTEMS 10

vapour compression refrigeration cycle - super heating, sub cooling-performance calculations. Working principle of vapour absorption system. Ammonia - water, Lithium bromide - water systems, comparison between vapour compression and absorption systems.

MODULE VI AIR-CONDITIONING SYSTEMS 10

Psychrometry, Psychometric chart, cooling load calculation, Concept of RSHF, GSHF, ESHF. Air conditioning Systems - summer and winter air conditioning systems Requirements for comfort and industrial air-conditioning.

List of Experiments:

1. (a)Experimental study on valve timing diagram in 4-stroke engine cut model.
   (b)Experimental study on port timing diagram in 2-stroke engine cut model.
2. Experiment on Fuel properties
   a) Viscosity
   b) Fire and Flash point
   c) Calorific Value
3. Performance test on constant speed 4-stroke diesel engine.
4. Heat balance test on 4-stroke twin cylinder diesel engine.
5. IC engine performance and heat balance evaluation using PC interface.
6. Motoring test on 4-stroke diesel engine with electrical loading.
7. Retardation test on 4-stroke diesel engine with mechanical loading.
8. Study on the composition of Exhaust gas of an IC engine using Orsat Apparatus under various loads.
9. Performance test on high pressure two stage reciprocating air compressor.
10. Experiment on air conditioning unit.
11. Experiment on vapour compression refrigeration unit.

12. Experiment on Vapour absorption refrigeration unit.

L – 45; P-15; Total Hours: 60

TEXT BOOKS:

1. Rajput, R.K, " Thermal Engineering", 8th Edition, Laxmi Publications Pvt Ltd., 2010

REFERENCES:

1. Rudramoorthy R, "Thermal Engineering", Tata McGraw Hill Publishers Co. Ltd., New Delhi, 2006.
2. Sarkar .B.K, "Thermal Engineering", Tata McGraw Hill Publishers Co. Ltd., New Delhi, 2005.
3. Ganesan V, "Internal Combustion Engine", 3rd edition, Tata McGraw Hill Publishers Co. Ltd., New Delhi, 2008.
4. Rajput, R.K, "Thermal Engineering", 8th edition, Laxmi publications Pvt Ltd., 2010
5. Arora. C.P. "Refrigeration and Air conditioning" 3rd edition, Tata McGraw Hill Publishers Co. Ltd., 2008.
6. Frank Kreith, "Hand Book of thermal Engineering", CRC press, 2000.
7. Manohar Prasad, "Refrigeration and Air-conditioning" 2nd edition, new age international, 2003.

OUTCOMES:

The students should be able to

- Explain the working and performance of IC engines, steamnozzles, turbines and air compressors.
- Illustrate the cycles and systems of refrigeration and air conditioning
- Analyze the performance and emission of IC engines
- Evaluate the performance of various engines
- Measure various heat transactions within and outside the engines
- Determine the properties of fuels and exhaust gases

MEC3103 MECHANICSLAB

L	T	P	C
0	0	3	1

OBJECTIVES:

- To study the various principles of mechanics using simple mechanisms.
- To study the various controlling mechanisms such as governors and gyroscope.
- To determine the vibration parameters under various modes of vibration.

LIST OF EXPERIMENTS:

1. Governors - Determination of sensitivity, effort, etc. for watt, porter, proell, Hartnell governors.
2. Cam - Study of jump phenomenon and drawing profile of the cam.
3. Motorised Gyroscope-Verification of law's -Determination of gyroscopic couple.
4. Whirling of shaft-Determination of critical speed of shaft with concentrated loads.
5. Balancing of reciprocating masses.
6. Balancing of rotating masses.
7. Determination of Moment of inertia by oscillation method for connecting rod and flywheel.
8. Vibrating system Spring mass-system-Determination of damping co-efficient of single degree of freedom system.
9. Determination of influence co-efficients for multi degree freedom suspension system.
10. Determination of transmissibility ratio - vibrating table.
11. Determination of torsional frequencies for compound pendulum and flywheel –system with lumped Moment of inertia
12. Transverse vibration –free- Beam. Determination of natural frequency and deflection of beam.

Total Hours: 45

OUTCOMES:

The students should be able to

- Apply the principles of mechanics in real time mechanisms.
- Be familiar with various controlling mechanisms.
- Analyze the vibration parameters under various modes of vibration.

ECC3182	ELECTRONICSLAB	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To study the characteristics of various electronic devices.
- To learn the usage of microprocessor and controllers for various operations.

LIST OF EXPERIMENTS:

1. VI characteristics of PN Junction Diode
2. VI characteristics of Zener Diode
3. Characteristic of CE Transistor
4. Characteristics of JFET
5. Characteristics of Uni Junction Transistor
6. Study of Logic Gates (Basic Gates)
7. Half Adder and Full Adder
8. Shift Register
9. Ripple counter
10. bit addition, subtraction
11. Multiplication and division
12. Maximum and Minimum of block of data
13. Sorting and block transfer
14. Stepper Motor Interfacing
15. Traffic light controller

Total Hours: 45

OUTCOMES:

Students will be able to

- Analyze the characteristics of various electronic devices.
- Apply microprocessors and controllers for various operations.

SEMESTER VI

MSC3181	LEADERSHIP AND CEOTRAINING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course aims at

- Bringing about positive transformation in students' attitude.
- Building unique leadership competencies that would ensure successful transition of students across all career stages.
- Sensitizing students to identify their strengths & weakness and training them to deal with it
- Assisting students in enhancing their expressive ability and inducing a high level of self-confidence to manage both business and emotions
- Training students to become more adaptable and flexible to changing business environment

MODULE I INTRODUCTION TO LEADERSHIP 12

Leadership concept - meaning, definitions, importance of leadership, leadership traits. Leadership functions- general functions, listening, observing, managing and decision making. Components of leadership - leaders, followers and situation. Leadership theories – Trait theory, Skills theory, Style theory, Situational theory, Transformational theory, Transactional theory, Path Goal Theory and LMX. Assessing emotional intelligence and exploring the capabilities and inherent traits. through psychometric tests - Multi factor leadership questionnaire and personal reflections

MODULE II LEADERSHIP STYLE AND COMMUNICATION 8

Leadership styles-visionary, Coaching, Affiliative, Democratic, Pacesetting Commanding, Transformational, Transactional. Autocratic, Participative, Laissez-Faire Leader versus Managers. Leadership communication - Rationale, tactic, assertive, formal, informal, communication in crisis- leadership and negotiations, Leadership Presentations-convincing and impressive style

MODULE III LEADERSHIP ROLES 8

Facets of leadership- Leader as an individual – personality and leadership, values, attitudes and ethics of a leader. Leader as a relationship builder- empowering people to meet higher order needs, initiating organization wide motivational programs, involvement with all stakeholders- focusing on organization growth. Leader as an inspirer- motivation and leadership, recognizing and appreciating contributions, empowering others to lead Leader as an innovator –leader's role in shaping culture and values in an organization. Leader as a Liaison- Leader as team player

MODULE IV LEADERSHIP CHALLENGES AND STRATEGIES 9

Challenges in leadership: Perception of organization culture and values, interpreting the power dynamics in the organization, establishing work life balance. Bad leadership – Reasons and impact.-Case Study of Marissa Mayer-Yahoo. Inc Organizational transformation through efficient leaders-Case study of Apple Inc. Blue Ocean Leadership-Steps to Blue ocean Leadership-Four Pillars of Blue Ocean leadership-Blue Ocean leadership grid

MODULE V LEADERSHIP AND CEO TRAINING 8

Leader as a CEO: Traits of a successful CEO, Key responsibilities of a CEO, the path to be a CEO ,Training on Board Room Discussions, Meeting the CEO –Live sessions with industry CEO's. Requirements of Leadership: - Cognitive skills, Interpersonal skills, Business skills, Strategic skills. Role of Emotional Intelligence in taking up key-positions in the organization.

Teaching Pedagogy:

Nurturing – Based on the identified strengths and weaknesses, training will be given to enhance the strengths and overcome the weakness.

Assessment - Continuous evaluation will be effected through group discussions, oratory assignments and situational enactments. Pre-and post-training assessment through peer reviews and faculty feedback.

Sustained development – Training will be imparted for self-development and monitoring of leadership skills to ensure sustained applicability of the skills learnt.

Total Hours: 45

REFERENCES:

1. Andrew J DuBrin. “Leadership: Research Findings, Practice, and Skills”, 8th Edition, South-Western College Pub, 2015.
2. Yukl G, “Leadership in Organisations”, 8th Edition, Pearson Education, 2013.
3. Richard L Daft, “Leadership”, 5th Edition, South Western Cengage Learning 2012.
4. Stephen P. Robbins and Timothy A. Judge. “Organizational Behaviour”, 15th Edition, New Delhi: Pearson, 2013.
5. Fred Luthans, “Organizational Behavior, An Evidence Based Approach”, 12th Edition, New Delhi: McGraw Hill Education, 2013.
6. Emotional Intelligence, Why it can matter no more than IQ by Daniel Goleman (include a book) Publisher: Bloomsbury Publishing India Private Limited; Latest edition (2017)
7. Primal Leadership: Unleashing the Power of Emotional Intelligence by Prof Daniel Goleman , Richard Boyatzis and McKee ,Harvard Business Review Press

RECOMMENDED READINGS:

1. Jim Collins, (2001). “Good To Great: Why Some Companies Make the Leap...And Others Don't”, Random House Publishers India Pvt.Ltd, New Delhi
2. George, B. with Sims, P. True North: Discover Your Authentic Leadership, The Times Group Books; First edition (1 October 2015)
3. Kim, W. C., & Mauborgne, R. A. (2014). Blue ocean strategy, expanded edition: How to create uncontested market space and make the competition irrelevant. Harvard business review Press
4. Leadership Wisdom by Robin Sharma Jaico Publishing House;

OUTCOMES:

The students will be able to

- Explore through self-introspection one’s own leadership style, their strength and weakness
- Gain self-confidence to lead a team in the organization
- Realize the role of leadership in making or breaking of an organization

- Acquire the practice of self-introspection and development of leadership competencies thorough continuous efforts
- Manage their own emotions as well as other resulting in successful relationship building with all stakeholders

MSC3182 SOCIAL ENTREPRENEURSHIP

L	T	P	C
3	0	0	3

OBJECTIVES:

- To be able to understand the field of social entrepreneurship and Social problems
- To be able to describe and understand the traits of social entrepreneurs
- To recognize the social business opportunities
- To synthesize the resource mobilization ways for social entrepreneurship
- To understand the social entrepreneurship models
- To recognize the impact of social entrepreneurship on societies

MODULE I INTRODUCTION TO SOCIAL ENTREPRENEURSHIP 7

Introduction - Emergence and Development of Social Entrepreneurship. Social Problems in India: An Overview. Social Development: The Indian Scenario. Emergence of Social Entrepreneurs and Sustainable Solutions to Social Problem. Characteristics and Context of Social Entrepreneurship .The Role of Social Entrepreneurship in Societies & Economies.

MODULE II SOCIAL ENTREPRENEURSHIP: DRIVERS AND CHALLENGES 7

The Drivers of Social Entrepreneurship. Elements of the Social Entrepreneurial Personality. Challenges of financial constraints. Challenge to attract and cultivate talented workers. Challenge of evaluation of social entrepreneur impact. Challenge of scaling and its impact. Cases

MODULE III SOCIAL ENTREPRENEURSHIP: OPPORTUNITY RECOGNITION 7

Opportunity Recognition and Planning Process. Opportunities for Social Entrepreneurs. The Nature of Social Entrepreneurial Opportunities. Social Problems into Opportunities. Idea development and conceptualization of social problem. Cases

MODULE IV RESOURCE MOBILIZATION FOR SOCIAL VENTURE 8

Resources at Initial Stage. Social Network as a role of Social Capital. Team and Collective Efforts. Need and Determination of Important Resources. Resource of

Knowledge, Skills and Abilities. Overview of venture capital and angel investment. Cases

MODULE V BUSINESS MODELS AND BUSINESS PLAN FOR SOCIAL ENTERPRISES **8**

Design Principles of Social Entrepreneurship Business Models, Evaluation of the Root Cause of a Societal Problem. Developing business plan for social ventures. Developing an investor presentation. Feasibility study and report. How to start a business - Procedures for registration of small scale industry

MODULE VI THE IMPACT OF SOCIAL ENTREPRENEURSHIP ON SOCIETIES AND CASES **8**

Static Impact of Social Entrepreneurship. Impact of Charitable NGOs vs. Social Entrepreneurship, Impact of For-Profit Companies vs. Social Entrepreneurship. Social entrepreneurship report preparation by students. Case Study of Social Entrepreneurs

Total Hours: 45

REFERENCES:

1. "Social Entrepreneurship: New models of sustainable social change" Alex Nicholls, Oxford University Press 2006
2. The Process of social value creation: A multiple case study on Social Entrepreneurship in India , Archana Singh Springer 2016
3. "Social Entrepreneurship and social business" Christine K Volkmann, Springer Gabler 2012
4. "Social Entrepreneurship" Manuel London ,Routlege, 2010

OUTCOMES:

The students can able to

- Conceptualize social entrepreneurship in terms of a theoretical framework between changing social values and institutions
- Think and communicate about social values
- Learn about practical models of social change to launch, lead, manage, and evaluate a social venture
- Analyze funding needs and sources for the social venture
- Experience the ideas can be critically and collaboratively examined prior to commitment.

ENC3281 English for Workplace

L	T	P	C
0	0	2	1

OBJECTIVES:

- To develop students' proficiency in English at CEFR B2 level (Business Vantage).
- To develop students' receptive skills (Listening and Reading) in a wide range of situations.
- To develop students' productive skills (Speaking and Writing) in a wide range of situations.
- To expose students to the nuances of the English language, grammar and usage

MODULE I **6**

SPEAKING

Taking part in interview sessions by assuming roles of an interviewer and interviewee- exchanging information in question answer format-use of question tags, direct questions-all in real life contexts, Pronunciation

READING

Reading short passages and answering matching tasks and error identification

LISTENING

Listening to audio recordings of short extracts of business-related texts and making note completion tasks.

WRITING

Writing intra office communication like a note, message for about 40-50 words.

MODULE II **6**

SPEAKING

Role play, participating in short talks relating to business topics-Discussion on a business related topic.

READING

Reading longer texts and answering questions

LISTENING

Listening to audio recordings of telephone calls, face to face conversations and attempting exercises on gap filling involving information in words on numerical data and completing the task.

WRITING

Writing a memo or email to a colleague or colleagues within a company-Writing letter of application with resume, Writing reports on conference, seminars etc.

MODULE III **6**

SPEAKING

Giving presentations on business related topics involving decision making for one minute.

READING

Reading texts related to business topics and answering multiple- choice questions.

LISTENING

Listening to audio recordings of interviews and answering multiple-choice questions.

WRITING

Writing a short report, proposal from the notes given in about 120-140 words, writing replies to customers.

MODULE IV **8**

SPEAKING

Group Discussion-Taking part in discussions-Exchanging information.

READING

Reading excerpts taken from newspapers, magazines and answering questions.

LISTENING

Listening to a range of business related conversations, interviews, telephone calls, face to face conversations and attempting questions based on them.

WRITING

Writing a letter of enquiry, letter of complaint, sales letter.

MODULE V **4**

GRAMMAR &VOCABULARY

Use of sequence words, collocations, linking words and phrases, coherence and cohesion, Business Vocabulary

Total Hours: 30

REFERENCES:

1. Guy Brook-Hart, 'Business Benchmark-Upper Intermediate, 2nd edition, Cambridge University Press, Shree Maitrey Printech Pvt. Ltd, Noida, 2016.
2. Leo Jones, 'New International Business English' Students book. Cambridge University Press, Cambridge, 2003.
3. Simon Sweeney, 'Communicating in Business' Teacher's Book. Cambridge University Press, Cambridge, 2004.
4. Simon Sweeney, 'Communicating in Business' Student's Book. Cambridge University Press, Cambridge, 2003.
5. Bill Mascull. 'Business Vocabulary in Use'. Advanced. Cambridge University Press, Cambridge, 2004.

OUTCOMES:

After completing the course students would be able to

- Use the LSRW skills effectively in business and in general situations.
- Demonstrate receptive skills effectively in various formal and informal communication situations.
- Demonstrate productive skills effectively in various formal and informal communication situations.
- Use appropriate grammar and vocabulary in any context.

MEC3211 MACHINEDESIGN

L	T	P	C
3	1	0	4

OBJECTIVES:

- To learn steady stresses and variable stresses in a machine component
- To impart knowledge on design of shafts and couplings
- To educate the design process of temporary and permanent joints
- To acquire knowledge on design of energy storing elements
- To learn the design of bearings
- To educate the design of miscellaneous components

MODULE I STEADY STRESSES AND VARIABLE STRESSES 12

Introduction to the design process - factors influencing machine design, selection of materials based on mechanical properties - Direct, Bending and torsional stress equations –calculation of principle stresses for various load combinations, eccentric loading – design of curved beams – crane hook and 'C' frame - factor of safety - theories of failure – stress concentration – design for variable loading, fatigue– Soderberg, Goodman and Gerber relations.

MODULE II DESIGN OF SHAFTS AND COUPLINGS 10

Design of solid and hollow shafts based on strength, rigidity and critical speed - Design of Keys, key ways and splines - Design of rigid, flange and muff couplings.

MODULE III DESIGN OF TEMPORARY AND PERMANENT JOINTS 10

Threaded fasteners - Design of bolted joints including eccentric loading, Knuckle joints – Design of welded joints, riveted joints for structures - theory of bonded joints-Limitations of bonded joints - Applications

MODULE IV DESIGN OF ENERGY STORING ELEMENTS 8

Design of helical and leaf springs - Design of flywheels considering stresses in rims and arms for engines and punching machines.

MODULE V DESIGN OF BEARINGS 12

Sliding contact and rolling contact bearings -Design of hydrodynamic journal bearings, McKee's Eqn., Sommerfield Number, Raimondi & Boyd graphs – Derivation of McKee's Eqn - Selection of Rolling Contact bearings.

MODULE VI DESIGN OF MISCELLANEOUS ELEMENTS 8

Design of Seals and Gaskets -Design of crankshafts- Design of Connecting Rod.

L – 45; T – 15; Total Hours:60

TEXT BOOKS:

1. Shigley J.E, Mischke C. R., "Mechanical Engineering Design", 6th Edition, Tata McGraw-Hill, 2003.
2. Bhandari V.B, "Design of Machine Elements", 6th Edition, Tata McGraw-Hill Book Co, 2007.

REFERENCES:

1. Sundararajamoorthy T.V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.
2. Orthwein W, "Machine Component Design", Jaico Publishing Co, 2003.
3. Ugural A.C, "Mechanical Design – An Integral Approach", McGraw-Hill Book Co, 5. 2004.
4. Spotts M.F., Shoup T.E, "Design and Machine Elements" Pearson Education, 2004.

OUTCOMES:

Students should be able to

- Identify the steady and variable stresses in a machine component
- Solve the problems on design of shafts and couplings
- Apply the knowledge on design of temporary and permanent joints
- Design the key parameters of energy storing elements
- Design different types of bearings for various loading
- Design of miscellaneous components for given conditions

MEC3212	METROLOGY AND MECHANICAL MEASUREMENTS (INTEGRATED LAB)	L	T	P	C
		3	0	3	4

OBJECTIVES:

- To study the basic concepts of measurement
- To learn the linear and angular measuring techniques
- To impart knowledge on form and finish measurements
- To acquire knowledge on laser and advanced metrology
- To educate about measurement of power flow and temperature related properties
- To learn about sensors and sensing systems for process, system and condition monitoring techniques

MODULE I CONCEPT OF MEASUREMENT 10

Definition of metrology, General Concepts of measurement system-Units and standards-measuring instruments- sensitivity, readability, range of accuracy, precision-static and dynamic response-repeatability-Measurement system behavior: General model for dynamic measurement system and special cases: zero order, first order and second order system, determination of time constant and settling time, phase linearity- systematic and random errors-correction, calibration, interchangeability, traceability. Statistical concepts: Mean, Range, Variance and Standard deviation in error analysis.

Hands on Practice : Calibration and Error analysis of measuring Instruments

MODULE II LINEAR AND ANGULAR MEASUREMENTS 11

Linear measuring instruments: Slip gauges, Tool Maker's microscope, limit gauges. Comparators: Mechanical, pneumatic and electrical types, applications. Angular measurements: -Sine bar, bevel protractor-Taper angle measurements.

Hands on Practice: Complete all measurements including intricate internal details of the given component using standard equipment and by other measuring procedures, Setting up of comparators for inspection (Mechanical / Pneumatic / Electrical), Measurement of angle using Sine bar / Sine Center / Toolmakers microscope/ Slip gauge. Measurement of taper using standard balls / rollers. Measurement of straightness and flatness.

MODULE III FORM AND FINISH MEASUREMENT 10

Form measurement- Measurement of screw threads- floating carriage micrometer-measurement of gears-tooth thickness-constant chord and base tangent method- straightness, flatness and roundness measurements- surface finish-surface roughness tester.

Hands on Practice: Measurement of thread parameters and Measurement of gear parameters.

MODULE IV LASER AND ADVANCES IN METROLOGY 9

Precision instruments based on laser-Principles- laser interferometer-application in measurements and machine tool metrology- Coordinate measuring machine (CMM): need, construction, types, applications - computer aided inspection. Machine Vision systems - principle and functions.

Hands on Practice: Scanning the surface using Coordinate Measuring Machine (CMM). Measurement using vision system.

MODULE V MEASUREMENT OF POWER FLOW AND TEMPERATURE RELATED PROPERTIES 10

Response of Measuring System: Amplitude, Frequency and Phase - Force, torque measurement- mechanical, pneumatic, hydraulic and electrical type-Flow measurement-Temperature measurement- bimetallic strip, pressure thermometers, thermocouples, electrical resistance thermistor.

Hands on Practice: Measurement of Temperature. Measurement of Displacement, Force and Torque.

MODULE VI SENSORS AND SENSING SYSTEMS FOR PROCESS, SYSTEM AND CONDITION MONITORING 10

Vibration measurement – Vibrometers and accelerometers, test methods and calibration- Acoustic Measurement- AE Parameters, principles of acoustic emission techniques ,– Advantages, limitations and applications –Acoustic sensors- piezo electric sensors -Microphones and its types.

Hands on Practice: Measurement of vibration

L – 45; P-15; Total Hours : 60

TEXT BOOKS:

1. Jain R.K., “Engineering Metrology”, Khanna Publishers, 2009
2. Alan S. Morris, “The Essence of Measurement”, Prentice Hall of India, 1997

REFERENCES:

1. Gupta S.C, “Engineering Metrology”, Dhanpat rai Publications, 2005.
2. Beckwith T.G, and R.D. Marangoni, “Mechanical Measurements”, Addison Wesley, 2007
3. Donald D Eckman, “Industrial Instrumentation”, Wiley Eastern, 1985.
4. ASTME, “hand book of industrial metrology” Prentice Hall of India, 1988
5. ASNT, “Nondestructive testing handbook Emission” Volme.5-Acoustic emission testing,1994

OUTCOMES:

Students should be able to

- Explain the basic concepts of measurement
- Perform the linear and angular measurements
- Execute form and finish measurements
- Demonstrate the laser measurement and advanced metrology
- Measure the power flow and temperature
- Use sensors and sensing systems for process, system andcondition monitoring techniques

MEC3213	HEAT AND MASS TRANSFER	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the different modes of heat transfer and their application in engineering
- To learn heat conduction equation in steady and transient states
- To impart knowledge on boundary layer development in convection process
- To educate thermal radiation with the influence of orientation of surfaces
- To learn various types of heat exchangers and boiling heat transfers
- To comprehend the basic concepts of mass transfer.

MODULE I BASIC OF HEAT TRANSFER & GOVERNING EQUATIONS 10

Basic Concepts- Modes of heat transfer- conduction, convection, and radiation, Fourier law of heat conduction, three-dimensional heat conduction equations in various co-ordinate systems, steady state heat conduction equation for plane, cylindrical and spherical shapes- overall heat transfer co-efficient, Composite systems, Critical radius of insulation.

MODULE II CONDUCTIVE HEAT TRANSFER 7

Variable thermal conductivity, heat transfer with heat generation in different shapes. Extended surfaces (fins)-numerical methods for varying sections of fins with different end conditions. Transient heat conduction Lumped parameter systems, infinite solids, semi-infinite solids, numerical and graphical methods.

MODULE III CONVECTIVE HEAT TRANSFER 7

Concepts of Boundary Layer: Differential and integral equations for hydrodynamics and thermal boundary layer. Convection Heat Transfer: Forced Heat transfer from flat plate, laminar and turbulent flow, cylinders and spheres, flow through tubes. Free convection, heat transfer from vertical and horizontal surfaces.

MODULE IV RADIATION HEAT TRANSFER 6

Radiation Heat Transfer: Emissive power, grey body. Radiation heat transfer between surfaces, shape factor.-Electrical analogy, Gas radiation.

MODULE V HEAT EXCHANGERS 9

Types-tube arrangements, single and multi-tube types, parallel, counter and cross flow, Overall heat transfer coefficient, Analysis – LMTD method, - NTU method. Fouling factor. Boiling and Condensation: Boiling heat transfer - bubble growth, freezing and melting. Condensation, film condensation and drop wise condensation.

MODULE VI MASS TRANSFER 6

Mass Transfer: Basic Concepts- Diffusion mass transfer- Fick's law of diffusion steady state molecular diffusion- convective mass transfer- momentum, Heat and mass transfer analogies- convective mass transfer correlations.

Total Hours: 45

REFERENCES:

1. Holman J P, "Heat Transfer", 9th edition, Tata McGraw Hill Inc., New York, 2008.
2. S. P. Sukhatme, "Text book of Heat transfer" 4th edition, University Press (India) Pvt. Ltd. 2006.
3. Yunus A Cengel, "Heat Transfer: A Practical Approach", 2nd Edition, Tata McGraw Hill Inc., New York, 2005.
4. Sachdeva R C, "Fundamentals of Engineering Heat and Mass Transfer", 4th edition, New Age International Publishers, New Delhi, 2010.
5. Nag P K., "Heat and Mass Transfer", Tata McGraw Hill Publishing Company, New Delhi, 2004.
6. Suhas V Patankar, "Numerical Heat transfer and fluid flow", ane books, 1st edition series in computational methods in mechanics and thermal sciences.
7. Frank P Incropera and David P Dewitt, "Heat and Mass Transfer", 5th edition 2001, Wiley.
8. Donald Q Kern, "Process Heat Transfer", TMH.

OUTCOMES:

The student should be able to

- Apply different modes of heat transfer and their application in engineering
- Solve heat conduction problems in steady and transient states
- Apply principle of convection and their relation to fluid dynamics
- Evaluate thermal radiation with the influence of orientation of surfaces
- Analyse various types of heat exchangers and boiling heat transfers
- Explain the basic concepts of mass transfer

MEC3214	HEAT AND MASSTRANSFER LAB	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To experimentally study the different modes of heat transfer.
- To determine the parameters such as thermal conductivity, heat transfer coefficient and Stefan Boltzmann constant.

LIST OF EXPERIMENTS:

1. Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.
2. Thermal conductivity of metal rod.
3. Thermal Conductivity of liquids.
4. Heat transfer through composite wall.
5. Thermal conductivity measurement using guarded plate apparatus.
6. Determination of heat transfer coefficient under natural convection from a vertical cylinder.
7. Determination of heat transfer coefficient under forced convection from a tube.
8. Heat transfer from pin-fin (natural & forced convection modes)
9. Determination of Stefan – Boltzmann constant.
10. Determination of emissivity of a grey surface.
11. Heat transfer studies on pool boiling.
12. Effectiveness of Parallel / counter flow heat exchanger.
13. Drop and Film-wise condensation study
14. Transient heat conduction study

Total Hours: 45

OUTCOMES:

- Students should be able to apply heat laws and equations to measure heat transfer

MEC3215 CNC LAB

L	T	P	C
0	0	3	1

OBJECTIVES:

- To learn part programming for CNC machines.
- To practice tool path simulation in CAD/CAM software.
- To generate NC code for CNC controllers from 3D models.
- To familiarize interfacing between software and machines.

LIST OF EXPERIMENTS:

CNC Lathe:

- Part programming for Linear and Circular interpolation.
- Part programming using standard canned cycles for Turning.

CNC Mill:

- Part programming for Linear, Circular interpolation and Contour motions.
- Part programming involving canned cycles for Drilling, Peck drilling and Boring.
- Modelling and Simulation in CAD/CAM software:
- Tool path generation and Mould design from 3D models using CAD/ CAM software.
- Post processing for standard CNC Controllers like FANUC, Sinumerik etc.
- Designing and realizing a product:
- Design a simple product and its required tooling and simulate its 3D model.
- Generate NC codes and interface with CNC machine to realize the product.

Total Hours: 45

TEXT BOOKS:

1. Lab Manual.

REFERENCES:

1. P.N. Rao, “CAD / CAM Principles and Applications”, 2nd Edition, Tata Mc Graw Hill, 2004.
2. Ibrahim Zeid, “CAD/CAM - Theory and Practice”, McGraw Hill, International Edition, 1998.

OUTCOMES:

Students should be able to

- Write part programs and operate CNC lathe.
- Write part programs and operate CNC milling machine.
- Choose proper manufacturing processes and tooling for machining.
- Create 3D models and simulate tool path using CAM software.
- Perform post processing for various CNC controllers and interface with machines.
- Develop their ideas into CAD models and realize it in a CNC machine.

SEMESTER VII

		L	T	P	C
MEC4101	**FINITE ELEMENT ANALYSIS (INTEGRATED LAB)**	**3**	**0**	**3**	**4**

OBJECTIVES:

- To study the basic concepts of mathematical modeling of engineering problems
- To learn the principles of discretization and finite element formulation
- To acquire knowledge on application of FEA in beams
- To impart knowledge on the use of FEM to a complex structures
- To learn isoparametric formulation and numerical integration
- To study the application of FEM in steady state thermal problems

MODULE I INTRODUCTION 8

Basic Concept, comparison with FDM and FVM, advantages and disadvantages, history of development, application. – Application to the continuum – Discretization – Governing equations for continuum – Variational methods - Weighted residual method.

Hands on Practice: Fundamentals of FEA software

MODULE II BASICS OF FINIETE ELEMENT FORMULATION 12

Finite Element Analysis of 1D Problems - Element type - Spring element, two noded line element - lower order and higher order element types - discretization, displacement function, shape function, formulation, element equations, assembly, boundary conditions, solution of equations- post processing, convergence criteria, examples from solid mechanics.

Hands on Practice: Analysis of uniform and stepped bar for different loading

MODULE III BEAM ELEMENT AND ITS APPLICATIONS 12

Element Shape Functions - C0, C1 continuity- completeness and compatibility condition, formulation, element equations, assembly, boundary conditions, solution of equations and examples - types of beam and different loading conditions.

Hands on Practice:

Point Loading of a beam [1D BEAM, 2D SHELL, 3D SOLID]

Bending Moment Loading of a beam [1D BEAM, 2D SHELL, 3D SOLID]

Distributed loading of a beam [1D BEAM, 2D SHELL, 3D SOLID]

MODULE IV TWO DIMENSIONAL STRUCTURAL ANALYSIS 10

Theory of Elasticity – Plane Stress – Plain Strain and Axisymmeteric Concept – CST - LST - shape function - strain - displacement matrix - constitutive matrix - stiffness matrix - assembly - solutions - examples - finite element formulation of plate, dam, pipe, pressure vessels problems.

Hands on Practice:

Analysis of truss structure [2D,3D]

Analysis of a Plate with a circular hole [plane stress]

Analysis of cylindrical pressure vessel under internal pressure [Plane Strain]

Analysis of an thick cylinder [Axisymmetric approach]

MODULE V ISOPARAMETRIC FORMULATION AND NUMERICAL INTEGRATION 8

Natural co-ordinate systems –Lagrangian Interpolation Polynomials-Serendipity Formulation- Isoparamatric Elements Formulation - Rectangular elements - Numerical integration – simple Problems using Gauss quadrature Technique.

Hands on Practice: Analysis of 2D and 3D complex problems using quadrilateral and brick elements

MODULE VI FEA IN THERMAL ANALYSIS 10

Governing equation - 1D heat flow and finite element formulation – 2D thermal element and its formulation - Conduction and Convection - Simple problems - heat transfer in composite wall, fins

Hands on Practice:

Analysis of cooling fin [conduction and convection]

Thermal stress in a composite pipe.

L – 45; T – 15; Total Hours: 60

REFERENCES:

1. Reddy J.N. – "A Introduction to Finite Element Method", McGraw Hill, International Edition, 1993.
2. Seshu. P – "Textbook of Finite Element Analysis", Prentice-Hall India Pvt. Ltd, 2006.
3. Cook, Robert Devis etal, - "Concepts and Application of finite Element Analysis", Wiley John & Sons, 1999.
4. David V Hutton "Fundamentals of Finite Element Analysis" 2004. McGraw-Hill Int. Ed.
5. O.C.Zienkiewicz and R.L.Taylor, "The Finite Element Methods", Vol.1, "The basic formulation and linear problems", Vol.1, Butterworth Heineman, 5th Edition, 2000.
6. Rao.S.S, - Finite Element Method in Engineering, Pergamon Press, 1989
7. Chandrupatla T.R., and Belegundu A.D., "Introduction to Finite Elements in Engineering", Pearson Education 2002, 3rd Edition.
8. Krishnamoorthy C.S – "Finite Element Analysis: Theory and Programming", Tata McGraw Hill Publishing Company .Ltd 1998.

OUTCOMES:

Students should be able to

- Formulate a mathematical modeling of engineering problems
- Discretize the given problem
- Solve various beam problems using FEA
- Apply FEM to a complex structures
- Explain isoparametric formulation and numerical integration
- Use steady state thermal problems

MEC4102 MECHATRONICS (INTEGRATED LAB)

L	T	P	C
3	0	3	4

OBJECTIVES:

- To study the basic concepts and various sensors
- To impart knowledge on actuator and its applications
- To acquire knowledge on programmable logic controllers
- To learn about different system models
- To educate about different system controllers
- To learn about design of a mechatronic systems for different applications

MODULE I INTRODUCTION 12

Introduction to Mechatronics- Systems- Concepts of Mechatronics approach – Need for Mechatronics- Emerging area of Mechatronics- Sequential controllers. Introduction to Sensors & Transducers – Performance Terminology- Sensors for motion and position measurement, force, torque, tactile, temperature sensors, ultrasonic sensors, hall-effect sensors. Selection of sensors for different applications, Signal Conditioning.

Hands on Practices - Potentiometer, Strain gauge, Torque, LVDT, Hall effect, speed, Vibration, Pressure - Practices on Transducer – Temperature, optical - operational amplifier circuits.

MODULE II ACTUATORS 12

Review of Pneumatic and Hydraulic Systems - Control Valves, Actuators. Review of Mechanical Actuation Systems – Electrical Actuation Systems – Mechanical Switches, Solid State Switches, Solenoids, Construction and working principle of DC and AC Motors –speed control of AC and DC drives, Stepper Motors-switching circuitries for stepper motor-servo motor

Hands on Practices - Electro Pneumatic trainer kit and simulation software.

MODULE III PROGRAMMABLE LOGIC CONTROLLER 8

Programmable Logic Controllers –Basic Structure, Input / Output Processing, Programming, Mnemonics, Timers, Internal relays and counters, Shift Registers,

Master and Jump Controls, Data Handling, Analogs Input / Output, Selection of a PLC.

Hands on Practices in Simulation of real life automation viz., bottling plant and punching operation using PLC Ladder Diagram

MODULE IV SYSTEM MODELS 9

System Models - Building blocks of Mechanical, Electrical, Fluid and Thermal Systems, Modeling spring, mass & damper systems, Rotational –Translational Systems, Electromechanical Systems, and Hydraulic –Mechanical Systems.

Hands on Practices in the development of an obstacle avoidance robot using servo motors, ultrasonic and touch sensors, Measurement of damping ratio of a machine tool base from free vibration studies using an impact hammer and an accelerometer pick up with data acquisition system.

MODULE V SYSTEM CONTROLLERS 9

Closed-Loop Controllers - Continuous and discrete process Controllers, Control Modes –Two –Step mode, Proportional Mode, Derivative Mode, Integral Mode, PID Controllers –Digital Controllers –Velocity Control –Adaptive Control –Digital Logic Control.

Hands on Practices in control of speed, direction and number of revolutions of a stepper motor using PC interface, control valve characteristics, Level Process Stations.

MODULE VI DESIGN OF A MECHATRONICS SYSTEM 10

Mechatronics Design process-stages -Traditional and Mechatronics design concepts- Case studies of Mechatronics systems- Pick and place Robot, Autonomous mobile robot - Engine Management system- Automatic car park barrier- Robot walking machine. Introduction to data acquisition and control systems, virtual instrumentation, interfacing of various sensors and actuators with PC-Design of three axis robot using ARDUINO

Hands on Practices in interfacing of a thermal sensor to monitor and control the temperature in a thermal chamber within a specified tolerance limits - Virtual process controls systems and Heating and Ventilation control using Data Acquisition techniques

L – 45; T – 15; Total Hours: 60

REFERENCES:

1. Bolton,W, “Mechatronics”, Pearson education, second edition, fifth Indian Reprint, 2003.

2. Smaili.A and Mrad.F, "Mechatronics integrated technologies for intelligent machines", Oxford university press, 2008.
3. Michael B. Histand and David G. Alciatore, “Introduction to Mechatronics and Measurement Systems”, McGraw-Hill International Editions, 2000.
4. Sanjay Gupta and Joseph John, "Virtual Instrumentation and LabVIEW", Tata McGraw Hill Publications, Co., 2005.
5. Bradley D. A., Dawson D., Buru N.C. and. Loader A.J, “Mechatronics”, Chapman and Hall, 1993.
6. Dan Necsulesu, “Mechatronics”, Pearson Education Asia, 2002 (Indian Reprint).
7. Lawrence J. Kamm, “Understanding Electro –Mechanical Engineering”, An Introduction to Mechatronics, Prentice –Hall of India Pvt., Ltd., 2000.

OUTCOMES:

Students will be able to

- Explain the basic concepts and various types of sensors
- Simulate different types of actuator for different applications
- To use programmable logic controllers for various applications
- Demonstrate different system models
- Devise a system controller for a given application
- Design of a mechatronic systems for different applications

MEC4103	DESIGN OF TRANSMISSION SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the design principles of belt, chain and rope drives
- To impart knowledge on the design aspects of spur and helical gears
- To acquire knowledge on design of bevel and worm gears
- To study the design procedure of gear box
- To learn the design aspects of various types of cam
- To educate the design procedure for clutches and brakes

MODULE I DESIGN OF BELT AND CHAIN DRIVES 10

Introduction: Selection of Flat belts and pulleys – Selection of V belts and pulleys –Wire ropes and pulleys-Selection of Transmission chains and Sprockets. Design of pulleys and sprockets.

MODULE II SPUR GEARS AND PARALLEL AXIS HELICAL GEARS 9

Gear Terminology-Speed ratios and number of teeth-Force analysis – Tooth stresses – Dynamic effects – Fatigue strength – Factor of safety – Gear materials – Module and Face width-power rating calculations based on strength and wear considerations – Parallel axis. Helical Gears – Pressure angle in the normal and transverse plane – Equivalent number of Teeth-forces and stresses. Estimating the size of the helical gear.

MODULE III BEVEL, WORM GEARS AND CROSSED HELICAL GEARS 9

Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits –Terminology. Thermal Capacity, Materials forces and stresses, efficiency, estimating the size of the worm gear pair. Crossed -helical Terminology-helix angles – Estimating the size of the pair of Crossed-helical gears.

MODULE IV DESIGN OF GEAR BOXES 7

Progression – Standard step ratio – Ray diagram, kinematic layout – Design of Sliding mesh gear box- Constant mesh gearbox – Design of multi speed gear box.

MODULE V DESIGN OF CAMS 5

Cam Design: Types-pressure angle and under cutting base circle determination-forces and Surface stresses.

MODULE VI DESIGN OF CLUTCHES AND BRAKES 5

Design of plate clutches – axial clutches-cone clutches-internal expanding rim clutches-internal and external shoe brakes. Case Studies and Mini Projects

Total Hours: 45

TEXT BOOKS:

1. Shigley J.E and Mischke C. R., “Mechanical Engineering Design”, Sixth Edition,Tata McGraw-Hill , 2003.
2. Sundararajamoorthy T. V and Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.

REFERENCES:

1. Maitra G.M. and Prasad L.V., “Hand book of Mechanical Design”, II Edition, Tata McGraw-Hill, 1985.
2. Bhandari, V.B., “Design of Machine Elements”, Tata McGraw-Hill Publishing Company Ltd., 1994.
3. Prabhu. T.J., “Design of Transmission Elements”, Mani Offset, Chennai, 2000,
4. Hamrock B.J., Jacobson B. and Schmid S.R., “Fundamentals of Machine Elements”, Tata McGraw-Hill Book Co., 1999.
5. Ugural A,C, "Mechanical Design, An Integrated Approach", Tata McGraw-Hill,2003.

STANDARDS:

1. IS 4460: Parts 1 to 3: 1995, Gears – Spur and Helical Gears – Calculation of Load Capacity.
2. IS 7443 : 2002, Methods of Load Rating of Worm Gears

3. IS 15151: 2002, Belt Drives – Pulleys and V-Ribbed belts for Industrial applications – PH, PJ, PK, PI and PM Profiles : Dimensions
4. IS 2122: Part 1: 1973, Code of practice for selection, storage, installation and maintenance of belting for power transmission : Part 1 Flat Belt Drives.
5. 5. IS 2122: Part 2: 1991, Code of practice for selection, storage, installation and maintenance of belting for power transmission: Part 2: V-Belt Drives.

OUTCOMES:

The students should be able to

- Design the belt, chain and rope drives
- Design spur and helical gears for the given conditions
- Design bevel and worm gears for the given conditions
- Design the gear box
- Design various types of cam
- Design the clutches and brakes

MEC4104 SIMULATION LAB

L	T	P	C
0	0	3	1

OBJECTIVES:

- To realize the importance of Computational efficiency in simulation of Real time Mechanical systems.
- To Implement Dynamics and control problems in Vibratory systems.
- To learn vibration pattern in vibratory systems with damping and without damping.
- To implement automation systems by virtual simulation and analysis of Real Time systems.

LIST OF EXPERIMENTS

1. Simulation of simple pendulum.
2. Simulation of Double pendulum.
3. Single degree of freedom spring-mass system with free and forced vibration.
4. Single degree of freedom spring-mass-damper system with free and forced vibration.
5. Two degree of freedom spring-mass system with free and forced vibration.
6. Two degree of freedom spring-mass-damper system with free and forced vibration.
7. Implementation of PID controller in Tuning and control of above dynamic systems.
8. Simulation of Four bar mechanism.
9. Simulation of Simple pendulum.
10. Simulations of Slider crank mechanism.
11. Simulation of Single link Robot Arm.
12. Simulation of Hydraulic system with Single-Acting Cylinder.
13. Simulation of Elevator system.
14. Simulation of Hydraulic system with Double-Acting Cylinder.

Total Hours : 45

OUTCOMES:

The students should be able to

- simulate and study different systems and mechanisms.
- acquire knowledge on automation through virtual simulation of real time systems

MEC4105 AUTOMOBILE LAB

L	T	P	C
0	0	3	1

OBJECTIVES:

- To study the various components of vehicle by dismantling and assembling
- To study the functions and performance of various automobile systems

LIST OF EXPERIMENTS

1. Dismantling & Assembling of petrol engine.
2. Dismantling & Assembling of diesel engine.
3. Study of oil filter, fuel filter, fuel injection system, carburetor, MPFI
4. Study of ignition system components – coil, magneto and electronic ignition systems.
5. Study of engine cooling system components
6. Study of engine lubrication system components
7. Dismantling & Assembling of Differential
8. Dismantling & Assembling of gear box
9. Dismantling & Assembling of Clutch assembly

Total Hours: 45

OUTCOMES:

Student should be able to

- Understand the function of various automobile components.
- Dismantle and assemble various components of a vehicle.

MEC4106	INTERNSHIP	L	T	P	C
		0	0	0	1

OBJECTIVES:

Students must undergo two weeks industrial training preferably in the industries relevant to Mechanical Engineering.

SEMESTER VIII

MEC4211	PROJECT WORK	L	T	P	C
		0	0	24	12

OBJECTIVES:

- To practice the knowledge gained from all the courses
- To develop individual responsibility and team work

Students should do a project which involves themselves with innovative ideas of design, fabrication, analysis, Industrial problem solving, new development.

Frequently, progress in the project work is evaluated by conducting reviews.

At end semester students should appear for their project viva-voce and submit the reports.

OUTCOMES:

Student can able to

- Examine a part or product feasibility
- Develop a real time working model
- Planning of activities and time management skills.
- Fault diagnosis of industrial parts.

ELECTIVES FOR DESIGN

MECX01	ADVANCED STRENGTH OF MATERIALS	L	T	P	C
		3	0	0	3

Prerequisite : Knowledge on fundamentals of Strength of Materials

OBJECTIVES:

- To study the stress strain relations and location of shear centers
- To educate stress and deflections in curved beams
- To impart knowledge on unsymmetrical bending
- To learn the stresses in flat plates
- To acquire knowledge on torsional stresses in thin walled tubes and non-circular sections.
- To study the stresses in rotary sections and contacts

MODULE I STRESS AND STRAIN RELATIONS& TORSION OF NON-CIRCULAR SECTIONS **8**

Elastic and Inelastic response of a solid, Transformation of stress, strain, principal stresses and strains, general equations of elasticity in Cartesian, differential equations of equilibrium-compatibility- boundary conditions. Representation of three dimensional stress of a tension, generalized hook's law – St. Venant's principle-plane stress-Airy's stress function.

Torsion of rectangular cross section – S.Venants theory – elastic membrane analogy, Prandtl's stress function. Torsional stress in hollow thin walled tubes.

MODULE II SHEAR CENTRE **7**

Shear Centre – Location of shear centre for various sections: thin wall beam cross section, channel section, box beams, beams formed from stringers and thin webs-shear flows-Plastic bending

MODULE III UNSYMMETRICAL BENDING **8**

Flexible Members – Circumference and radial stresses-deflections-curved beam with restrained ends-closed ring subjected to concentrated load and uniform load-chain links and crane hooks.

MODULE IV FLAT PLATES 7

Stresses in circular and rectangular plates due to various types of loading and end conditions, buckling of plates.

MODULE V THEORY OF PLASTICITY 8

Theory of plastic deformation – Yield criteria – Tresca and Von-mises-Distortion energy – Stress-stress relation – Mohr's circle representation of a state of stress – Cylindrical and spherical co-ordinate system – Upper and lower bound solution methods – Overview of FEM applications in metal forming analysis.

MODULE VI STRESSES DUE TO ROTARY SECTIONS & CONTACTS 7

Radial and tangential stresses in solid disc and ring of uniform thickness and varying thickness allowable speeds. Contact Stresses – Methods of computing contact stress - deflection of bodies in point and line contact applications.

Total Hours: 45

REFERENCES:

1. Boresi A.P., Schmidt R.J., "Advanced Mechanics of Materials", John Wiley and Sons, Sixth edition, 2003.
2. Seely and Smith, "Advanced Mechanics of Materials", John Wiley International Edn, 1952.
3. Timoshenko and Goodier, "Theory of Elasticity", McGraw Hill.
4. Wang, "Applied Elasticity", McGraw Hill.
5. Robert D. Cook, Warren C. Young, "Advanced Mechanics of Materials", Mcmillan pub. Co., 1985.

OUTCOMES:

Students will be able to

- Explain the stress strain relations and location of shear centers
- Solve problems on stress and deflections in curved beams
- Express the bending phenomenon in unsymmetrical sections
- Evaluate stresses in flat plates
- Find torsional stresses in thin walled tubes and non-circular sections
- Comprehend the stresses in rotary sections and contacts

MECX02	COMPOSITE MATERIALS FOR MANUFACTURE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study various fibers and matrix materials in the composites
- To learn various polymer matrix composites processes
- To acquire knowledge on metal matrix composites
- To impart knowledge on ceramic matrix composites
- To educate about micromechanics
- To study fatigue and creep behaviour in composite materials

MODULE I INTRODUCTION 9

Fundamentals of composites - Need for composites - Matrix materials - Properties- Reinforcement - Fibres - Glass fibre, Aramid fibre, Carbon fibre, boron fibre - Fabrication - Properties - Applications - Comparison of fibres - Particulate and whisker reinforcements. Matrix Reinforcement Interface - Wettability - Effect of surface roughness - Interfacial bonding - Methods for measuring bond strength.

MODULE II POLYMER MATRIX COMPOSITES 8

Polymer matrix resins - Thermosetting resins -Thermoplastic resins – PMC Processes - Hand layup and spray processes - Compression moulding - Reinforced reaction injection moulding - Resin transfer moulding - Pultrusion- Filament winding - Injection moulding - Fibre Reinforced Plastics (FRP) – Glass fibre Reinforced Plastics(GRP).

MODULE III METAL MATRIX COMPOSITES 8

Characteristics - Types - Alloy vs. MMCs - Advantages - Limitations – Metallic materials - Reinforcement - Particles - Fibres - Effect of reinforcement – Volume fraction - Rule of mixtures - Processing of MMCs - Solid state, liquid state, deposition and insitu - Applications.

MODULE IV CERAMIC MATRIX COMPOSITES 8

Engineering ceramic materials - Properties - Advantages - Limitations – Need for CMCs - Processing - Hot pressing, liquid infiltration technique, Lanxide process, insitu chemical reaction techniques - CVD, CVI, Solgel process - Interface in CMCs - Applications.

MODULE V MICROMECHANICS 6

Micromechanics models for stiffness - Micromechanics models for strength - Thermal and moisture effects.

MODULE VI FATIGUE AND CREEP IN COMPOSITE MATERIALS 6

Fatigue - S-N curves - Fatigue behavior of CMCs - Fatigue of particle and whisker reinforced composites -Hybrid composites - Thermal fatigue - Creep.

Total Hours: 45

REFERENCES:

1. Mathews F.L. and Rawlings R.D., “Composite materials: Engineering and Science”, Chapman and Hall, London, England, 1st edition, 1994.
2. Chawla K.K., “Composite materials”, Springer - Verlag, 1987.
3. Clyne T.W. and Withers P.J. “Introduction to Metal Matrix Composites”, Cambridge University Press, 1993.
4. Strong A.B., “Fundamentals of composite Manufacturing”, SME, 1989.
5. Sharma S.C., “Composite Materials”, Narosa Publications, 2000.
6. Mathews F. L. and Rawlings R. D., “Composite Materials: Engineering and Science”, CRC Press and Woodhead Publishing Limited, 2002.
7. Derek Hull, “Introduction to Composite Materials”, Cambridge University Press, 1988.
8. Handbook of Composites - American Society of Metals, 1990.

OUTCOMES:

Students will be able to

- Discuss various fibers and matrix materials in the composites
- Explain various polymer matrix composites processes
- Elucidate metal matrix composites
- Describe ceramic matrix composites
- Expose micromechanics of the composites
- Deliberate fatigue and creep behaviour in composite materials

MECX03	DESIGN OF HYDRAULICS ANDPNEUMATICS	L	T	P	C
		3	0	0	3

Prerequisite : Basic knowledge on Hydraulics and Pneumatics

OBJECTIVES:

- To study the fundamentals and fluid power principles
- To learn about various hydraulic systems and components
- To acquire knowledge on design of hydraulic circuits
- To educate about various pneumatic systems
- To impart knowledge on design of various hydraulic and pneumatic circuits
- To instruct the students in the area of troubleshooting and maintenance of hydraulic and pneumatic systems

MODULE I FLUID POWER PRINCIPLES & REVIEW OF FUNDEMENTALS 7

Introduction to Fluid power- Advantages and Applications- Fluid power systems – Types of fluids- Properties of fluids Basics of Hydraulics – Pascal's Law- Principles of flow – Work, Power and Torque. Properties of air– Perfect Gas Laws. General types of fluids – fluid power symbols.

MODULE II HYDRAULIC SYSTEM AND COMPONENTS 8

Sources of Hydraulic power: Pumping Theory – Pump Classification-Gear, vane and piston pumps - Construction, Working, Advantages, Disadvantages, Performance- Variable displacement pumps. Fluid power actuators: Linear hydraulic actuators – Types of hydraulic cylinders – single & double acting – special cylinders like tandem, rodless, Telescopic, cushioning Mechanism, construction of double acting cylinder, Rotary Actuator – Fluid motors, Gear, Vane and piston motors. Construction of control components – DCV – 3/2, 4/ 2 valves – shuttle valve – check valve – pressure control valve – pressure reducing valve, sequence valve, flow control valve- Fixed and adjustable, electrical control solenoid valves, relays, ladder diagrams.

MODULE III DESIGN OF HYDRAULIC CIRCUITS 7

Reciprocating, quick return, sequencing, synchronizing circuits, simple industrial circuits – Press circuits, earth movers, grinding machines. Safety and emergency

emergency modules. Accumulators and intensifiers: Types, sizing and applications.

MODULE IV PNEUMATIC SYSTEM 8

Compressors- Filter, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust valves, Pneumatic actuators, Servo systems. Fluid power design, speed control circuits, synchronizing circuit, Pneumo hydraulic circuit, and sequential circuit design for simple industrial applications using cascade methods.

MODULE V DESIGN OF HYDRALIC AND PNEUMATIC CIRCUITS 8

Servo systems – hydro mechanical servo systems, electro hydraulic servo systems and proportional valves. Introduction to electro hydraulic pneumatic logic circuits, ladder diagrams, PLC applications in fluid power control. Fluid power circuits.

MODULE VI TROUBLESHOOTING AND MAINTENANCE 7

Common faults in hydraulic system, Procedure for repair, contamination, Component fittings and failure due to contaminants, Filter and filter maintenance, Pump maintenance, hydraulic system maintenance, performance monotoring General safety measures for fluid power system.

Total Hours: 45

REFERENCES:

1. Anthony Esposito," Fluid Power with Applications", PHI / Pearson Education, 2005.
2. Shanmugasundaram.K, "Hydraulic and Pneumatic controls", Chand & Co, 2006.
3. Majumdar, S.R., "Oil Hydraulics Systems- Principles and Maintenance", TataMcGraw Hill, Fourth Reprint 2003.
4. Majumdar, S.R., "Pneumatic Systems – Principles and Maintenance", TataMcGraw Hill, 2007.
5. Dudelyt, A Pease and John J Pippenger, "Basic Fluid Power", Prentice Hall, 1987.

OUTCOMES:

Students will be able to

- Explain the fundamentals and fluid power principles
- Use various hydraulic systems and components for a given applications
- Design of hydraulic circuits
- Explain about various pneumatic systems
- Design of various hydraulic and pneumatic circuits
- Perform troubleshooting and maintenance of hydraulic and pneumatic systems

MECX04 NOISE, VIBRATION AND HARSHNESS

L	T	P	C
3	0	0	3

Prerequisite : Basic knowledge on kinematics and Dynamics

OBJECTIVES:

- To study the fundamental concepts of vibration
- To impart knowledge on basics of noise
- To acquire knowledge on modelling of vibrating systems
- To learn about different types of vibration measurement techniques
- To educate about noise controlling techniques
- To learn different types vibration controlling techniques

MODULE I INTRODUCTION **7**

Introduction to Noise, Vibration and Harshness (NVH) and its role in automotive and industrial applications. Sources of vibration and noise. Physiological effects of noise and vibration. Vibration and noise standards and limit.

MODULE II BASICS OF NOISE **8**

Basic concept about sound. Sound intensity measurements. Sound propagation characteristics. Acoustic parameters. Sound pressure level and sound intensity; frequency and time weightings. Assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine accessory contributed noise, transmission noise, aerodynamic noise, tyre noise, brake noise.

MODULE III MODELING OF VIBRATING SYSTEMS **7**

Relevance and need for vibration analysis – Mathematical modeling of Vibrating Systems – Discrete and Continuous systems - Single degree of freedom Systems – Free and Forced Vibrations- Various Damping Models.

MODULE IV VIBRATION MEASUREMENTS **8**

Vibration Monitoring. Data Acquisition. Vibration Parameter Selection. Vibration Sensors. Accelerometers. Performance Characteristics. Sensor Location Signal. Preamplifications. Types of Preamplifiers. Real Time Analysis. Digital Fourier Transforms. FFT Analysis. Vibration Meters. Vibration Signatures. Standards. Vibration Testing Equipment. Modal analysis.

MODULE V NOISE CONTROLLING METHODS 7

Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers.

MODULE VI VIBRATION CONTROLLING TECHNIQUES 8

Methods of vibration control. Excitation reduction at source, Balancing of rigid, flexible and variable mass rotors. Dynamic properties and selection of structural materials. Vibration absorbers. Tuned absorber. Tuned and damped absorber. Untuned viscous damper. Vibration isolation. Harshness. Sources and its Effects, Measurement and control.

Total Hours: 45

REFERENCES:

1. W.T. Thomson. (1997) “Mechanical Vibration”, 5th edition, Prentice-Hall.
2. S.S. Rao. (1995) “Mechanical Vibrations”, 3rd edition, Addison Wesley.
3. M.P. Norton. (1994) “Fundamentals of Noise and Vibrations Analysis for Engineers”, Cambridge University Press.
4. S.P. Parker. (1987) Acoustics Source Book, McGraw-Hill.
5. Gatti P. and Ferrari V. “Applied Structural and Mechanical Vibrations: Theory, Methods and Measuring Instrumentation”, E & FN Spon, London, 1999.
6. D.J. Ewins. (2000) Modal Testing: Theory, Practice and Applications, Research Studies.
7. Clarence W. de Silva. (2007) Vibration Monitoring, Testing, and Instrumentation, CRC Press.
8. M. Harrison. (2004) Vehicle Refinement: Controlling Noise and Vibration in Road Vehicles, Elsevier Butterworth-Heinemann.

OUTCOMES:

Student should be able to

- Explain the fundamental concepts of vibration
- Describe about basics of noise

- Model simple vibrating systems
- Use different types of vibration measurement techniques
- Apply various noise controlling techniques for a given condition
- Use various vibration controlling techniques for a given condition

MECX05	DESIGN OF JIGS, FIXTURES ANDPRESS TOOLS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the basic functions of jigs and fixtures
- To learn about clamp and tolerances
- To educate about jigs, types of jigs and its applications
- To acquire knowledge on various types of fixtures
- To impart knowledge on dies and strip layouts
- To study the design and development of dies

MODULE I PURPOSE TYPES, FUNCTIONS OF JIGS AND FIXTURES 7

Tool design objectives - Production devices - Inspection devices – Materials used in Jigs and Fixtures – Types of Jigs - Types of Fixtures.

MODULE II CLAMPS AND TOLERANCE 8

Types of clamps - Mechanical actuation-pneumatic and hydraulic actuation Analysis of clamping force-Tolerance and error analysis.

MODULE III JIGS 9

Drill bushes –different types of jigs-plate latch, channel, box, post, angle plate, angular post, turnover, pot jigs-Automatic drill jigs-Rack and pinion operated. Air operated Jigs components. Design and development of Jigs for given components.

MODULE IV FIXTURES 9

General principles of boring, lathe, milling and broaching fixtures- Grinding, planning and shaping fixtures, assembly, Inspection and welding fixtures, Modular fixtures. Design and development of fixtures for given component.

MODULE V PRESS WORKING TERMINOLOGIES AND ELEMENTS OF DIES AND STRIP LAYOUT 6

Press working terminology-Presses and press accessories-Computation of capacities and tonnage requirements. Elements of progressive combination and compound dies: Die block-die shoe. Bolster plate-punch plate-punch holder-guide

pins and bushes – strippers – knockouts-stops –pilots-Selection of standard die sets strip lay out-strip lay out calculations.

MODULE VI DESIGN AND DEVELOPMENT OF DIES 6

Design and development of progressive and compound dies for Blanking and piercing operations. Bending dies – development of bending dies-forming and drawing dies-Development of drawing dies. Design considerations in forging, extrusion, casting and plastic dies.

Total Hours: 45

TEXT BOOKS:

1. Edward G Hoffman, “Jigs & Fixture Design”, Thomson – Delmar Learning, Singapore 2004.
2. Donaldson. C, “Tool Design”, Tata McGraw-Hill, 1986.

REFERENCES:

1. Kempster, “Jigs & Fixtures Design”, The English Language Book Society”, 1978.
2. Joshi, P.H., “Jigs & Fixtures”, Second Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi 2004.
3. Hiram E Grant, “Jigs and Fixture” Tata McGraw-Hill, New Delhi, 2003.
4. “Fundamentals of Tool Design”, CEEE Edition, ASTME, 1983.
5. Design Data Handbook PSG College of Technology, Coimbatore.

OUTCOMES:

- **Students will be able to**
  - Explain the basic functions of jigs and fixtures
  - Apply suitable clamp and tolerances for a given application
  - Use suitable jigs based on the applications
  - Practice suitable fixture for a particular application
  - Demonstrate dies and strip layouts
  - Elucidate design and development of dies

MECX06	INDUSTRIAL PROBLEM SOLVING TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the basic concepts of problem solving techniques
- To learn about statistical techniques
- To use optimization techniques
- To acquire knowledge on PERT & CPM
- To impart knowledge on artificial intelligence techniques
- To explore the knowledge on different domains

MODULE I PROBLEM SOLVING TECHNIQUES – AN INTRODUCTION 9

Introduction - 8 step problem solving methodology – Symptoms, Root cause , Difference between symptoms and root cause – Role of problem solving for continuous improvement – Various tools and techniques for problem solving – Action plan for execution of problem solving.

MODULE II STATISTICAL TECHNIQUES 9

Introduction to statistical quality control (SQC) – Need for SQC in industries – Different Techniques – Failure Mode and Effect Analysis – Quality function Deployment – Control charts for variable and attributes – Sampling techniques

MODULE III OPTIMISATION TECHNIQUES 9

Transportation –Mathematical model- algorithm – methods for finding initial solutions – North West corner method, Least cost method, Vogel's Approximation method – variations in transportation problem –Assignment – Mathematical formulation – Hungarian method for solving assignment problem – traveling salesman problem – variations in assignment problems

MODULE IV PERT & CPM 9

Introduction – Difference between PERT and CPM – different phases for project management – PERT/CPM network components – precedence relationships – Critical Path Method – Forward pass method – Backward pass method – Project Time – Cost Trade-off

MODULE V ARTIFICIAL INTELLIGENCE TECHNIQUES 9

Definition of Artificial Intelligence - Application and methods - Neural Computing – Artificial Neural Network – learning from big data – data processing- prediction- Genetic Algoirthms – introduction - Fuzzy Logic – Rule based learning – processing of big data.

MODULE VI CASE STUDIES 9

Case study - Automobile industries, Chemical industries, Cement and Pulp industries

Total Hours: 45

REFERENCES:

1. J K Sharma, Operations Research- Theory and Applications, Trinity Press, Edition 3.
2. Montgomery, Douglas C. (2009). Introduction to Statistical Quality Control, Sixth Edition. John Wiley and Sons, Inc. (ISBN: 978 -0-470-16992-6)
3. Stuart Russell, Peter Norvig, "Artificial Intelligence - A Modern Approach", 3rd Edition, Pearson Education / Prentice Hall of India, 2009.
4. Stephen Lucci, Danny Kopec," Artificial Intelligence in the 21st Century", Mercury Learning and Information, 2012.

OUTCOMES:

Students will be able to

- Explain the basic concepts of problem solving techniques
- Solve the problems using statistical techniques
- Perform optimization techniques
- Elucidate PERT & CPM
- Demonstrate on artificial intelligence techniques
- Solve problems in different domains

MECX07 GEOMETRIC MODELLING

L	T	P	C
2	0	0	2

OBJECTIVES:

- To study the basics of mathematical representation of geometry
- To learn the modeling techniques, tools and algorithms
- To educate the graphics standards and applications

MODULE I INTRODUCTION AND PRINCIPLES OF COMPUTER GRAPHICS 10

The design process and the role of CAD/CAM - Defining the modeling schemes: wire frame geometry, surface representation, Solid modeling – Elements of interactive computer graphics: Introduction, input and output devices, raster graphics, 2D (Translations, Rotation, Scaling and Shear) and 3D transformation (Translations, Rotation, Scaling, Shear, Orthographic and Perspective Projections), Windows to View port transformation, Clipping, Hidden line removal, Hidden Surface removal.

MODULE II LINES AND CURVES 10

Introduction to Equations - Implicit, explicit, parametric - Line Drawing Algorithm – Circles - Introduction to curves, parametric continuity condition, geometric continuity condition, Conics, Spline representation, Hermite Curves (Algebraic and Geometric Forms, Basis Functions, Matrix Form, Tangent Vectors, Truncating and Sub-dividing, 3-point and 4-point interpolation), Bézier Curves (Bézier basis functions, control points, truncating and subdividing, composite Bézier curve, characteristics of Bézier curve), B-Spline Curves (Uniform and Nonuniform B-Spline basis function, Quadratic and Cubic B-Spline basis function, Closed B-Spline Curve, Continuity, NURBS, Representation of conics with NURBS).

MODULE III SURFACES AND SOLIDS 10

Surfaces: Introduction, Implicit and explicit function of surfaces, types of surfaces, Surface Representation, Surface Analysis (Tangent, Normal, Twist, Distance Calculation, Curvature, Tangent Plane), Plane Surface, Ruled Surface, Surfaces of Revolution, Tabulated Surfaces, Hermite Bi-cubic surface, Bézier Surface, Coons Surface, Introduction, Solid Representation, Properties of Solid model, Regularized Boolean set operations, Primitive instancing, Sweep representations,

Boundary representations (B-rep), Constructive Solid Geometry (CSG), Comparison of representations.

Total Hours: 30

REFERENCES:

1. Mastering CAD / CAM Ibrahim Zeid McGraw-Hill
2. Geometric Modelling M Mortenson Industrial Press.
3. CAD / CAM: Theory and Practice Ibrahim Zeid McGraw-Hill
4. Mathematical Elements of Computer Graphics David F Roger McGraw Hill
5. Computer Graphics: C Version Hearn and Baker Pretice Hall of India
6. Curves and Surfaces for CAGD: A Practical Guide 5/e, Gerald Farin Morgan Kaufmann
7. Computer Graphics and Geometric Modelling David Salomon Springer.
8. Computer Aided Engineering Design Anupam Saxena and Birendra Sahay Springer
9. Mechanical Assemblies: Their Design, Manufacture, and Role in Product Development D E Whitney Oxford Press

OUTCOMES:

The students should be able to

- Explain the basics of mathematical representation of geometry
- Use the suitable modeling techniques, tools and algorithms
- Apply the graphics standards for the given applications

MECX08 REVERSE ENGINEERING

L	T	P	C
2	0	0	2

OBJECTIVES:

- To study the tools for reverse engineering and its scope
- To learn about the data management
- To educate about the integration in reverse engineering

MODULE I INTRODUCTION & TOOLS FOR REVERSE ENGINEERING **10**

Scope and tasks of reverse engineering - Domain analysis- Process of duplicating - Functionality- Dimensional- Developing technical data - Digitizing techniques - Construction of surface model - Solid-part material- Characteristics evaluation - Software and application- Prototyping – Verification - History of reverse engineering – Preserving and preparation for the four stage process – Evaluation and verification- Technical data generation, Data verification, Project implementation.

MODULE II DATA MANAGEMENT **10**

Data reverse engineering – Three data reverse engineering strategies – Definition– Organization data issues - Software application – Finding reusable software components – Recycling real-time embedded software – Design of experiments to evaluate a reverse engineering tool – Rule based detection for reverse engineering user interfaces – Reverse engineering of assembly programs: A model based approach and its logical basics.

MODULE III INTEGRATION **10**

Cognitive approach to program understated – Integrating formal and structured methods in reverse engineering – Integrating reverse engineering, reuse and specification tool environments to reverse engineering - Coordinate measurement– Feature capturing – Surface and solid members.

Total Hours: 30

REFERENCES:

1. Bigger staff T J, Design Recovery for Maintenance and Reuse, IEEE Corpn. July 1991.
2. Rugaban S, White paper on RE, Technical Report, Georgia Instt. of Technology, 1994.
3. Katheryn A. Ingle, Reverse Engineering, McGraw-Hill, 1994
4. Aiken Peter, Data Reverse Engineering, McGraw-Hill, 1996
5. Linda Wills, Reverse Engineering, Kluiver Academic Publishers, 1996
6. Donald R. Honsa, Co-ordinate Measurement and reverse engineering, American Gear Manufacturers Association.

OUTCOMES:

Students should be able to

- Explain the tools for reverse engineering and its scope
- Discuss about the data management
- Demonstrate the integration in reverse engineering

MECX09 RELIABILITY ENGINEERING

L	T	P	C
2	0	0	2

OBJECTIVES:

- To study about various reliability concepts
- To learn about reliability improvement and fault tree analysis
- To impart knowledge on maintainability/ availability and repairable systems

MODULE I RELIABILITY CONCEPTS 10

Probability concept-Definition of reliability-Failure data analysis: Mean time to failure and Mean time between failure- Bathtub curve and Hazard Model: Constant Hazard and linearly Increasing Hazard- System reliability: Series configuration, parallel configuration and mixed configurations. System Relaiblity Problems.

MODULE II RELIABILITY IMPROVEMENT AND FAULT TREE ANALYSIS 10

Improvements of components – Redundancy: Element redundancy, unit redundancy- Standby redundancy- Reliability cost Trade off- Redundancy problems- Fault Tree Construction- Calculation of Reliability from Fault tree.

MODULE III MAINTAINABILITY/ AVAILABILITY AND REPAIRABLE SYSTEMS 10

Maintainability approach, Availability aspect, System down time, Availability types: Inherent Availability, Achieved availability and operational availability- Reliability and Maintainability trade off- Instantaneous repair rate- Mean time to repair.

Total Hours: 30

REFERENCES:

1. L.S.Srinath," Reliability Engineering" , Affiliated East West (PVT) Ltd, New Delhi
2. Patrick D To' corner "Practical Reliability Engineering", John Wiley and sons Inc, 2002.
3. Modarres, "Reliability and Risk analysis", Maral Dekker Inc. 1993

4. Charles E Ebeling, “An Introduction to Reliability and Maintainability Engineering”, Tata McGraw Hill, New Delhi, 2009.
5. Dhillon , Engineering Maintainability – How to design for reliability and easy maintenance, PHI, 2008
6. David J Smith, Reliability, maintainability and Risk: Practical Methods for Engineers, Butterworth 2002.

OUTCOMES:

Students will be able to

- Explain various reliability concepts
- Discuss reliability improvement and fault tree analysis
- Demonstrate maintainability/ availability and repairable systems

MECX10	MICRO ELECTRO MECHANICAL YSTEMS (MEMS)	L	T	P	C
		2	0	0	2

Prerequisite : Basic knowledge on Electronics

OBJECTIVES:

- To study about fundamentals of MEMS and micro sensors and micro actuators
- To learn about circuit and system design issues
- To impart knowledge on mems materials and fabrication technologies

MODULE I INTRODUCTION, MICRO SENSORS AND MICRO ACTUATORS 12

MEMS and Microsystems, Miniaturization, Typical products, Micro sensors, Micro accelerometers, Micro actuators, Micro fluidics, Bio chemical micro system - Static bending of thin plates, Configurations of accelerometers, Thermo mechanics, Fracture mechanics, Thin film mechanics.

Pressure sensors, Thermal sensors, Electrostatics: basic theory, Gap and finger pull up, Electro static actuators, Comb generators, Inchworms, Electromagnetic actuators, Bistable actuators, Micro motors.

MODULE II CIRCUIT AND SYSTEM DESIGN ISSUES 8

System types, Basic modeling elements in system, Feedback systems, Noise, Modeling of MEMS systems, CAD for MEMS, Capacitive accelerometers.

MODULE III MEMS MATERIALS AND FABRICATION TECHNOLOGIES 10

MEMS materials, Substrates and wafers, Micro system fabrication: Photolithography, Etching techniques, CVD process, Oxidation, Diffusion, Micro machining process: Bulk micro machining, Surface micro machining, and LIGA process.

Total Hours: 30

TEXT BOOKS:

1. Stephen Santeria," Microsystems Design", Kluwer publishers, 2000.

REFERENCES:

1. Nadim Maluf," An introduction to Micro electro mechanical system design", Artech House, 2000.
2. Mohamed Gad-el-Hak, editor," The MEMS Handbook", CRC press Baco Raton, 2000.
3. Tai Ran Hsu," MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002.
4. Nitaigour Premch and Mahalik "MEMS" McGraw hill education (India) private limited, 2007.

OUTCOMES:

Students will be able to

- Explain about fundamentals of MEMS and micro sensors and micro actuators
- Demonstrate circuit and system design issues
- Discuss about mems materials and fabrication technologies

MECX11	GEOMETRIC DIMENSIONING ANDTOLERANCING	L	T	P	C
		1	0	0	1

OBJECTIVES:

- To study the basic principles of geometric product definition
- To educate the students on types of tolerances.

MODULE I INTRODUCTION 5

Introduction to limits fits and tolerances – GDNT definitions and importance – Datum reference frame – Feature control frame - MMC & LMC – General Rules – Datum System.

MODULE II PRINCIPLES OF MEASUREMENT FOR GEOMETRIC CHARACTERISTICS 10

Geometric characteristic symbols and meanings – Form tolerances – Profile tolerances – Location tolerances – Runout tolerances – Orientation tolerances – True position theory – Dimensional and tolerance schemes.

Total Hours: 15

REFERENCES:

1. ASME Y – 14.5
2. Rao Ming, Harry Peck, “Designing for Manufacture”, Pitman Publications, London, 1983.
3. Krulikowski. A, “Fundamentals of Geomtric Dimensioning and Tolerancing”, Delmar Publishers – New York, 1997
4. Spotts.M.F, “Dimensioning and Tolerance for Quality Production”, Prentice Hall Inc., New Jersey, 1983.
5. Oliver R Wade, “Tolerance Control in Design and Manufacturing”, Industrial Press Inc., New York, 2008.

OUTCOMES:

Students should be able to

- Apply the basic principles for product definition
- Use different types of tolerances for a given application

MECX12 TOOL AND DIE DESIGN

L	T	P	C
1	0	0	1

OBJECTIVES:

- To learn the design aspects of cutting tools
- To study the design of dies

MODULE I DESIGN OF CUTTING TOOLS 8

Single Point Cutting Tools: Classification, Nomenclature, geometry, design of single point tools for lathes, shapers, planers etc. Chip breakers and their design. Multipoint Cutting Tools: Classification and specification, nomenclature, Design of drills, milling cutters, broaches, taps etc. Design of Form Tools: Flat and circular form tools, their design and applications.

MODULE II DESIGN OF DIES 7

Classification of dies, Design of Dies for Bulk metal Deformation-Wire Drawing, Extrusion, Forging and Rolling; Design of Dies for Sheet metal: Blanking and Piercing, Bending and Deep-drawing; Design of Dies used for Casting and Moulding, Powder Metallurgy die design.

Total Hours: 15

REFERENCES:

1. Donaldson, C., “Tool Design”, Tata Mc-Graw Hill, 2006
2. Pollack, H.W., “Tool Design” Reston Publishing Company, Inc. 1976.
3. Joshi, P.H., “Jigs and Fixtures, Tata Mc-Graw Hill, 2003
4. Grant, H,E., “Jigs and Fixtures, Tata Mc-Graw Hill, 2006
5. Kempster, M.H.A., “Principles of Jig and Tool Design”, English University Press Ltd., 1968.

OUTCOMES:

Students should be able to

- Design the cutting tools
- Design the dies

MECX13 PRODUCT DESIGN AND MANUFACTURING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To know the basic concepts of product design with focus on the front end processes.
- To address the methods and application of Value Engineering.
- To know the concept of design for manufacturing, assembly.
- To know the computer application in design for manufacturing and assembly.
- To acquire knowledge on principles of implementing quality and design for sustainability
- To perceive the knowledge of Intellectual property rights and patent registering.
- To know the aspects of reverse engineering in manufacturing

MODULE I INTRODUCTION TO PRODUCT DESIGN AND MANUFACTURING **8**

Introduction to product design and manufacturing, Product design: definition, and evolution, Product design morphology, Preliminary and detailed design, translating customer needs, Product Development process.

MODULE II VALUE ENGINEERING **7**

Value Engineering: a product design approach, Elements of Value Engineering, Value Engineering tools, Case study in Value Engineering

MODULE III PRODUCT MANUFACTURING & COSTING

Process selection, Design for Manufacturing (DFM), Design for Manufacturing and Assembly (DFMA),. Elements of product cost, Product costing: Life Cycle Costing, Material selection: Metals and alloys, Plastics, Ceramics, Rubber

MODULE IV DESIGN FOR SUSTAINABILITY AND QUALITY CONTROL

Quality monitoring: Control charts for processes, Quality monitoring: Control charts for attributes and defects, Quality assurance. Design for Environment: Life Cycle Impact Assessment

MODULE V PATENTING & CREATIVITY

Patenting: Creativity versus Innovation, need and process, methods of prototyping: laboratory demonstration

MODULE VI PRODUCT MANUFACTURING ASPECTS

Layout design, Process simulation, managing competitiveness: Benchmarking, Outsourcing, and mass customization, Reverse Engineering, and Managing Competitiveness, Computer Integrated Manufacturing.

Total Hours: 45

REFERENCES:

1. Eppinger, S. and Ulrich, K., 2015. Product design and development. McGraw-Hill Higher Education.
2. Magrab, E.B., Gupta, S.K., McCluskey, F.P. and Sandborn, P., 2009. Integrated product and process design and development: the product realization process. CRC Press.
3. Kevin Otto, Kristin Wood, “Product Design”, Indian Reprint 2004, Pearson Education, ISBN 9788177588217
4. Yousef Haik, T. M. M. Shahin, “Engineering Design Process”, 2nd Edition Reprint, Cengage Learning, 2010.
5. Clive L.Dym, Patrick Little, “Engineering Design: A Project-based Introduction”, 3rd Edition, John Wiley & Sons, 2009.
6. Del L. Younker, “Value Engineering analysis and methodology”, Marcel Dekker Inc, New York, 2004.

OUTCOMES:

- To demonstrate an understanding of product development processes and knowledge of concept generation and selection tools.
- To identify different areas of Product Development & Value Engineering.
- To apply various of aspects of industrial design, design for manufacture, economic analysis.
- To acquaint with the design for quality and sustainability
- To apply various concepts in quality and reliability principles in the design.
- To understand the procedures for obtaining Patent Rights as well as the rules and regulations involved in Copyrights and Trade Marks.
- To select the suitable tools and methodology for reverse engineering any product

ELECTIVES FOR THERMAL

MECX21	REFRIGERATION AND AIRCONDITIONING	L	T	P	C
		3	0	0	3

Prerequisite : Basic knowledge on Thermodynamics and Thermal Engineering

OBJECTIVES:

- To study the principles of refrigeration
- To acquire knowledge on various components of air conditioning
- To learn the principles of psychrometry
- To educate cooling and heating loads
- To learn system components of refrigeration
- To study about various control equipment used in refrigeration and air conditioning

MODULE I REFRIGERATION SYSTEMS 7

Review of thermodynamic principles of refrigeration – Concept of air craft refrigeration system- Vapour compression refrigeration system – use of PH charts- Multi stage and multi evaporator systems- Cascade system- COP comparison- Vapour Absorption system- Ammonia water and lithium Bromide water systems - Steam jet refrigeration system.

MODULE II REFRIGERANTS AND COMPONENT SELECTION 8

Compressors- reciprocating and rotary (elementary treatment)-condensers evaporators- cooling towers-Refrigerants-Properties- selection of refrigerants, alternate refrigerants, refrigeration plant controls- testing and charging of refrigeration units. Balancing of system components. Application to refrigeration systems-ice plant-food storage plants-milk chilling plants-refrigerated cargo ships.

MODULE III PSYCHROMETRY 7

Psychrometric Processes-use of psychrometric charts- Grand and Room Sensible Heat Factors-by bass factor-requirements of comfort air conditioning comfort charts-factors governing optimum effective temperature, recommended design condition and ventilation standards.

MODULE IV COOLING LOAD CALCULATION 8

Types of load – design of space cooling load- heat transmission through building. Solar radiation–infiltration – internal heat sources (sensible and latent heat)-outside air and fresh air load-estimation of total load-domestic, industrial systems-central air conditioning systems.

MODULE V AIR CONDITIONING SYSTEMS 7

Air conditioning equipment – air cleaning and filters-humidifiers-dehumidifiers air washers-condensers-cooling tower and spray ponds.

MODULE VI AIR CONDITIONING SYSTEM DESIGN & CONTROLS 8

Design of summer and winter air conditioning systems-Elementary treatment of duct design- Air distribution system- Temperature, Pressure and Humidity sensors, Actuators- Thermal insulation of air conditioning system – Applications: Car, industry, Stores and public buildings.

Total Hours: 45

REFERENCES:

1. Manohar Prasad, “Refrigeration and Air conditioning”, Wiley Eastern Ltd, 1983.
2. Arora C.P. “Refrigeration and Air conditioning”, TataMcgraw-Hill NewDelhi,1988.
3. Roy.J.Dosaat, “Principles of Refrigeration”, Pearson Education 1997.
4. Jordan and Prister, “Refrigeration and Air conditioning”, Prentice Hall of India Pvt Ltd. New Delhi, 1985.
5. Stoecker N.F. and Jones, “Refrigeration and Air conditioning”, Tata McGrawHill, New Delhi, 1981.
6. Arora & Domkundwar, A course in Refrigeration & Air Conditioning –, Dhanpat Rai & Sons.
7. R.C. Jordan and G.B. Priester, “Refrigeration & Air conditioning” – Prentice Hall of India. Manohar Prasad, “Refrigeration and Air conditioning”, Wiley Eastern Ltd, 1983.

OUTCOMES:

Student will be able to

- Discuss the principles of refrigeration
- Comprehend the knowledge of various components of air conditioning
- Explain the principles of psychrometry
- Evaluate the cooling and heating loads
- Design refrigeration systems
- Demonstrate control equipments used in refrigeration and air conditioning

MECX22	ADVANCED I.C. ENGINES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn various fuel supply systems used in I.C. engine
- To educate the combustion process in I.C. engine
- To study various components of I.C. engine.
- To learn about automobile emissions and ways to control it.
- To educate about alternate fuels and its usage in automobile.
- To impart knowledge on recent advancements in I.C. engine.

MODULE I FUEL SUPPLY SYSTEM FOR IC ENGINE 7

Carburetion- Theory of carburetion, Mixture requirements for components in S.I Engines, Simple carburetor, Requirements of ignition system; types of ignition system- Direct and indirect- Mono point, Multipoint injection – MPFI Types of Nozzles.

MODULE II COMBUSTION IN I.C. ENGINES 8

combustion phenomena S.I Engine– Normal and abnormal combustion – Factors affecting combustion in S.I. Engines, Combustion chamber for S.I engines, octane rating of fuels; knocking in S.I and C.I Engine- combustion phenomena C.I Engine– Normal and abnormal combustion - Factor affecting combustion in C.I. Engines, Combustion chamber for C.I engines, Cetane rating.

MODULE III ENGINE SYSTEM AND COMPONENTS 7

Ignition system, Lubrication system, Engine starting system, Engine cooling system, Governing system.

MODULE IV AIR POLLUTION FROM IC ENGINE AND ITS REMEDIES 8

Pollutants - sources - formation of carbon monoxide , unburnt hydrocarbon, NOx, Smoke and particulate matter – Method of controlling Emissions -Catalytic converters and particulate Traps - EGR – SER, Method of measurement – Emissions norms.

MODULE V ALTERNATIVE FUELS 8

Alcohol, Hydrogen, Compressed Natural Gas, LPG, Bio Diesel – properties, Suitability, Merits and Demerits – Engine Modifications.

MODULE VI RECENT TRENDS 7

HCCI - Variables Geometry turbochargers - CRDI- Free piston Engines, Plasma Jet Ignition, Stratified charge engine- six stroke engine, fuel cells.

Total Hours: 45

REFERENCES:

1. Heywood, J.B., Internal Combustion Engine Fundamentals, Tata Mc-Graw-Hill, 1988.
2. V.Ganesan, Internal Combustion Engines, 4th Edition, Tata Mc-graw Hill Publishing Co. Ltd. 2012.
3. K.K. Ramalingam, Internal Combustion Engines Fundamentals, Scitech Publications (India) Pvt Ltd, 2009.
4. Dr. V.M. Domkundar, A Course In Internal Combustion Engines, Dhanapat Rai &Co, Delhi.
5. R.Yadav, I.C. Engines, Central book Depot, Allahabad.
6. Willard w. Pulkrabek, Internal Combustion Engines, Pearson Education.

OUTCOMES:

Student will be able to

- Analyse and compare different fuel supply system of an I.C. Engine.
- Identify the different combustion process and the factors which are involved in it.
- Demonstrate the various systems of I.C engines
- Realize the ill effects of automobile emissions and the use of alternate fuels.
- Demonstrate the alternate fuels and its usage
- Recognize recent trends and developments in I.C. Engines

MECX23 NUCLEAR ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the basics of nuclear physics.
- To learn nuclear reactions and reaction materials.
- To educate nuclear fuel cycles and reprocessing of fuel.
- To impart knowledge about various nuclear reactors.
- To elucidate separation of reactor products.
- To educate safe disposal of nuclear waste.

MODULE I NUCLEAR PHYSICS 7

Nuclear model of an atom-Equivalence of mass and energy-binding- radioactivity-half life-neutron interactions-cross sections.

MODULE II NUCLEAR REACTIONS AND REACTION MATERIALS 8

Mechanism of nuclear fission and fusion- radio activity- chain reactions-critical mass and composition-nuclear fuel cycles and its characteristics-uranium production and purification-Zirconium, thorium, beryllium.

MODULE III REPROCESSING 7

Reprocessing: nuclear fuel cycles-spent fuel characteristics-role of solvent extraction in reprocessing-solvent extraction equipment.

MODULE IV NUCLEAR REACTOR 8

Nuclear reactors: types of fast breeding reactors-design and construction offast breeding reactors-heat transfer techniques in nuclear reactors- reactorshielding. Fusion reactors.

MODULE V SEPARATION OF REACTOR PRODUCTS 8

Processes to be considered - 'Fuel Element' dissolution - precipitation process– ion exchange - redox - purex - TTA - chelation -U235 - Hexone - TBP and thorax Processes - oxidative slaging and electro - refining - Isotopes – principles of Isotope separation.

MODULE VI SAFETY AND DISPOSAL 7

Safety and disposal: Nuclear plant safety-safety systems-changes and consequences of accident-criteria for safety-nuclear waste-types of waste and its disposal-radiation hazards and their prevention-weapons proliferation.

Total Hours: 45

REFERENCES:

1. Thomas J.Cannoly, “Fundamentals of nuclear Engineering” John Wiley 1978.
2. Collier J.G., and Hewitt G.F, “Introduction to Nuclear power”, Hemisphere publishing, New York. 1987.
3. Wakil M.M.El., “Power Plant Technology” – McGraw-Hill International, 1984.
4. S. Glasstone and A. Sesonske, “Nuclear Reactor Engineering: Reactor Design Basics”, Vol. 1, Ed. 4, Chapman and Hall, London, 1994.
5. S. Glasstone and A. Sesonske, “Nuclear Reactor Engineering: Reactor Systems Engineering”, Vol. 2, Ed. 4, Chapman and Hall, New York, 1994.

OUTCOMES:

Students will be able to

- Demonstrate basic concepts of nuclear physics.
- Explain nuclear reactions and materials.
- Analyze nuclear fuel cycles.
- Describe various nuclear reactors
- Discuss separation of nuclear products
- Recognise various methods of nuclear waste disposal.

MECX24 GAS DYNAMICS AND JET PROPULSION L T P C

3 0 0 3

Prerequisite : Basic knowledge on Fluid Mechanics and Thermodynamics

OBJECTIVES:

- To educate the applications of compressible flows and their fundamentals
- To study the governing equations in compressible flow for variable area ducts
- To learn governing equations in compressible flow for constant area ducts
- To impart knowledge on the flow properties in normal and oblique shocks
- To learn the elements of jet engines
- To educate space vehicles and its applications

MODULE I COMPRESSIBLE FLOW – FUNDAMENTALS 7

Energy and momentum equations for compressible fluid flows, reference velocities, stagnation state, velocity of sound, critical states, Mach number, critical Mach number, types of waves, Mach cone, Mach angle-Effect of Mach number on compressibility.

MODULE II FLOW THROUGH VARIABLE AREA DUCT 8

Isentropic flow through variable area ducts, comparison of isentropic and adiabatic process, T-s and H-s diagrams for nozzle and diffuser flows- Mach number Variation- Impulse function Area ratio as a function of Mach number mass flow rate through nozzles and diffusers.

MODULE III FLOW THROUGH CONSTANT AREA DUCT 8

Flow in constant area ducts with friction (Fanno flow)- Fanno curves, variation of flow properties, variation of Mach number with duct length, Isothermal flow with friction- Flow in constant area ducts with heat transfer(Rayleigh flow),Rayleigh line, variation of flow properties, maximum heat transfer.

MODULE IV NORMAL SHOCK 8

Governing equations, variation of flow parameters like static pressure, static temperature, density, stagnation pressure and entropy across the normal shock, Prandtl-Meyer equation, Impossibility of shock in subsonic flows, flow in

convergent and divergent nozzle with shock, normal shock in Fanno and Rayleigh flows, flow with oblique shock (elementary treatment only).

MODULE V JET PROPULSION 7

Aircraft propulsion- types of jet engines- energy flow through jet engines, study of turbo jet engine components- diffuser, compressor, combustion chamber, turbine and exhaust systems, performance of turbo jet engines- thrust, thrust power, propulsive and overall efficiencies, thrust augmentation in turbojet engines, Ram jet and pulse jet engines.

MODULE VI SPACE VEHICLES 7

Rocket propulsion- Types of rocket engines- Constructional details and working principle – Thrust equation- effective jet velocity, specific impulse- Rocket engine performance, solid and liquid propellants, and comparison of different propulsion systems. Space vehicle applications.

Total Hours: 45

REFERENCES:

1. Yahya. S.M., “Fundamentals of compressible flow with Aircraft and Rocket Propulsion”, New Age Internal Pvt Ltd., New Delhi, 2003.
2. Patrich.H. Oosthvizen, William E.Carscallen, “Compressible Fluid Flow”, TataMcGraw –Hill, 1997.
3. Cohen.H., Rogers R.E.C and Saravanmutoo, “ Gas Turbine theory”, Addision Wesley Ltd., 1987.
4. Ganesan. V., “Gas Turbines”, Tata McGraw –Hill, New Delhi, 1999.
5. Radha Krishnan. E, “Gas Dynamics”, Prentice Hall of India, New Delhi, 2001.

OUTCOMES:

Student should be able to

- Apply the concepts of gas dynamics for applications related to compressible flows
- Calculate the flow variables in variable area duct
- Possess the knowledge of jet engines and space propulsion theories
- Evaluate the flow properties associated with shock waves
- Explain elements of jet engines
- Demonstrate space vehicles and its applications

MECX25 ENERGY CONVERSION

L	T	P	C
3	0	0	3

OBJECTIVES:

- To impart knowledge on power generation from thermal power plant.
- To study about energy extraction from diesel and hydroelectric plant.
- To learn about nuclear and gas turbine plant and methods to improve efficiency
- To acquire knowledge on renewable energy sources and its uses.
- To obtain knowledge on the methods of energy recovery and conservation
- To study about effective utilisation of energy and ill effects of pollution.

MODULE I COAL BASED THERMAL POWER PLANT 9

High Pressure and Super Critical Boilers – Fluidized Bed Boilers, coal and ash handling, burning-stoker firing, burners, FBC, dust collection-scrubbers, ESP, boiler calculations. Layout of thermal plant – components.

MODULE II DIESEL ENGINE AND HYDROELECTRIC PLANTS 7

Diesel engine power plant layout – components, various operating systems, merits, demerits, applications. hydel plant – layout and system components, hydraulic turbines, types of hydel plants, safety.

MODULE III NUCLEAR AND GAS TURBINE PLANTS 7

Development of nuclear plant in India, nuclear energy – fission chain reaction, reactor components, types of reactors and plants, waste disposal and safety. Gas turbines – working, types, methods to improve power output and efficiency, layout with inter-cooling, reheating and regeneration.

MODULE IV RENEWABLE ENERGY BASED PLANTS AND MHD PLANTS 9

Power from wind – wind turbine working and types, solar thermal power plants– low medium and high power generation, power from wave, tidal, geothermal sources, OTEC system, Energy from biomass. MHD power plants – working, types, merits and demerits.

MODULE V ENERGY CONSERVATION AND WASTE HEAT RECOVERY 6

Energy conservation – need and importance, energy efficient equipment, energy conservation opportunities (ECOs) in residential, transport, commercial and industrial sectors. Energy from wastes, Waste heat recovery – need and importance, cogeneration, combined cycle plants.

MODULE VI ENERGY ECONOMICS AND ENVIRONMENTAL POLLUTION 7

Cost of Energy generation – load curves– Economics of load sharing, comparison of economics of various power plants. Environmental degradation- emissions from fossil based power plants and their implications –remedial measures.

Total Hours: 45

REFERENCES:

1. EI- Wakil M.M, “Power Plant Technology”, McGraw-Hill 1984.
2. G.R. Nagpal, “Power Plant Engineering”, Hanna Publishers, 1998.
3. G.D. Rai, “Introduction to Power Plant Technology”, Khanna Publishers, 1995
4. Arora S.C and Domkundwar S, “A course in Power Plant Engineering”, Dhanpatrai, 2001.
5. Nag P.K, “Power plant Engineering”, Tata McGraw-Hill, 1998.
6. R.K. Rajput, “Power Plant Engineering”, Laxmi Publications, 1995.

OUTCOMES:

Students should be able to

- Recognize the construction and working of thermal power plant.
- Demonstrate power generation from diesel and hydro electric power plant
- Comprehend the construction and working of nuclear and gas turbine power plants
- Explain renewable energy sources and its uses
- Implement the concepts of cogeneration and combined cycle plants appropriate applications

- Implement the concepts of energy conservation and waste heat recovery wherever applicable.

MECX26 TURBO MACHINERY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To obtain knowledge on the basic principles of turbo machinery
- To study the types of fans and blowers and their performance
- To learn the constructional details and performance curves of centrifugal compressor
- To educate velocity diagram in designing the axial flow compressor
- To elucidate the characteristics of an axial and radial flow turbine
- To learn the performance of steam turbine and their affecting parameters.

MODULE I PRINCIPLES 9

Energy transfer between fluid and rotor, classification of fluid machinery, dimensionless parameters, specific speed, applications, stage velocity triangles, work and efficiency for compressors and turbines.

MODULE II CENTRIFUGAL FANS AND BLOWERS 7

Types, stage and design parameters, flow analysis in impeller blades, volute and diffusers, losses, characteristics curves and selection, fan drives and fan noise.

MODULE III CENTRIFUGAL COMPRESSOR 7

Construction details, types, impeller flow losses, slip factor, diffuser analysis, losses and performance curves.

MODULE IV AXIAL FLOW COMPRESSOR 9

Stage velocity triangles, enthalpy-entropy diagrams, stage losses and efficiency, work done factor, simple stage design problems and performance characteristics.

MODULE V AXIAL AND RADIAL FLOW TURBINES 6

Stage velocity diagrams, reaction stages, losses and coefficients blade design principles, testing and performance characteristics.

MODULE VI STEAM TURBINES 7

Flow through nozzles, compounding, effect of wetness in steam turbines, gas turbines, Hydraulic turbines – Pelton, Francis and Kaplan turbines

Total Hours: 45

REFERENCES:

1. Yahya, S.H., “Turbines, Compressor and Fans ", Tata McGraw Hill Publishing Company, 1996.
2. Bruneck, Fans, Pergamom Press, 1973.
3. Earl Logan, Jr., “Hand book of Turbomachinery ", Marcel Dekker Inc., 1992.
4. Dixon, S.I., “Fluid Mechanics and Thermodynamics of Turbomachinery ", Pergamom Press, 1990.
5. Shepherd, D.G., “Principles of Turbomachinery ", Macmillan, 1969.
6. Stepanff, A.J., “Blowers and Pumps ", John Wiley and Sons Inc., 1965.
7. Ganesan .V., " Gas Turbines ", Tata McGraw Hill Pub. Co., New Delhi, 1999

OUTCOMES:

Student will be able to

- Express the principle of turbo machinery
- Recognise the different types fans and blowers available
- Evaluate the performance of centrifugal compressor
- Demonstrate the velocity diagram in designing the axial flow compressor
- Discuss the characteristics of axial and radial flow turbine
- Explain the concept of steam turbine and their application

MECX27	ENERGY CONSERVATION AND MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To educate the need for energy conservation
- To learn the potential opportunities for thermal energy conservation
- To educate various heat exchanging equipment
- To study energy conservation opportunities in industrial sectors
- To acquire knowledge on energy conservation opportunities in residential and commercial sectors
- To educate the important aspects of energy audit and management

MODULE I CONCEPTS AND NEED FOR ENERGY CONSERVATION 7

Concept of energy conservation – Sankey diagram – thermodynamic limitations: first and second laws of thermodynamics of energy transfer – availability analysis of various thermodynamic processes/devices/cycles. Need for energy conservation in domestic, transportation, agricultural and industrial sectors – Lighting and HVAC systems – simple case studies.

MODULE II THERMAL ENERGY CONSERVATION 8

Thermal energy conservation: combustion systems and processes – combustion efficiency –boiler performance – methodology of improving the boiler performance – steam turbine and distribution systems: energy conservation in turbines – necessity for maintenance of correct pressure, temperature and quality of steam – condensate recovery – recovery of flash steam – air and gas removal – thermal insulation.

MODULE III HEAT EXCHANGER ANALYSIS 7

Heat exchange systems – recuperative and regenerative heat exchangers – compact heat exchangers – fluidized bed heat exchange systems – heat pumps – heat pipes – heat recovery from industrial processes - waste heat recovery and cogeneration schemes, combined cycle plants.

MODULE IV ENERGY CONSERVATION IN INDUSTRIES 8

Energy conservation in industries - energy conservation in pumps, fans, compressed air systems, refrigeration & air conditioning systems, emergency DG

sets, illumination, electrical motors – energy efficient motors and variable speed motors. Case studies for energy conservation in various industries such as cement, iron and steel, glass, fertilizer, food processing, refinery etc.

MODULE V ENERGY CONSERVATION IN RESIDENTIAL, COMMERCIAL AND TRANSPORT SECTORS **7**

Energy conservation opportunities in residential house, office, educational institutions and commercial shops – Energy efficient lighting - use of CFL, LED, movement sensors, tiny switches, ventilation – concept of green building. Energy conservation in transport sector - fuel economy, additives, preventive and periodic maintenance.

MODULE VI ENERGY MANAGEMENT **8**

Concept of energy management – Energy demand and supply – Economic analysis of energy options – Duties of energy managers. Energy auditing: definition, necessity and types. Understanding energy costs – bench marking – energy performance – matching energy use to requirement – maximizing system efficiencies – optimizing the input energy requirements. Fuels and energy: supplementing and substitution – energy audit instruments – energy economics: discount rate, payback period, internal rate of return, life cycle costing – energy conservation systems analysis for safety, health and pollution.

Total Hours: 45

REFERENCES:

1. S.S. Rao and Parulekar, “Energy Technology”, Khanna Publishers Ltd, 1996
2. Archie, W Culp, “Principles of Energy Conservation”, McGraw Hill, 1991
3. Wayne C Turner, “Energy Management Handbook”, The Fairmount Press,1988
4. D Patrick and S W Fardo, “Energy Management and Conservation”, PHI,1990
5. P. O’Callaghan: “Energy Management”, McGraw - Hill Book Company, 1993.
6. Kenney, W. F., “Energy Conservation in Process Industries”, Academic Press,1983
7. Tyagi A. K, “Handbook of energy audits and management”, TERI.

OUTCOMES:

Students should be able to

- Demonstrate the need for energy conservation
- Implement potential opportunities for thermal energy conservation
- Analyze various heat exchanging equipments
- Identify energy conservation opportunities in industrial sectors
- Employ energy conservation opportunities in residential and commercial sectors
- Comprehend energy economics and management.

MECX28	COMPUTATIONAL FLOW AND HEAT TRANSFER	L	T	P	C
		3	0	0	3

Prerequisite : Basic knowledge on Fluid Mechanics and Heat & Mass Transfer

OBJECTIVES:

- To learn the Governing Equations of viscous fluid flows.
- To study the governing equation in algebraic form and to study various schemes
- To learn numerical modelling and its role in the field of fluid flow and heat transfer in finite volume method.
- To educate the numerical modelling for diffusion oriented problem.
- To elucidate the flow field for appropriate problem.
- To acquire knowledge on the turbulence modelling

MODULE I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS 8

Basics of computational fluid dynamics – Governing equations of fluid dynamics– Continuity, Momemtum and Energy equations – Chemical species transport– Physical boundary conditions – Mathematical behaviour of PDEs on CFD -Elliptic, Parabolic and Hyperbolic equations.

MODULE II FINITE DIFFERENCE METHOD 8

Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – solution methods for finite difference equations – Elliptic equations – Iterative solution Methods – Parabolic equations– Explicit and Implicit schemes – Example problems on elliptic and parabolic equations.

MODULE III FINITE VOLUME METHOD (FVM) FOR DIFFUSION 8

Finite volume formulation for steady state One, Two and Three –dimensional diffusion problems. One dimensional unsteady heat conduction through Explicit, Crank – Nicolson and fully implicit schemes.

MODULE IV FINITE VOLUME METHOD FOR CONVECTION DIFFUSION 7

Steady one-dimensional convection and diffusion – Central, upwind differencing schemes properties of discretization schemes – Conservativeness, Boundedness, Trasnportiveness, Hybrid, Power-law, QUICK Schemes.

MODULE V CALCULATION FLOW FIELD 7

Representation of the pressure gradient term and continuity equation –Staggered grid – Momentum equations – Pressure and Velocity corrections –Pressure Correction equation, SIMPLE algorithm and its variants.

MODULE VI TURBULENCE 7

Introduction-Time-averaged equations for Turbulent Flow – Turbulent–Kinetic Energy Equations Turbulence models, mixing length model, two equation (k-ϵ) models – High and low Reynolds number models.

Total Hours: 45

REFERENCES:

1. T.J. Chung, “Computational Fluid Dynamics”, Cambridge University, Press, 2002.
2. Versteeg, H.K., and Malalasekera, W., “An Introduction to Computational Fluid Dynamics: the finite volume Method”, Longman, 1998.
3. Ghoshdastidar, P.S., “Computer Simulation of flow and heat transfer”, TataMcGraw Hill, Publishing Company Ltd., 1998.
4. Patankar, S.V. “Numerical Heat Transfer and Fluid Flow”, Hemisphere Publishing Corporation, 2004.
5. Muralidhar, K., and Sundararajan, T., “Computations Fluid Flow and Heat Transfer”, Narosa Publishing House, New Delhi, 1995.
6. Ghoshdastidar P.S., “Heat Transfer”, Oxford Unversity Press, 2005.
7. Prodip Niyogi, Chakrabarty .S.K., Laha .M.K. “Introduction to Computational Fluid Dynamics”, Pearson Education, 2005
8. Anil W. Date “Introduction to Computational Fluid Dynamics” Cambridge University Press, 2005.

OUTCOMES:

Students should be able to

- Derive the governing equations to solve real time problems.
- Relate the governing equation with finite difference scheme and solve problems
- Solve problems in the field of heat transfer.
- Evaluate convection dominated fluid flow and heat transfer problems.
- Analyse the flow field and know the appropriate algorithm to be chosen.
- Evaluate problems which involves turbulence.

MECX29 RENEWABLE SOURCES OF ENERGY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To impart knowledge on the global and national energy scenario of renewable energy resources.
- To study harnessing of energy from solar
- To learn harnessing of energy from wind and geothermal sources
- To educate harnessing of energy from ocean and tides
- To study harnessing of energy from bio system
- To learn harnessing of energy from renewable sources

MODULE I INTRODUCTION **7**

Primary energy sources - World energy resources-Indian energy scenario, energy cycle of the earth-environmental aspects of energy utilisation-CO2emmisions and Global warming, Global dimming - renewable energy resources and their importance. Potential impacts of harnessing the different renewable energy sources.

MODULE II SOLAR ENERGY **8**

Principles of solar energy collection – solar radiation- measurements –instruments – data and estimation – types of collectors- characteristics and design principles of different types of collectors – performance of collectors –testing of collectors. Solar thermal applications – water heaters and air heaters,-performance and applications – simple calculations – solar cooling – solar drying, solar ponds- solar tower concept. Solar furnace.

MODULE III WIND AND GEOTHERMAL ENERGY **8**

Wind potential in India, Energy from the wind – general theory of wind mills, types of windmills design aspects of horizontal axis wind mills – applications, Potential Sites, Estimations of Geothermal Power, Nature of Geothermal Sites, Hot-Dry Rocks, Resources, Magma Resources, Systems for Energy Generation, Applications of Geothermal, Energy, Environmental Issues.

MODULE IV OCEAN ENERGY, TIDAL ENERGY AND SMALL SCALE HYDRO ELECTRIC POWER PLANTS **7**

Basic theory of OTEC, potential and application of technologies- Energy from tides and waves – working principles of tidal plants, Classification of Small Hydro Power Stations, Mini and Micro Hydel Projects, Turbines and Generators for Small Scale Hydro Electric, Protection, Advantages and Limitations

MODULE V BIO ENERGY **8**

Energy from bio mass and bio gas plants – various types – design principles of biogas plants – applications. Energy from wastes – waste collection, Reduction and transfer. Waste burning power plants – utilization of industrial and municipal wastes – energy from the agricultural wastes.

MODULE VI OTHER RENEWABLE ENERGY SOURCES **7**

Direct energy conversion (Description, principle of working and basic design aspects only) – Magneto hydrodynamic systems (MHD) – thermo electric generators – thermionic generators, fuel cells – solar cells – types – EMF generated, power output losses and efficiency and applications. Hydrogen conversion and storage systems.

Total Hours: 45

REFERENCES:

1. Sukhatme. S.P., Solar Energy, 2nd Edition, TMH, 2003.
2. Sulton, “Direct Energy Conversion”, Mc-Graw-Hill, 1966.
3. Duffie and Beckmann, “Solar Energy Thermal Processes”, John Wiley, 1974.
4. Garg. H.P and Prakash. J.,” Solar Energy – Fundamentals and Applications”, TMH, New Dwlhi, 1997.

OUTCOMES:

Students should be able to

- Recognize the significance of renewable energy and its harnessing.
- Understand and Harness energy from solar energy and apply it to real world problem.

- Identify the sources and techniques of wind and geothermal energy extraction.
- Apply the techniques of effective utilisation of ocean, tidal and hydro-electric power plants.
- Utilise ecosystem as energy source for various process.
- Identify other renewable sources of energy

MECX30 SOLAR ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn solar radiation measurement and data estimation
- To impart knowledge on performance characteristics of flat plat collectors
- To study performance characteristics of concentrating collectors
- To learn the principle and application of photovoltaic cells
- To acquire knowledge on the application of solar energy in various fields
- To elucidate the economic use of solar energy

MODULE I SOLAR RADIATION AND MEASUREMENT 9

The Solar energy option- an overview of thermal applications. Solar Radiation analysis – Solar constant, electromagnetic energy spectrum, determination of earth-sun angles, Solar time, solar angles, sunset, sunrise, and day length. Solar Radiation -Measurements and data estimation.

MODULE II FLAT PLATE COLLECTOR 9

Physical principle and general characteristics of a Liquid flat plate collectors- Performance and thermal analysis of liquid flat plate collector, Coatings and selection of materials, effect of dust and shade. High temperature non concentrating collectors.

Solar Air heaters collectors – materials, types, Performance analysis and applications.

MODULE III CONCENTRATING COLLECTORS 7

Line focusing and point focusing collectors- cylindrical parabolic collector, compound parabolic concentrators (CPC), Parabolic disc collector, Thermal performance of focusing collectors. Solar energy storage – types, Solar Ponds

MODULE IV SOLAR CELLS 7

Photovoltaic principle- materials for solar cells. Design and fabrication of Photovoltaic cells. Performance analysis of P-V cells- thermoelectric generator solar cells.

MODULE V APPLICATIONS OF SOLAR ENERGY 6

Solar heating, solar cooling, heat pump, solar pumping, Solar distillation, solar cooking. Solar Thermal Power generation.

MODULE VI ECONOMIC ANALYSIS 7

Cost analysis and pay back calculations for different types of solar panels and collectors, installation and operating costs; Environmental and safety issues, protection systems, performance monitor.

Total Hours: 45

REFERENCES:

1. G.D.Rai, “Solar energy utilisation, Khanna Publishers”, New Delhi.
2. S.P. Sukhatme, “Solar Energy”, Tata McGrew Hill Company Ltd., New Delhi.
3. H.P. Garg, “Advanced in Solar Energy Technology”, D. Reidel Publishing Co., Drdricht.
4. Mathur and Methaf – “Solar Energy”.
5. Duffle and Beckman, “Solar Thermal Engineering Process’, John Wiley &Sons, New York.
6. J.S. Hsieh, “Solar Energy”, Prentice Hall Inc. New Jerssey.
7. A.B. Meinel and M.B. Meinel, “Applied Solar Energy”, Addison – Wiley Pub. Co., Reading.
8. G.N. Tiwari and S. Suneja, “Solar Thermal Engineering Systems”, Narosa Publishing House.

OUTCOMES:

Students will be able to

- Demonstrate the solar radiation measurement and data estimation
- Evaluate the performance characteristics of flat plat collector
- Explain the performance characteristics of concentrating collector
- Express solar photovoltaic principle and its applications
- Demonstrate the application of solar energy in various fields
- Recognise the economic and effective use of solar energy

MECX31 DESIGN OF THERMAL SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the working and performance of basic heat transfer equipment.
- To learn design of thermal systems for effective and efficient heat transfer.
- To educate the design of compact Heat exchanger
- To impart knowledge on the purpose of condenser and its application
- To study the design of evaporator for Refrigeration Air-conditioning and chillers
- To acquire knowledge on the characteristics of cooling tower and its accessories.

MODULE I DOUBLE PIPE HEAT EXCHANGER AND HEAT PIPES 8

Thermal and hydraulic design-Inner pipe- Annulus, Hairpin heat exchangers-Base inner tube-finned inner multi tubes-parallel and series arrangements, pressure drop and constructional features. Heat pipes-structures-Applications-Basic relations-Performance characteristics-Effects of working fluid and operating temperature, Wick- selection of material-pore size

MODULE II SHELL AND TUBE HEAT EXCHANGERS 7

Basic components-shell-tube bundles-Baffles –Types and geometry, Design procedure-Preliminary estimation of size, pressure drop and heat transfer calculations- shell and tube sides-Kenn method –bell-Delaware method.

MODULE III COMPACT AND GASKETTED PLATE HEAT EXCHANEGRS 8

Compact heat exchangers- types-constructional features, heat transfer and pressure drop calculation- Finned plate and tube. Gasketted plate heat exchangers- Constructional features-Plate pack and frame-operational characteristics- flow arrangement, heat transfer and pressure drop calculation, performance analysis, comparison with other type of heat exchangers.

MODULE IV CONDENSERS 7

Shell and tube condenser- horizontal and vertical types- temperature distribution and heat flow in a condenser-pressure drop in a condenser -extended surfaces-design and operational consideration, plate heat condenser, air cooled and direct contact types, condensers for refrigeration, evaporative condenser.

MODULE V EVAPORATORS 7

Temperature distribution and heat flow in an evaporator-Evaporator for refrigeration and air conditioning- chillers- air coolers- thermal analysis- Shah, Kandhar and Ghngor and Wintertom correlations, standard types.

MODULE VI COOLING TOWERS 8

Cooling tower-types-Basic relation- heat balance and heat transfer-Characteristics, effects of: Packings- Geometry, spray Design- Selection of: Pumps, Fans, Testing, Maintenance, Environmental effects, Wind loads, Typical Installations.

Total Hours: 45

REFERENCES:

1. Sadic Kakac and Hongtan Lin, Heat Exchangers – CRC Press, London, 1998.
2. Arthur P.Fraas, Heat Exchnger design – John Wiley & Sons, 1997.
3. Kenn.D.Process Heat Transfer –Tata McGraw Hill, 1980.
4. Walker, Industrial Heat Exchangers-Tata Mcgraw Hill, 1997.
5. Holger Martin, Heat Exchangers- Hemisphere Publishing Corporation, London, 1992.
6. Arora, Domkundwar, A course in Heat and mass Transfer – Dhanpat Rai & co. (P) ltd -2003.

OUTCOMES:

Student will be able to

- Demonstrate the characteristics and performance of various thermal systems.
- Calculate the effectiveness of Heat exchanger.
- Recognise the selection the compact HX for specific application
- Evaluate the condenser performance and its affecting parameters

- Estimate the load on the evaporator for R&AC and chiller application
- Demonstrate the performance of cooling tower

MECX32 AUTOMOBILE ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the automobile vehicle structures, internal combustion engines and to identify the functions and materials of internal combustion engines.
- To educate the working of internal combustion engines sub systems.
- To learn the manual and automatic transmission system.
- To obtain knowledge on the steering geometry and wheel alignment parameters.
- To study about the suspension systems.
- To impart knowledge on safety and recent technological developments.

MODULE I VEHICLE STRUCTURE AND ENGINES 7

Types of Automobiles- Vehicle construction- Chassis – Frame and Body – aerodynamics. Components of Engine – Their forms, Functions and Materials- Basic layout of Automotive vehicles.

MODULE II ENGINE SYSTEMS 8

Cooling and Lubrication systems in Engine - fuel injection systems- Electrical systems- Battery generator- Starting Motor and drives – Lighting and Ignition (Battery ,Magneto Coil and Electronic Types)- Regulators – Cut outs.

MODULE III TRANSMISSION SYSTEM 7

Types of Clutch- gear box (manual and automatic)-differential and types ofrear axle- Transfer Box Fluid flywheel – Torque convertors- Propeller shaft.

MODULE IV STEERING AND BRAKING SYSTEM 8

Wheels and Tyres- Wheel Alignments Parameters – Steering Geometry and Types of Steering gear box- Power Steering- Breaking Systems – Types and Constructions – Diagonal Braking Systems

MODULE V SUSPENSION SYSTEMS 7

Shock absorbers – Independent Suspension -Torsions bars – Air suspensions systems.

MODULE VI AUTOMOTIVE SAFETY AND RECENT TRENDS 8

Safety systems- Active safety- Passive safety – Electric Vehicle- Hybrid vehicles, Fuel cells – Antilock Braking Systems- Adaptive lighting- Active cruise Control-Traction control-Drive by wire.

Total Hours: 45

REFERENCES:

1. Automotive Mechanics, William H Crouse and Donald L. Anglin, Tata McGrawHill Publishing Company Ltd., 2004, Tenth Edition.
2. Automotive Handbook, Bosch, Robert Bosch GmbH, Germany 2004, Eighth edition.
3. Automotive Technology – A Systems Approach, Jack Erjavek, Thomson Learning, 3rd Edition, 1999.
4. The Motor Vehicle K. Newton, W. Steeds, T. K. Garrett, SAE International,13thedition
5. Advanced Vehicle Technology, Heinz Heisler, Elsevier Ltd, (Second Edition)

OUTCOMES:

Student should be able to

- Identify the automobile vehicle structures and list the number of component present in internal combustion engines
- Discuss the working of sub-systems of Internal combustion engines
- Relate the functions of manual and automatic transmission system.
- Inspect steering geometry and wheel alignment parameters.
- Compare different suspension systems of automobile vehicles.
- Validate the safety and recent technological developments.

MECX33	AUTOMOTIVE POLLUTION AND CONTROL	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To educate about emission and noise pollution in automobiles
- To learn pollution control techniques for SI and CI engines
- To study about automotive pollution measuring instruments

MODULE I EMISSION AND NOISE POLLUTION IN AUTOMOBILES 10

Sources of Air Pollution. Various emissions from Automobiles — Formation — Effects of pollutants on environment and human beings. Emission control techniques – Modification of fuel, after treatment devices. Emission standards. Automotive waste management, old vehicle disposal, recycling, tyre recycling

Sources of Noise — Engine Noise, Transmission Noise, vehicle structural Noise, aero dynamics noise, Exhaust Noise. Noise reduction in Automobiles — Encapsulation technique for noise reduction —Silencer Design.

MODULE II SI ENGINE AND CI ENGINE EMISSIONS AND CONTROL 10

Emission formation in SI Engines- Carbon monoxide & Carbon di oxide – Unburned hydrocarbon, NOx, Smoke —Effects of design and operating variables on emission formation – controlling of pollutants - Catalytic converters, Charcoal Canister, Positive Crank case ventilation system, Secondary air injection, thermal reactor.

Formation of White, Blue, and Black Smokes, NOx, soot, Effect of Operating variables on Emission formation — Fumigation, Split injection, Catalytic Coating, EGR, Particulate Traps, SCR, Fuel additives — Cetane number Effect.

MODULE III TEST PROCEDURES AND EMISSION MEASUREMENTS 10

Constant Volume Sampling I and 3 (CVSI &CVS3) Systems- Sampling Procedures —Chassis dynamometers - Seven mode and thirteen mode cycles for Emission Sampling.

Emission analysers —NDIR, FID, Chemiluminescent, Smoke meters, Dilution Tunnel, SHED Test, Sound level meters.

Total Hours: 30

REFERENCES:

1. V.Ganesan, 'Internal combustion Engines', Tata McGraw Hill Book Co, Eighth Reprint, 2005.
2. Crouse and Anglin, 'Automotive Emission Control', McGraw Hill company, Newyork 1993.
3. G.P.Springer ad D.J.Patterson, Engine Emissions, Pollutant formation, Plenum Press, NewYork. 1986.
4. D.J.Patterson and N.A.Henin, 'Emission from Combustion Engine and their control', Anna Arbor Science Publication, 1985.
5. L.Lberanek, 'Noise Reduction', Mcgrawhill Company., Newyork 1993.
6. C.Duerson, 'Noise Abatment', Butterworths ltd., London1990.
7. A.Alexander, J.P.Barde, C.lomure and F.J. Langdan, 'Road traffic noise', Applied science publisher ltd., London, 1987.

OUTCOMES:

The student should be able to

- Demonstrate sources of emission and noise pollution in automobiles
- Explain pollution control techniques for various types of engines
- Apply appropriate instrument and procedure for measurement of emissions

MECX34 FUELS AND COMBUSTION

L	T	P	C
2	0	0	2

OBJECTIVES:

- To study the types and utility of solid and liquid fuels
- To study the types and utility of gaseous fuels
- To educate the concept of combustion phenomenon and stoichiometric analysis of different fuels.

MODULE I SOLID, LIQUID FUELS 12

Fuels - Types and Characteristics of Fuels - Determination of Properties of Fuels- Solid fuel types - Coal Family - Properties - Calorific Value - ROM, DMMF, DAF and Bone Dry Basis - Ranking - Bulk & Apparent Density - Storage - Washability -Coking & Caking Coals - Renewable Solid Fuels - Biomass - Wood Waste -Agro Fuels – Manufactured Solid Fuels

Liquid fuel types - Sources - Petroleum Fractions - Classification - Refining – Properties of Liquid Fuels - Calorific Value, Specific Gravity, Flash & Fire Point, Octane Number, Cetane Number etc, - Alcohols - Tar Sand Oil

MODULE II GASEOUS FUELS 8

Classification - Composition & Properties - Estimation of Calorific Value –Gas Calorimeter. Rich & Lean Gas - Wobbe Index - Natural Gas - Dry & Wet Natural Gas - Stripped NG - Foul & Sweet NG - LPG - LNG - CNG – Methane- Producer Gas - Gasifiers - Water Gas - Town Gas - Coal Gasification -Gasification Efficiency - Non - Thermal Route - Biogas - Digesters – Reactions- Viability - Economics.

MODULE III COMBUSTION STOICHIOMETRY & KINETICS 10

Stoichiometry - Mass Basis & Volume Basis - Excess Air Calculation - Fuel &Flue Gas. Compositions - Calculations - Rapid Methods – Combustion Processes – Stationary. Flame - Surface or Flameless Combustion -Submerged Combustion - Pulsating & Slow. Combustion Explosive Combustion. Mechanism of Combustion - Ignition & Ignition Energy -Spontaneous Combustion - Flame Propagation - Solid, Liquid & Gaseous Fuels Combustion - Flame Temperature - Theoretical, Adiabatic & Actual -Ignition Limits - Limits of Inflammability

Total Hours: 30

REFERENCES:

1. Bhatt, Vora Stoichiometry, 2nd Edition, Tata Mcgraw Hill, 1984.
2. Fuels and Combustion (3rd Edition), Samir Sarkar, Orient Black Swan.
3. Sharma SP, Mohan Chander, Fuels & Combustion, Tata Mcgraw Hill, 1984
4. Civil Davies, Calculations in Furnace Technology, Pergamon Press, Oxford, 1966

OUTCOMES:

Student will be able to

- Recognize the nature, characteristics and suitability of solid and liquid fuels
- Identify the characteristics of gaseous fuels
- Calculate the air – fuel ratio for different fuels under different types of combustion.

MECX35 ALTERNATE FUELS

L	T	P	C
1	0	0	1

OBJECTIVES:

- To study the various types of alternative fuels
- To educate production methods and application of alternate fuels

MODULE I INTRODUCTION TO ALTERNATE FUELS 8

Introduction to alternative fuels. – Need for alternative fuels – Availability of different alternative fuels for SI and CI engines. Alcohols as fuels. Production methods of alcohols. Properties of alcohols as fuels. Methods of using alcohols in CI and SI engines. Blending, dual fuel operation, surface ignition and oxygenated additives. Various vegetable oils and their important properties. Different methods of using vegetable oils engines – Blending, preheating Transesterification and emulsification of Vegetable oils – Performance in engines.

MODULE II ALTERNATE FUELS AND ELECTRIC VEHICLES 7

Production methods, properties studies, modification required to use in SI and CI engines – hydrogen, biogas, natural gas and LPG as fuels,- electric, hybrid and fuel cell vehicles

Total Hours: 15

REFERENCES:

1. Ayhan Demirbas, 'Biodiesel A Realistic Fuel Alternative for Diesel Engines', Springer- Verlag London Limited 2008,
2. Gerhard Knothe, Jon Van Gerpen, Jargon Krahl, The Biodiesel Handbook, AOCS Press Champaign, Illinois 2005.
3. Richard L Bechtold P.E., Alternative Fuels Guide book, Society of Automotive Engineers, 1997 ISBN 0-76-80-0052-1.
4. Transactions of SAE on Bio fuels (Alcohols, vegetable oils, CNG, LPG, Hydrogen, Biogas etc.).
5. Science direct Journals (Biomass & Bio energy, Fuels, Energy, Energy conversion Management, Hydrogen Energy, etc.) on biofuels.

6. Devaradjane. Dr. G., Kumaresan. Dr. M., “Automobile Engineering”, AMK Publishers, 2013.

OUTCOMES:

The students will be able to

- Discuss the various types of alternate fuels and modification required in I.C. engines
- Demonstrate production method of alternate fuels and working of electric vehicles

ELECTIVES FOR MANUFACTURING & MATERIAL SCIENCE

MECX41	MODERN MANUFACTURING SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To elucidate the concepts and applications of flexible manufacturing systems.
- To study the importance of computer control in FMS
- To learn simulation of FMS model.
- To practice creating part families through group technology.
- To learn the applications of FMS.
- To educate the future of FMS.

MODULE I INTRODUCTION TO FLEXIBLE MANUFACTURING SYSTEMS 7

Introduction to FMS– benefits - the challenge – major elements – types of flexibility – FMS application – single product, single batch, n – batch scheduling problem Production Flow Analysis - Rank Order Clustering – knowledge based scheduling system.

MODULE II COMPUTER CONTROL FOR FLEXIBLE MANUFACTURING SYSTEMS 8

Introduction – composition of FMS– hierarchy of computer control –computer control of work center and assembly lines – FMS supervisory computer control – types of software specification and selection – trends.

MODULE III SIMULATION AND DATABASE 7

Application of simulation–model of FMS–simulation software – advantages and limitation – manufacturing data systems–data flow–FMS database systems–planning for FMS database.

MODULE IV MODULE IV GROUP TECHNOLOGY 8

Introduction – matrix formulation – graph formulation – knowledge based system for group technology – Part Family sequencing - Dispatching rules - economic justification of FMS- application of possibility distributions in FMS systems justification.

MODULE V APPLICATIONS OF FMS AND TOOLS 8

FMS application in machining, sheet metal fabrication, prismatic component production – aerospace application. Tools – Cellular Manufacturing, Automation, Material Handling - Just In Time Manufacturing – Kanban - CONWIP and Kanbanetc,

MODULE VI SYNCHRONOUS MANUFACTURING AND FMS FUTURE FACTORIES 7

The Goal - Principles of SM - TOC and LP - Scheduling FMS development towards factories of the future – artificial intelligence and expert systems in FMS.

Total Hours: 45

REFERENCES:

1. Montgomery, Douglas C., “Introduction to Statistical Quality Control”, 6th Edition, John Wiley and Sons, Inc., 2009.
2. Raouf, A. and Ben-Daya, M., “Flexible manufacturing systems: recent development”, Elsevier Science, 1995.
3. Groover M.P., “Automation, production systems and computer integrated manufacturing”, Prentice Hall of India Pvt., New Delhi, 1996.
4. Kalpakjian, “Manufacturing engineering and technology”, Addison-Wesley Publishing Co., 1995.
5. TaiichiOhno, “Toyota production system: beyond large-scale production” Productivity Press (India) Pvt. Ltd. 1992.
6. Askin R G and Strandridge C R (1993), Modelling and Analysis of Manufacturing

OUTCOMES:

Students will be able to

- Identify the different types of flexible manufacturing systems
- Explain the aspects of computer control in FMS.
- Simulate and develop database for FMS
- Develop part families through group technology
- Implement FMS in the modernization of manufacturing systems
- Incorporate latest technologies like artificial intelligence in FMS

MECX42	PROCESS PLANNING AND COST ESTIMATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the need for process planning
- To learn the concept of work study and ergonomics
- To educate the importance of estimation and costing
- To elucidate about the elements of cost
- To learn basic calculation in manufacturing processes
- To study the cost estimation in different manufacturing units

MODULE I INTRODUCTION 9

Types of production- Standardization, Simplification- Production design and selection-Process planning, selection and analysis- steps involved in manual experience based planning and computer aided process planning- Retrieval, generative-Selection of processes analysis-Break-even analysis

MODULE II WORK STUDY AND ERGONOMICS 8

Method study, Definition- Objectives-Motion economy- Principles-Tools and Techniques – Applications- Work measurements- Purpose, Use, Procedure, tools and techniques, standard time- Ergonomics- Principles and applications.

MODULE III ESTIMATION AND COSTING 8

Importance and aims of cost estimation –Functions of estimation –costing – Importance and aims of costing- Difference between costing and estimation - importance of realistic estimates- Estimation procedure.

MODULE IV ELEMENTS OF COST 7

Introduction-Material cost- Determination of material cost, Labor cost - Determination of Direct Labor cost-Expenses- Cost of Product(Ladder of cost)- Illustrative examples, Analysis of overhead expenses-Factory expenses - Depreciation-Causes of depreciation- Methods of depreciation- Administrative expenses- selling and distributing expenses- allocation of overhead expenses.

MODULE V ESTIMATION OF MACHINE TIME AND COST 6

Estimation of machining time for machining operations involved in lathe, drilling, and milling and grinding – Estimation of machining cost

MODULE VI COST ESTIMATION IN FORMING, CASTING AND WELDING SHOP **7**

Product cost Estimation: Estimation in forging shop-Losses in forging-Forging cost- Illustrative examples. Estimation in foundry shop-Estimation of pattern cost and casting cost- Illustrative examples. Estimation in welding shop-Gas cutting-Electric welding- illustrative examples

Total Hours: 45

REFERENCES:

1. Sinha.B.P., "Mechanical Estimation and costing", Tata McGraw hill publishing co., 1995
2. Nanusa Singh, "System approach to Computer Integrated Design and Manufacturing" John Wiley & Sons, Inc., 1996
3. Joseph G. Monks, "Operations Management, Theory & Problems", McGraw Hill Book Company, 1982
4. G.B.S. Narang and V. Kumar, "Production and costing ", Khanna Publishers, 1995

OUTCOMES:

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

- Explain about the need and various types of process planning
- Implement the process planning concepts
- Practice the concepts of work study and ergonomics in manufacturing units
- Distinguish various cost components
- Estimate the machining time for metal cutting operations
- Elucidate the cost for other different manufacturing units

MECX43 PRODUCTION PLANNING AND CONTROL

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the various functions of production planning and control.
- To study the steps involved in the work study and principles of ergonomics.
- To provide knowledge on product and process planning.
- To learn the scheduling process to reduce the production time.
- To educate the line balancing problems
- To comprehend the production scheduling procedures, inventory control and recent trends in manufacturing requirement Planning (MRP) and Enterprise Resource Planning (ERP).

MODULE I INTRODUCTION 7

Objectives and benefits of planning and control-Functions of production control-Types of production-job- batch and continuous-Product development and design-Marketing aspect - Functional aspects-Operational aspect-Durability and dependability aspect aesthetic aspect. Profit consideration- Standardization, Simplification & specialization- Break even analysis- Economics of a new design.

MODULE II WORK STUDY 8

Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study – work measurement - Techniques of work measurement - Time study- Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.

MODULE III PRODUCT AND PROCESS PLANNING 7

Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning-Steps in process planning- Quantity determination in batch production-Machine capacity, balancing- Analysis of process capabilities in a multi-product system.

MODULE IV PRODUCTION SCHEDULING 8

Introduction to Scheduling and Shop Floor Planning and Control; Production Control Systems-Loading and scheduling; Master Scheduling-Scheduling rules-Gantt charts-Perpetual loading, Basic scheduling problems – Flow production scheduling-Batch production scheduling; Order Sequencing Rules and Their Performance Based on Different Evaluation Criteria; Changeover Costs and Job Sequence; Sequencing Jobs Through Two Work centers - Johnson's Rule.

MODULE V LINE BALANCING 8

Introduction to Line Balancing – Steps involved in line balancing - Techniques for Analyzing Line Balancing Problems; Application of Incremental Utilization and Longest-Task-Times Heuristics.

MODULE VI INVENTORY CONTROL AND RECENT TRENDS IN PPC 7

Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system -Ordering cycle system-Determination of Economic order quantity and economic lot size-ABC analysis-Recorder procedure-Introduction to computer integrated production planning systems-elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP.

Total Hours: 45

TEXT BOOKS:

1. Martand Telsang, “Industrial Engineering and Production Management”, First edition, S.Chand and Company, 2000.

REFERENCES:

1. S.K.Mukhopadhyay, “ Production Planning and control : Text and cases”, Prentice-Hall of India Pvt. Ltd; 3rd Revised edition, 2015
2. Stephen N.Chapman, “The Fundamentals of Production Planning and Control”, Pearson, 2005.
3. Samuel Eilon, “Elements of Production Planning and Control”, 1st Edition, Universal Publishing Corp., 1999.
4. Baffa & Rakesh Sarin, “Modern Production / Operations Management”, 8th Edition, John Wiley & Sons, 2002.

OUTCOMES:

Students should be able to

- Explain the overall aspects of production planning and control activities.
- Conduct method study and time study to improve process and resource utilization
- Plan the product and processes effectively.
- Implement the concepts of scheduling in manufacturing.
- Analyze and provide solution for line balancing problems.
- Analyze and control inventory effectively.

MECX44	STATISTICS AND QUALITY CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the various statistical concepts and approaches
- To discuss the various statistical process control techniques
- To educate the quality management concepts and its requirements
- To elucidate the various tools and techniques for quality management
- To interpret the different control charts for the process control and improvement.
- To select the suitable sampling techniques for quality control

MODULE I STATISTICS 7

Introduction to Statistics - Meaning and significance of statistical process control (SPC) Process capability – meaning, significance and measurement – Six sigma concepts of process capability.

MODULE II STATISTICAL PROCESS CONTROL 8

Reliability concepts – definitions, reliability in series and parallel, product life characteristics curve. Total productive maintenance (TMP) – relevance to TQM, Terotechnology. Business process re-engineering (BPR) – principles, applications, reengineering process, benefits and limitations.

MODULE III INTRODUCTION TO QUALITY MANAGEMENT 7

Definitions – TQM framework, benefits, awareness and obstacles. Quality – vision, mission and policy statements. Customer Focus – customer perception of quality, Translating needs into requirements, customer retention. Dimensions of product and service quality. Cost of quality.

MODULE IV TOOLS AND TECHNIQUES FOR QUALITY MANAGEMENT 8

Overview of the contributions of Deming, Taguchi techniques – introduction, loss function, parameter and tolerance design, signal to noise ratio. Concepts of Quality circle, Japanese 5S principles and 8D methodology. Quality functions development (QFD) – Benefits, Voice of customer, information organization, House of quality (HOQ), building a HOQ, QFD process.

MODULE V CONTROL CHARTS 8

Control Charts for X and R (statistical basis, development and use, estimating process capability; interpretation, the effect of non-normality on the chart, the OC function, average run length); Control Charts for X and S; Control Chart for Individual Measurements. Control Chart for Fraction Nonconforming (OC curve of the control chart, variable sample size, nonmanufacturing application, the OC function and ARL calculation); Control Charts for Nonconformities or Defects; Choices Between Attribute and Variable Control Charts.

MODULE VI SAMPLING 7

Introduction to sampling distributions, sampling distribution of mean and proportion, application of central limit theorem, sampling techniques. Estimation: Point and Interval estimates for population parameters of large sample and small samples, determining the sample size.

Total Hours: 45

REFERENCES:

1. Montgomery, Douglas C. (2009). Introduction to Statistical Quality Control, Sixth Edition. John Wiley and Sons, Inc. (ISBN: 978 -0-470-16992-6).
2. M. Jeya Chandra (2001) , Statistical Quality Control, CRC Press
3. Kaoru Ishikawa, Introduction to Quality Control, JUSE Press Ltd.

OUTCOMES:

Students should be able to

- Demonstrate the various statistical concepts and approaches
- Apply statistical tools and techniques for quality improvement.
- Appraise the quality management concepts and its requirements
- Operationalise the various tools and techniques for quality management
- Distinguish the different control charts for the process control and improvement
- Practice the suitable sampling techniques for quality control and improvement.

MECX45 MODERN PRODUCTION MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the manufacturing and production system
- To Design a layout for optimal usage of plant
- To learn the demand forecasting and project management
- To educate optimized way of controlling the processes in an industry
- To learn about maintaining the inventory level
- To elucidate the scope in maintenance part of firm

MODULE I INTRODUCTION 5

Manufacturing systems – types and concepts, manufacturing automation - Performance measures – types and uses of manufacturing models.

MODULE II FACILITY, CAPACITY & LAYOUT PLANNING 8

Facility planning – Factors affecting selection of plant location, Factor rating analysis: Break – event, Load distance model, closeness ratings.

Types of plant layout, criteria for good layout, Process layout, Assembly line balancing. Computer based solutions to layout problems such as CRAFT, ALDEP, CORELAP and PREP.

Capacity planning – Analysis of designed capacity, installed capacity, commissioned capacity, utilized capacity, factors affecting productivity and capacity expansion strategies.

MODULE III DEMAND FORECASTING & PROJECT MANAGEMENT 8

Demand forecasting – Quantitative and qualitative techniques, measurement of forecasting errors, numerical problems, Long term forecast methodologies.

Project management – its role in functional areas of management, network representation of a project, CPM and PERT techniques, Analyzing cost-time trade-offs – Case study.

MODULE IV PRODUCTION PLANNING & CONTROL 8

Steps in PPC process mapping, preparation of process mapping and feedback control for effective monitoring. Aggregate production planning, production planning strategies, Disaggregating the aggregate plan, Materials Requirement

Planning (MRP), MRP-II, Supply chain management, Operation scheduling, prioritization.

MODULE V INVENTORY PLANNING & CONTROL 8

EOQ models- with and without shortages, price breaks, effect of quantity discount – selective inventory control techniques – ABC, FSN, VED etc. Types of inventory control – Perpetual, two-bin and periodic inventory system – JIT, SMED, kanban, Zero inventory – Case study.

MODULE VI MAINTENANCE SYSTEM 8

Maintenance strategies and planning, Maintenance economics: quantitative analysis, optimal number of machines, Replacement strategies and policies – economic service life, opportunity cost, replacement analysis using specific time period, spares management, Maintenance records.

Total Hours: 45

REFERENCES:

1. S. N. Chary, “Production and Operations Management”, 4th Edition, SIE, TMH, 2009.
2. R. Pannererselvam, “Production and Operations Management”, 3rd Edition, PHI, 2012.
3. James. B. Dilworth, “Operations Management – Design, Planning and Control for Manufacturing and Services”, McGraw Hill Inc. Management Series, 1992.
4. Melnyk Denzler, “Operations Management – A Value Driven Approach”, Irwin McGraw Hill 1996.
5. Lee. J. Krajewski, L. P. Ritzman, & M. K. Malhothra, “Operations Management – Process and Value Chains”, 8th Edition, PHI/Pearson Education, 2007.
6. R. B. Chase, N. J. Aquilano, & F. R. Jacobs, “Operations Management – For Competitive Advantage”, 11th Edition, SIE, TMH, 2007.
7. Kanishka Bedi, “Production and Operations Management”, 2nd Edition, Oxford Higher Education, 2007.

OUTCOMES:

Students must able to:

- Identify the type of automation process in a manufacturing industry.
- Design an optimized plant layout.
- Apply forecasting techniques
- Prepare process plan for various production activities
- Control the inventory level
- Explain the various maintenance strategies

MECX46 ADVANCED OPTIMISATION TECHNIQUES L T P C

3 0 0 3

OBJECTIVES:

- To introduce the various advanced optimization tools.
- To gain basic knowledge on the different heuristics methods.
- To learn the use of genetic algorithm in optimization.
- To study the concepts of Ant colony optimization techniques.
- To impart knowledge to deal with ill identified and fuzzy problems.
- To relate optimisation techniques and its applications

MODULE I INTRODUCTION 7

Review of conventional optimization techniques - limitations - limitation of exhaustive search - need for artificial intelligence - bio mimicking methods

MODULE II HEURISTICS METHODS 8

Introduction – Advanced methods of algorithm design: Greedy method, Backtracking method, Divide and Conquer method – Dynamic programming– Heuristics exploration algorithms – Greedy search - Local search – Hill climbing – Tabu search – Gradient search – Beam search – Simulated Annealing

MODULE III GENETIC ALGORITHM 7

Introduction - Basics of GA – Population – Reproduction – Cross over – Mutation –genetic algorithms in search, optimization and machine learning practical genetic algorithms

MODULE IV ANT COLONY OPTIMIZATION 8

Introduction: Ant Colony Optimization – Meta-heuristic Optimization – History – The ACO Meta-heuristic – ACO Algorithms: Main ACO – Ant system – Ant colony system – Max-Min Ant system – Applications: Routing in telecommunication networks – Travelling salesmen – Graph Coloring –Advantages & Disadvantages

MODULE V FUZZY LOGIC AND ANN 8

Fuzzy logic, knowledge representation and inference mechanism – Fuzzy and expert control – standard Takagi-Sugeno mathematical characterizations –

Design example – Biological foundations to intelligent systems: Artificial neural networks, Back-propagation networks, Radial basis function networks, and recurrent networks.

MODULE VI IMPLEMENTATIONS & APPLICATIONS 7

Reduction of size of an optimization problem – multilevel optimization – parallel processing – multi objective optimization – Job shop scheduling – Vehicle scheduling – Line balancing – Sensor integration.

Total Hours: 45

REFERENCES:

1. Singiresu S. Rao, “Engineering optimization – Theory and practices”, John Wiley and Sons, 1996.
2. Ravindran – Phillips –Solberg, “Operations Research – Principles and Practice”, John Wiley and Sons, 1987.
3. Fredrick S.Hillier and G.J.Liberman, “Introduction to Operations Research”, McGraw Hill Inc. 1995.
4. Kalymanoy Deb, “Optimization for Engineering Design”,PHI,2003
5. Christos H. Papadimitriou, Kenneth Steiglitz, Combinatorial Optimization, PHI 2006

OUTCOMES:

Student will be able to

- Explain about optimization techniques.
- Formulate a real life situation as an optimization problem.
- Utilize Genetic algorithm to solve optimization problems.
- Implement the concepts of Ant colony optimization techniques.
- Utilize Fuzzy Logic and ANN to solve optimization problems.
- Identify the appropriate solution methodology and provide a solution

MECX47 MECHANICAL MAINTENANCE

L	T	P	C
2	0	0	2

OBJECTIVES:

- To study the importance of reliability in engineering and products.
- To impart knowledge on the maintenance concepts and models fors different types of industries.
- To learn about maintenance quality and total productive maintenance OEE

MODULE I CONCEPTS OF RELIABILITY, DESIGN FOR RELIABILIGY AND MAINTAINABILITY **8**

Definition of reliability – reliability Vs quality – reliability function – derivation of the reliability function -MTTF – hazard rate function - Reliability improvement – techniques – Pareto analysis – Design for reliability– Redundancy – standby redundancy – failsafe systems classifications – failure characteristics – failure data analysis – mean time to failure maintainability and availability – system reliability in terms of probability of failure – MTBF –Acceptance sampling based on reliability test

MODULE II MAINTENANCE CONCEPT AND MODELS **12**

Need for maintenance – Maintenance definition – Maintenance objectives – Challenges of Maintenance management – Tero technology – Scope of maintenance department – Maintenance costs.

Proactive/Reactive maintenance – Imperfect maintenance – Maintenance policies – PM versus b/d maintenance – Optimal PM schedule and product characteristics – Optimal Inspection frequency: Maximizing profit – Minimizing downtime – Replacement models.

MODULE III MAINTENANCE QUALITY AND TOTAL PRODUCTIVE MAINTENANCE **10**

Maintenance excellence –Five Zero concept –FMECA –Root cause analysis– System effectiveness – Design for maintainability – Maintainability allocation– CMMS – Reliability Centered Maintenance - TPM features – Chronic and sporadic

losses – Equipment defects – Six major losses – Overall Equipment Effectiveness – TPM pillars –TPM implementation– Autonomous maintenance.

Total Hours: 30

REFERENCES:

1. Patrick D T o'connor, "Practical Reliability Engineering", John-Wiley and Sonsinc, 2002.
2. David J Smith, "Reliability, Maintainability and Risk: Practical Methods for Engineers", Butterworth, 2002
3. Way kuo, Rajendra Prasad V, Frank A and Tillman, ching- lai Hwang "Optimal Reliability Design and Applciations", Cambridge University Press P ltd., 2001.
4. Srinath I.S, Engineering Design and Reliability, ISTE, 1999.
5. Oleg Vinogradov, "Introduction to Mechanical Reliability: A Designers Approach, Hemisphere Publications, 1991.
6. An introduction to Reliability and Maintainability Engineering – Charles E. Ebeling, Tata McGraw-Hill, New Delhi, 2003.
7. Maintenance, Replacement and Reliability –Andrew K.S.Jardine and Albert H.C.Tsang, Taylor & Francis, New York, 2006.
8. Autonomous maintenance in seven steps – Masaji Tajiri and Fumio Gotoh, Productivity Inc., Oregon, 1999.

OUTCOMES:

Students should be able to

- Effectively implement reliability concepts and maintenance strategies for different types of industries.
- Develop different maintenance models to reduce the downtime of machines
- Calculate overall equipment effectiveness of difference machines

MECX48 ROBOTICS AND AUTOMATION

L	T	P	C
2	0	0	2

OBJECTIVES:

- To study the basic concepts and working principles of different sensors
- To learn about various drives and controls of robot
- To impart knowledge about kinematics, dynamics and control of robots

MODULE 1 INTRODUCTION AND SENSORS 10

Robot – Definition – Robot Anatomy – Coordinate Systems, Work Envelope Types and classification – Specifications – pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and their Functions – Need for Robots

Range sensing – Proximity sensing –Touch sensing – Force and Torque sensing. Introduction to Machine vision – Sensing and Digitizing – Image processing and analysis

MODULE II ROBOT DRIVES AND CONTROL 10

Controlling the Robot motion – Design of drive systems – Hydraulic and Pneumatic drives – Linear and rotary actuators and control valves – Electro hydraulic servo valves, electric drives – Motors.

End Effectors – Grippers – Mechanical Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Selection and Design Considerations.

MODULE III ROBOT MOTION ANALYSIS AND CONTROL 10

Manipulator kinematics, homogenous transformations and robot kinematics, manipulator path control, robot dynamics, configuration of robot controller.

Total Hours: 30

TEXT BOOKS:

1. K.S.Fu, R.C. Gonzalez and C.S.G. Lee, “Robotics Control, Sensing, Vision and Intelligence”, Mc Graw Hill, 1987

REFERENCES:

1. Yoram Koren," Robotics for Engineers' Mc Graw-Hill, 1987.
2. Kozyrey, Yu. "Industrial Robots", MIR Publishers Moscow, 1985.
3. Richard. D, Klafter, Thomas, A, Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Prentice-Hall of India Pvt. Ltd., 1984.
4. Deb, S.R." Robotics Technology and Flexible Automation", Tata Mc Graw- Hill, 1994.
5. Mikell, P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey," Industrial Robotics Technology, Programming and Applications", Mc Graw- Hill, Int. 1986.

OUTCOMES:

Students should be able to

- Explain the basic components of robots and sensors
- Apply suitable drives and controls for robot design
- Model forward and inverse kinematics of robot manipulators

MECX49	ADVANCED PRODUCTION PROCESS FOR AUTOMOTIVE COMPONENTS	L	T	P	C
		2	0	0	2

Prerequisite : Basic knowledge on Manufacturing Process

OBJECTIVES:

- To study the various processes involved in powder metallurgy and gear manufacturing
- To learn various metal forming techniques for manufacturing automotive components
- To learn various casting process followed by the machining techniques

MODULE I POWDER METALLURGY AND GEAR MANUFACTURING 10

Powder Metallurgy -Process flow chart - Production of metal powders and their raw materials - Manufacture of friction lining materials for clutches and brakes - Testing and inspection of PM parts.

Gear milling, Hobbing and shaping - Gear finishing of automobile gears and inspection.

MODULE II METAL FORMING 10

Forging - process flow chart, forging of valves, connecting rod, crank shaft,cam shaft, propeller shaft, transmission gear blanks, foot brake linkage, steering knuckles, Extrusions: Basic process steps, extrusion of transmission shaft, steering worm blanks, brake anchor pins, rear axle drive shaft, axle housing spindles, piston pin and valve tappets. Thermoforming, hydro forming& press forming, welding of body panels.

MODULE III METAL CASTING AND MACHINING 10

Sand casting of cylinder block and liners - Centrifugal casting of flywheel, piston rings, bearing bushes, and liners, permanent mould casting of piston, pressure die casting of carburettor other small auto parts. Machining of connecting rods - crank shafts - cam shafts - pistons - piston pins – piston rings - valves - front and rear axle housings - fly wheel - Honing of cylinder bores - Copy turning and profile grinding machines.

Total Hours: 30

REFERENCES:

1. Heldt.P.M., " High Speed Combustion Engines ", Oxford Publishing Co., NewYork, 1990
2. Haslehurst.S.E., " Manufacturing Technology ", ELBS, London, 1990.
3. Rusinoff, “Forging and Forming of metals ", D.B. Tara porevala Son & Co. Pvt Ltd., Mumbai, 1995.
4. Sabroff.A.M. & Others, “Forging Materials & Processes ", Reinhold Book Corporation, New York, 1988.
5. Upton, "Pressure Die Casting ", pergamon Press, 1985.
6. High Velocity " Forming of Metals ", ASTME, prentice Hall of India (P) Ltd., New Delhi, 1990
7. HMT handbook.

OUTCOMES:

Students will be able to

- Demonstrate powder metallurgy process to manufacture superior automotive components such as gears
- Recognize different metal forming techniques available for different products
- Evaluate various casting techniques for different applications

MECX50	PLANT LAYOUT AND MATERIAL HANDLING	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To learn the different types of plant and process layout with essential requirements and safety aspects.
- To study the requirements of layout with standard work conditions
- To study the need and use of appropriate equipment for effective material handling.
- To analyse the different material handling equipments used in various industries

MODULE I PRODUCT AND PROCESS LAYOUT 12

Selection of plant locations, territorial parameters, considerations of land, water, electricity, location for waste treatment and disposal, further expansions Safe location of chemical storages, -Safe layout for process industries, engineering industry, construction sites, pharmaceuticals, pesticides, fertilizers, nuclear power stations, thermal power stations, metal powders manufacturing and match works. Safe layout, equipment layout, safety system, fire hydrant locations, fire service rooms, facilities for safe effluent disposal and treatment tanks, site considerations, approach roads, plant railway lines, security towers

MODULE II LAYOUT REQUIREMENTS 8

Principles of good ventilation, purpose, physiological and comfort level types, local and exhaust ventilation, hood and duct design, air conditioning, ventilation standards, application. Purpose of lighting, types, advantages of good illumination, glare and its effect, lighting requirements for various work, standards-Housekeeping, principles of 5S.

MODULE III MATERIAL HANDLING AND EQUIPMENT 10

Fiber rope, types, lubrication, overloading, rope fitting, inspection and replacement – slings, types, method of attachment, rated capacities, alloy chain slings, hooks and attachment, inspection. Hoisting apparatus, types - cranes, types, design and construction, guards and limit devices, – conveyors, precautions, types, applications.

Powered industrial trucks, requirements, operating principles, operators selection and training and performance test, inspection and maintenance, electric trucks, gasoline operated trucks, LPG trucks – power elevators, types of drives, hoist way and machine room emergency procedure, requirements for the handicapped, types- Escalator, safety devices and brakes, moving walks – man lifts, construction, brakes, inspection.

Total Hours: 30

REFERENCES:

1. Spivakosky, “Conveyors and related Equipment”, Vol.I and II Peace Pub. Moscow, 1982.
2. APPLE M. JAMES “Plant layout and material handling”, 3rd edition, John Wiley and sons.
3. Accident prevention manual for industrial operations” N.S.C., Chicago, 1982.
4. Safety and good housekeeping”, N.P.C. New Delhi, 1985.
5. Reymond, A.Kulwice, “Material Handling Hand Book - II”, John Wiley and Sons, New York, 1985.
6. Rudenko, N., “Material handling Equipment”, Mir Publishers, 1981.
7. “Industrial ventilation (A manual for recommended practice), American conference of Governmental Industrial Hygiene, USA, 1984.

OUTCOMES:

Students will be able to

- Design appropriate product layout for manufacturing considering safety.
- Evaluate layout procedures for different process
- Estimate proper maintenance procedures to handle various material handling equipment

MECX51 INDUSTRIAL SAFETY ENGINEERING

L	T	P	C
2	0	0	2

OBJECTIVES:

- To study the basics of industrial hazards, safety measures, safety analysis and safety management activities
- To bring the awareness on safety in material handling and manufacturing processes,
- To learn the ergonomics used in material handling.

MODULE I INDUSTRIAL SAFETY SYSTEM 10

Evolution of modern safety concept - industrial hazard - significant of safety - causes of industrial accidents - accident preventions - personal protective equipment - safety signs and colour at work - safety analysis - JSA – FMEA

Organizational safety culture - safety organization - safety committee - safety policy - Budgeting for safety - Safety education and training

MODULE II SAFETY IN MATERIAL HANDLING AND MANUFACTURING 10

Material handling basics - principles - classifications of material handling equipment - general safety considerations in material handling devices - ropes, chains, slinks, hoops, clamps, arresting gears and prime movers

Machine guarding - safety in metal working - safety in welding and gas cutting - safety in cold forming and hot working of metals - safety in finishing - safety in inspection and testing - health and safety regulations - OSHA

MODULE III ERGONOMICS IN MATERIAL HANDLING 10

Ergonomic and anatomy - ergonomic consideration in material handling, design, installation, operation and maintenance of conveying equipment, hoisting, traveling and slewing mechanisms - storage and retrieval of common goods of shapes and sizes in a general store of big industry

Total Hours: 30

REFERENCES:

1. Mahajan.M, “Industrial engineering and production management”, Dhanpat ray & co (p) ltd., 2001.
2. Krishnan N.V, “Safety management in industry”, Jaico publication house, Bombay, 1997.
3. Blake R.B, “Industrial safety”, Prentice Hall, Inc., New jersey, 1973.
4. Edel Engineering consultancy (p) ltd., “Safety Manual”, Novena publications, 2000.
5. IAPA , “Safety Signs and Colour at Work”, Industrial Accident Prevention Association, 2007
6. Alexandrov M.P, “Material Handling Equipment”, Mir Publishers, Moscow, 1981.
7. Siddhartha ray, “Introduction to Materials Handling”, New age international publications, 2008

OUTCOMES:

Upon satisfactory completion of the course, the student will be able to:

- Identify safety hazards and implement appropriate safety measures in industries.
- Recognize the hazards in various material handling and manufacturing processes and provide suitable safety prevention through appropriate safety regulations
- Use the ergonomic considerations in material handling equipment

MECX52	OPERATIONS RESEARCH &SYSTEM ANALYSIS	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To acquire knowledge in linear programming problems and transportation problem
- To impart knowledge on network analysis, assignment and sequencing problems
- To learn the replacement model, inventory models and simulation analysis

MODULE I LINEAR PROGRAMMING PROBLEMS AND TRANSPORTATION PROBLEM **10**

Linear programming problem: Formulation of problem- Determination of unknown values by Simplex method – Graphical method- Big M method. Transportation Problem: Initial Basic feasible cost- MODI method- Non degeneracy type

MODULE II ASSIGNMENT, NETWORK ANALYSIS AND SEQUENCING PROBLEMS **10**

Assignment Problems: Hungarian method for Minimization and Maximization type Network Analysis: Determination of Project duration and slack time for PERT and CPM type of problem Sequencing problem: Determination of Elapsed time and idle time for N Jobs 2 & 3 Machines

MODULE III REPLACEMENT MODELS, INVENTORY MODELS AND SIMULATION ANALYSIS **10**

Replacement of items that deteriorate with time- Value of money changing with time- not changing with timenventory Model; Deterministic inventory model Simulation Analysis: Random number generation- Monte carlo simulation

Total Hours: 30

TEXT BOOKS:

1. Taha H.A. Operations Research, pearson Education, 6th Edition, 2003

REFERENCES:

1. Hira and Gupta, Problems in Operations research, S.Chand and Co. 2002
2. Panneer selvam, Operations Research, Prentice Hall of india, 2003.

OUTCOMES:

Students should be able to

- Solve problems on linear programming problems and transportation problem
- Discuss network analysis, assignment and sequencing problems
- Use the replacement model, inventory models and simulation analysis

MECX53 NANO MATERIALS & FABRICATIONS

L	T	P	C
2	0	0	2

OBJECTIVES:

- To study the nano material classes and properties
- To learn synthesis, characterization and production of nanomaterial
- To impart knowledge on inspection and applications of nanomaterial

MODULE I NANOMATERIAL CLASSES AND PROPERTIES 10

Classification of Nano materials– size effects-surface to volume ratio- surface curvature-strain confinement –quantum effects - Mechanical properties-Thermal-electrical-mechanical-optical-acousticproperties-study of carbon Nanotubes and Nano Composites

MODULE II SYNTHESIS, CHARACTERIZATION AND PRODUCTION OF NANOMATERIAL 10

Methods for making 0D,1D,2D and 3D Nanomaterial -Top down process-Intermediate process-Bottom up process-Nano profiling-Characterization of Nanomaterial.

Methods of production-Mechanical alloying- Sol-gel, Electro deposition, Inertgas condensation.

MODULE III INSPECTION AND APPLICATIONS OF NANOMATERIAL 10

Electron Microscopy, X- ray Diffraction-Scanning Probe Microscopy-contact mode-tapping mode- Atomic Force Microscopy-Scanning Tunnel Microscopy-Nano Indentation. Nano coatings-Nano films-self cleaning and easy cleaning materials-self healing materials-smart materials-Nano drugs and its delivery-Nano Tribology -Molecular Nano machines

Total Hours: 30

REFERENCES:

1. Michel F.Ashby, Paulo J Ferreira and Daniel L Schodek “Nanomaterials, Nanotechnologies and design” Elsiever, 2009.
2. T.Pradeep “Nano: The essentials”, Tata Mcgraw Hill Education pvt. Ltd, New Delhi, 2007.

3. Mark Ratner and Daniel Ratner, “Nanotechnology”, Pearson Education, New Delhi, 2003.
4. Guozong Cao “Nano structures and Nanomaterials” Imperial college press, London, 2006.

OUTCOMES:

Students will be able to

- Explain the nano material classes and properties
- Discuss the synthesis, characterization and production of nanomaterial
- Relate the inspection and applications of nanomaterial.

MECX54 ADVANCED MATERIALS **L T P C**

2 0 0 2

Prerequisite : Fundamental knowledge on Materials

OBJECTIVES:

- To acquire knowledge on synthesis of ceramic and carbon materials.
- To learn the materials used in nuclear reactors.
- To impart knowledge on applications of polymers in bio-medical applications.

MODULE I CERAMIC AND CARBON SCIENCE 10

Crystal chemistry — structure and bonding in materials, ceramic raw materials, production of powders by chemical and physical mean, powder consolidation, addition in ceramic processing, sintering theory, cold and hot isostatic pressing, processing of electronic ceramic, sol-gel processing - Nano carbon materials

MODULE II NUCLEAR METALLURGY 10

Structure of nucleus- Radioactivity - Binding energy - Nuclear interaction -radiation effects on fissile and non fissile materials - Radiation damage and radiation growth - Types of reactors and classification - Materials for nuclear reactors: Considerations in selection and properties of common materials used as fuels, physical and chemical properties - Canning materials - Coolants - Control rods - Reflectors and shielding materials.

MODULE III POLYMERS FOR BIO MEDICAL APPLICATIONS 10

Introduction to classes of materials used in medicine - world-wide market for biomaterials - Types of materials-inert, toxic, bioactive, natural materials - collagen, biopolymers - Polymers as biomaterials - polymers for controlled drug delivery applications - Concepts of polymer composites - Biomimetic materials

Total Hours: 30

REFERENCES:

1. Y. V. C. Rao, “Introduction to Thermodynamics” Universities Press, 2004
2. Ahindra Ghosh, “Textbook of Materials and Metallurgical Thermodynamics”, PHI Learning Pvt. Ltd, 2002.
3. W. D. Kingry, “Introduction to Ceramics” , Jhon-Wiley Publications
4. Mohamed N. Rahaman, Ceramic Processing and Sintering, CRC Press, 2003.
5. J.C. Wright, “Metallurgy in Nuclear Power Technology, Iliffe Book Ltd., 1962
6. J. Park and R.S.Lakes, “Biomaterials An Introduction” , 3rd Edn., Springer Science, New York, 2007
7. D.L.Wise et al. Eds., “Encyclopedic handbook of Biomaterials and Bioengineering”, Part A. Materials & part B. Applications, Volume 1 &2, Marcel Dekker Inc., New York, 1995

OUTCOMES:

Students will be able to

- Explain the synthesis of ceramic and carbon materials.
- Identify the materials used in nuclear reactors.
- Use suitable polymers in bio-medical applications.

MECX55 PROTOTYPING TECHNIQUES

L	T	P	C
2	0	0	2

OBJECTIVES:

- To learn the fundamentals of rapid prototyping and RPT file generation
- To study the liquid based and solid based rapid prototyping systems
- To impart knowledge on applications on rapid prototyping

MODULE I INTRODUCTION AND RPT FILE GENERATION 10

Introduction to RP –Technology- Description -Definition to RP -Overview of RP - Benefits and Application

RP Processes: Process overviews, STL file Generation, File Verification & Repair, Build File Creation, Part Construction, Part Cleaning and finishing, Process Strength & limitations.

MODULE III LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS 10

Classes of RP systems: 3D Printers, Enterprise Prototyping centers, Direct digital tooling, Direct digital manufacturing, system classification, Stereo lithography, SL with photo polymerization, Selective Laser Sintering, Fused deposition modeling, Laminated object manufacturing, Laser powder forming. Prototype properties: Material, color, dimensional accuracy, stability, surface finish, machine-ability, environmental resistance, operational properties

MODULE IV RAPID PROTOTYPING APPLICATIONS 10

RP Applications: Design, Concept Models, Form & fit checking, Ergonomic Studies, Functional testing, Requesting Price quotes, CAD data verification, Rapid Tooling, rapid manufacturing, Science & Medicine, Archeology, Paleontology & forensic Science, miniaturization

Total Hours: 30

REFERENCES:

1. Chua C.K., Leong K.F., and Lim C.S., Rapid prototyping: Principles and applications, second edition, World Scientific Publishers, 2003.

2. Andreas Gebhardt, Hanser Gardener, Rapid prototyping, Publications, 2003.
3. Liou W. Liou, Frank W. Liou, Rapid Prototyping and Engineering applications: A tool box for prototype development, CRC Press, 2007.
4. Ali K. Kamrani, Emad Abouel Nasr, Rapid Prototyping: Theory and practice, Springer, 2006.
5. Peter D. Hilton, Hilton / Jacobs, Paul F. Jacobs, Rapid Tooling: Technologies and Industrial Applications, CRC press, 2000.

OUTCOMES:

Students will be able to

- Explain the fundamentals of rapid prototyping and RPT file generation
- Discuss the liquid based and solid based rapid prototyping systems
- Use rapid prototyping for various applications

MECX56 INDUSTRIAL MARKETING

L	T	P	C
1	0	0	1

OBJECTIVES:

- To acquire knowledge on concepts and frameworks which may be more relevant in industrial marketing situations
- To develop skills in identifying an interesting industrial marketing problem to study, as well as finding relevant facts.

MODULE I OVERVIEW AND PREPARATION 7

The Industrial Marketing system and the Industrial Marketing concept, Industrial goods demand and product characteristics market levels and product types, the industrial customer, buyer motives business and institutional buyers.

MODULE II INDUSTRIAL BUYER BEHAVIOUR AND INPUTS TO MARKETING 8

Analysis of micro and macro environment of industrial markets, BUYGRID MODEL, phases in purchasing decision process & their marketing implications, buying center - Webster and Wind model - Sheth model. Purchasing Agents in Industrial Buying; Negotiation in Industrial Marketing

Total Hours: 15

REFERENCES:

1. Krishna K. Havaldar, “Industrial Marketing,” Tata McGraw Hill Pub Co. Ltd, New Delhi, 2002.
2. Richard M. Hill, Ralph S. Alexander, James S.Cross, “Industrial Marketing”, AITBS, 2000
3. Robert R. Reeder, Edward G. Brittle and Pretty H. Reedier, “Industrial Marketing – Analysis Planning and Control,” Prentice Hall of India Limited, New Delhi, 2000.

OUTCOMES:

Students should be able to

- Take strategic decisions to promote marketing.
- Analyse the industrial market potential

MECX57 ENTREPRENEURIAL DEVELOPMENT

L	T	P	C
1	0	0	1

OBJECTIVES:

- To study the importance of entrepreneurship opportunities available in the society for the entrepreneur
- To acquire knowledge on the challenges faced by the entrepreneur

MODULE I INTRODUCTION 8

Objectives, scope & philosophy, Characteristics and skills of a Successful Entrepreneur, Design Thinking for Customer Delight, creativity & entrepreneurship, harnessing locally available resources, Role of small Enterprise in Economic development, Problems of Small scale industrial units,

MODULE II BUSINESS REQUIREMENTS 7

Market Survey and Research - Feasibility Study –Preparation and Evaluation of report – Central and State Government Industrial Policies and Regulations –Taxes - Global Business, Sources of finance mobilization – External factors

Total Hours: 15

REFERENCES:

1. Hisrich, “Entrepreneurship”, Tata McGraw Hill, New Delhi, 2006.
2. P.C. Jain (ed.), “Handbook for New Entrepreneurs”, EDII, Oxford University Press, New Delhi, 1999.
3. Rabindra N. Kanungo, “Entrepreneurship and Innovation”, Sage Publications, New Delhi, 1998.

OUTCOMES:

Students should be able to

- Explain the importance of entrepreneurship opportunities available in the society for the entrepreneur
- Discuss the challenges faced by the entrepreneur

MECX58 DIGITAL MANUFACTURING

L	T	P	C
1	0	0	1

OBJECTIVES:

- To study about principles of digital manufacturing process and geometric modelling used for different materials
- To educate about algorithmic design for digital manufacturing & future development

MODULE I OVERVIEW OF DIGITAL MANUFACTURING PROCESS AND GEOMETRIC MODELLING WITH MATERIAL PROPERTIES **09**

What makes a manufacturing process “digital” – The ten disruptive principles of digital manufacturing processes – Basic concept and Connotation of digital manufacturing science – Research method of digital manufacturing science - Solid representations – Boundary representations – Function representations – Voxel representations - Mechanical properties of printed materials – Post processing – Empirical and data driven models.

MODULE II ALGORITHMIC DESIGN FOR DIGITAL MANUFACTURING & FUTURE DEVELOPMENT **06**

Parametric models – Vibrational Geometry – Generative models – Topology optimization - Precision of digital manufacturing – Extremalization of digital manufacturing - Environmental protection of digital manufacturing -Safety, Liability and intellectual property – Environmental impact – On-demand fabrication models and mass customization

Total Hours: 15

TEXT BOOKS:

1. Zhou,Z .; Xie, S.; Chen,D, “ Fundamentals of Digital Manufacturing Science”, Springer Publications, 2012, ISBN:978-0-85729-563-7
2. Ian Gibson, David W Rosen, & Brent Stucker, “Additive Manufacturing Technologies “, Springer Publication, 2014. ISBN-10: 1489983643

REFERENCES:

1. Christoph Haag, Torsten Niechoj, “Digital Manufacturing: Prospects and Challenges”, Metropolis Verlag, 2016
2. Lihui Wang , Andrew Yeh Ching Nee, “Collaborative Design and Planning for Digital Manufacturing”, Springer; 2009 edition
3. Philip M. Parker, “The 2018-2023 World Outlook for Digital Manufacturing (DM) “,ICON Group International, Inc., 2017

OUTCOMES:

The students will be able to

- Demonstrate the principles of digital manufacturing process and geometric modelling used for different materials
- Create an algorithmic design for digital manufacturing

MECX59 ADDITIVE MANUFACTURING

L	T	P	C
1	0	0	1

OBJECTIVES:

- To gain the knowledge of importance of Additive manufacturing techniques in manufacturing
- To learn the various additive processes and their principles and applications

MODULE I INTRODUCTION 5

Introduction and basic fundamentals of AM technology- Traditional manufacturing Vs Additive manufacturing- Reverse Engineering: Introduction, From Scanner to Model validation - Development of Additive Manufacturing Technology- Classifications- Materials for Additive Manufacturing Technology – Additive manufacturing in medical applications- Bio-manufacturing.

MODULE II ADDITIVE MANUFACTURING PROCESS 10

Extrusion Based Additive Manufacturing Process- Fused Deposition Modeling (FDM), Shape Deposition Manufacturing (SDM), Laminated Object Manufacturing (LOM)-Photo-polymer vat Additive Manufacturing Process-Streolithography (SLA), Solid Ground Curing (SGC), Selective Laser Sintering (SLS)-Powder bed fusion and material jetting Additive Manufacturing Process- Electron Beam Melting (EBM), Laser Engineered Net Shaping (LENS), Three Dimensional Printing (3DP) - Hybrid Additive Manufacturing Process- Issues with additive manufacturing

Total Hours: 15

REFERENCES:

1. Gibson, I., Rosen, D.W. and Stucker, B., “Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010.
2. Chua, C.K., Leong K.F. and Lim C.S., “Rapid prototyping: Principles and applications”, second edition, World Scientific Publishers, 2010.
3. Gebhardt, A., “Rapid prototyping”, Hanser Gardener Publications, 2003.

4. Liou, L.W. and Liou, F.W., “Rapid Prototyping and Engineering application: A tool box for prototype development”, CRC Press, 2011.
5. Hilton, P.D. and Jacobs, P.F., Rapid Tooling: Technologies and Industrial Applications, CRC press, 2005.
6. Chee Kai Chua, Kah Fai Leong, 3D Printing and Additive Manufacturing: Principles and Applications: Fourth Edition of Rapid Prototyping
7. Andreas Gebhardt, Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing
8. Jacobs, Paul F, Rapid Tooling: Technologies And Industrial Applications
9. D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling

OUTCOMES:

Student will be able to:

- Explain the importance of Additive manufacturing techniques in manufacturing
- Discuss the various additive processes and their principles and applications

MECX60 FAILURE ANALYSIS AND TECHNIQUES

L	T	P	C
1	0	0	1

OBJECTIVES:

- To study the concept of material failure analysis and Techniques
- To impart knowledge on failure analysis techniques

MODULE I FAILURE ANALYSIS INTRODUCTION 8

Historical background, origin, detection and prevention of failure, types of mechanical failure: Ductile and brittle fracture, fatigue fracture, buckling, creep rupture, stress concentration, statistical aspect of failure analysis, loading spectrum, metallurgical aspect of component failure.

MODULE II FAILURE ANALYSIS TECHNIQUES 7

Processing-structure-property relationship, metallurgical imperfection, processing defects, NDT methods, surface defects and corrosion, propagation of defects, tools for metallurgical failure analysis, Case study reports

Total Hours: 15

REFERENCES:

1. George E. Dieter, Mechanical metallurgy, McGraw-Hill Book Company, SI Metric Edition Printed in Singapore.

OUTCOMES:

Students should be able to

- Explain the concept of material failure analysis and techniques
- Discuss on failure analysis techniques

MECX61	ADVANCED SYSTEM SIMULATION (1D MODELLING)	L	T	P	C
		1	0	0	1

OBJECTIVES:

- To study the basics of modelling of engineering and simulation systems
- To impart knowledge on modelling of mechanical systems

MODULE I INTRODUCTION TO MODELLING AND SIMULATION 8

Dynamic systems, Modeling of dynamic systems, Formulation of models for engineering systems, solution of the differential equations, Input types, Engineering system similarity, Introduction to simulation, MATLAB as a simulation tool.

MODULE II MODELLING OF MECHANICAL SYSTEMS 7

Translational systems, Rotational systems, Combined systems, Three dimensional motion, Properties of fluids, Reynolds number, Derivation of passive components, Basic thermal properties, Circuit analysis of static and dynamic thermal systems.

Total Hours: 15

TEXT BOOKS:

1. Woods Robert L. and Lawrence Kent L., “Modelling and Simulation of Dynamic Systems”, Prentice Hall, 1997.

REFERENCES:

1. Philip D. Cha, James J. Rosenberg, and Clive L. Dym, “Fundamentals of Modelling and Analysis of Engineering Systems”, Cambridge University Press, 2000.
2. R. Gentle, P. Edwards, B. Bolton, “Mechanical Engineering Systems”, Butterworth Heinemann, 2001.
3. Ashish Tiwari, “Modern Control Design with MATLAB and SIMULINK”, John Wiley, 2002.

OUTCOMES:

Students will be able to

- Explain the basics of modelling of engineering and simulation systems
- Perform modelling of mechanical systems

MECX62 PROJECT MANAGEMENT

L	T	P	C
1	0	0	1

OBJECTIVES:

- To study project management design, development, and planning
- To learn the project management tools, techniques, and skills

MODULE I Overview: Concept and Characteristics - Project Management: Importance, types of project - Organizational Structures and behavior -Project Planning: Project Planning and Scheduling techniques, Developing the project network (Using CPM/PERT). **8**

MODULE II Resource Scheduling- Project Quality Management- Project Performance Assessment and Control- Project Closure/ Termination- Management of Time And Stress. **7**

Total Hours: 15

TEXT BOOKS:

1. Clifford F Gray, Erik W Larson, “Project Management-The Managerial Process” Tata Mcgraw-Hill Publishing Co Ltd.
2. Jack Meredith, Samuel J. Mantel Jr., “Project Management- A Managerial Approach” John Wiley and Sons.
3. John M Nicholas, “Project Management for Business and Technology” Prentice Hall of India Pvt Ltd.
4. James P Lewis, “Project Planning, Scheduling and Control” Tata Mcgraw-Hill Publishing Co Ltd.
5. K. Nagarajan, “Project management” New Age International, 2004

REFERENCES:

1. Principles & Practices of Management - Saxena
2. Principles and Practices of Management - Shejwalkar and Ghanekar Management Concepts & Practices - Hannagan
3. Essentials of Management – Koontz – TMGH
4. Organizational Behaviour - K.Aswathappa

OUTCOMES:

Students should be able to

- Explain the project management design, development, and planning
- Utilize the project management tools, techniques, and skills

MECX63	INTERNET OF THINGS FOR MANUFACTURING	L	T	P	C
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OBJECTIVES:

- To study the usage of Internet of things in various aspects of manufacturing system
- To learn for effective usage of data base in scheduling production system

MODULE I INTRODUCTION OF IOT & IIOT 10

Introduction- The concept of IoT, limitations, Applications of IoT in manufacturing system, Key features and limitations of IoT-MS - Overview of IoT-Enabled Manufacturing System- Overall architecture of IoT-MS, Integration framework of real-time manufacturing information, The worklogic of IoT-MS - Real-Time and Multisource Manufacturing Information Sensing System - Fundamentals of M2M Communication : Sensor Network and Wireless Protocols Hardware/Protocol-Elements of IIOT for manufacturing - Machine Learning for Intelligent IIoT - Analytic Engine for IIoT - Security in IoT Implementation

MODULE II PRODUCTION SCHEDULING SYSTEM 5

Cloud Computing-Based Manufacturing Resources Configuration Method - IoT-Enabled Smart Trolley -Real-Time Information-Driven Production Scheduling System - IoT-MS Prototype System

Total Hours: 15

TEXT BOOKS:

1. Alasdair Gilchrist , “Industry 4.0: The Industrial Internet of Things” 1st ed. Edition
2. Alec Ross, “The Industries of the Future”
3. Yingfeng Zhang Fei Tao, “Optimization of Manufacturing Systems Using the Internet of Things”, Academic press 2016

OUTCOMES:

Students will be able to

- Discusss the use of Industry Internet of things in manufacturing system
- Apply the resources for effective production scheduling system