UNIVERSITY VISION AND MISSION

VISION

B.S. Abdur Rahman Institute of Science & 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

VISION AND MISSION OF THE DEPARTMENT OF MECHANICAL ENGINEERING

VISION

To excel in providing quality education and training through undergraduate and postgraduate programs 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 facilitate 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 AND OUTCOMES
B.Tech. (Mechanical Engineering)

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

The Graduates in Mechanical Engineering will

- Possess self-learning capability involving any new concept or idea depending on the need
- Have a strong fundamental knowledge in Mathematics and Science with ability to apply them suitably
- Be able to demonstrate a clear understanding of the underlying principles in different aspects like thermal, mechanics, materials and manufacturing in Mechanical Engineering including related inter disciplinary aspects

- Demonstrate their capability in design and analysis of mechanical system, process and components taking into account social, economic and environmental impacts
- Be able to use the knowledge of materials and manufacturing process in product realization
- Adopt analytical approach in design and conduct of experiments, use of metrics, analysis and interpretation of results and draw appropriate conclusions
- Be able to use soft skills acquired, exhibit professional approach in problem solving, work in multi-functional teams and adopt an ethical approach.

B.S.ABDUR RAHMAN
UNIVERSITY
B.S. ABDUR RAHMAN INSTITUTE OF SCIENCE & TECHNOLOGY
(Estd.u/s 3 of the UGC Act, 1956)
(FORMERLY B.S.ABDUR RAHMAN CRESCENT ENGINEERING COLLEGE)
Seethakathi Estate, G.S.T. Road, Vandalur, Chennai - 600 048.

REGULATIONS 2013
FOR
B.Tech. DEGREE PROGRAMMES

(WITH AMENDMENTS INCORPORATED TILL JUNE 2015)

REGULATIONS - 2013 FOR
B.TECH. DEGREE PROGRAMMES
(With Amendments Incorporated Till June 2015)

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) **"University"** means B.S.Abdur Rahman University.

v) **"Dean (Academic Affairs)"** means the Dean (Academic Affairs) of B.S. Abdur Rahman University.

vi) **"Dean (Student Affairs)"** means the Dean (Students Affairs) of B.S.Abdur Rahman University.

vii) **"Controller of Examinations"** means the Controller of Examination of B.S. Abdur Rahman University, 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 University 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 University 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 University for admission. The entrance examination shall test the proficiency of the candidate in Mathematics, Physics and Chemistry on the standards prescribed for plus two academic stream.

2.3 The eligibility criteria such as marks, number of attempts and physical fitness shall be as prescribed by the University 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. Polymer Engineering
12. Biotechnology
13. Cancer Biotechnology
14. 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 courses

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 not exceeding seven and practical courses not exceeding four.

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. This minimum will be between 175 and 185 credits, depending on the program.

4.5 The medium of instruction, examinations and project report shall be English, except for courses on 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 a 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 or 450 periods.

5.3 Semester end examination will normally follow immediately 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 whole class (2nd to 8th semester).

He/she is responsible for maintaining the academic, curricular and co-curricular records of all students throughout their period of study.

However, for the first semester alone the class advisors and faculty advisors will be nominated by first year coordinator.

6.2 FACULTY ADVISOR

To help the students in planning their courses of study and for general counseling on the academic programme, the Head of the Department of the students will attach a certain number of 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 offer advice to the students on academic and personal matters, and guide the students in taking up courses for registration and enrolment every semester.

7.0 COURSE COMMITTEE

Common course offered to more than one discipline or group, shall have a "Course Committee", comprising all the faculty members 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 on whether all the faculty members teaching the common course belong to the same department / different departments.

8.0 CLASS COMMITTEE

During first semester, a common Class Committee will be constituted for all branches by the Dean (Academic Affairs). During other semesters, separate Class Committees will be constituted by the respective Head of the Department of the students

8.1 The first semester Class Committee composition will be as follows:

i) The first semester Coordinator shall be the Chairman of the class committee

ii) Course coordinators of all common courses.

iii) Faculty members of all individual courses.

iv) One male and one female first semester student of each class of B.Tech, program to be nominated by the first semester coordinator

v) All first semester class advisors and faculty advisors

8.2 The composition of the class committee for each branch of B.Tech, from 2nd to 8th semester, will be as follows:

i) One senior faculty member preferably not teaching to the concerned class, appointed as Chairman by the Head of the Department

ii) Faculty members of individual courses

iii) Two students, (preferably one male and one female) of the class per group of 30 students or part thereof, to be nominated by the Head of the Department, in consultation with the faculty advisors.

iv) All faculty advisors and the class advisor of the class

v) Head of the Department

8.3 The class committee shall meet at least thrice 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, second and third assessments. 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 of the class students to improve the effectiveness of the teaching-learning process.

8.5 The class committee, excluding the student members, shall meet within 10 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 the grades for students 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 current 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.

10.1 CHANGE OF A COURSE

A student can change an enrolled course within 15 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 second 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 A PROGRAMME

A student can avail a onetime temporary break of study covering the current semester and/or next semester period with the approval of the Head of the Institution at any time before the start of third assessment of current semester, within the maximum period of 14 or 12 semesters as the case may be. 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 availed break of study has to rejoin only in the same semester from where he left.

12.0 CREDIT LIMIT FOR ENROLMENT & MOVEMENT TO HIGHER SEMESTER

12.1 A student can enroll for a maximum of 30 credits during a semester including redo courses.

12.2 The minimum credit requirement to move to the higher semester is

- Not less than a total of 20 credits, to move to the 3rd semester
- Not less than a total of 40 credits, (20 for lateral entry) to move to the 5th semester
- Not less than a total of 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 four assessments during a semester as given below:

Assessment No.	Course Coverage in Weeks	Duration	Weightage of Marks
Assessment 1	1 to 4	1.5 hours	15%
Assessment 2	5 to 8	1.5 hours	15%
Assessment 3	9 to 12	1.5 hours	15%
Attendance #	-	-	5%
Semester End Exam	Full course	3 hours	50%

\# 76-80% - 1 Mark ; 81-85 – 2 Marks ; 86-90 – 3 Marks ; 91-95 – 4 Marks and 96-100 – 5 Marks

13.2 Appearing for semester end 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 assessment 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 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.

13.5 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% and remaining 50% for the project report and Viva Voce examination.

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

13.7 The continuous assessment marks earned for a course during his/her first appearance will be used for grading along with the marks earned in the semester-end examination / arrear examination for that course until he/she completes.

14.0 SUBSTITUTE EXAMINATIONS

14.1 A student who has missed, for genuine reasons, a maximum of one of the four assessments of a course may be permitted to write a substitute examination. However, permission to take up a substitute examination will be given under exceptional circumstances, such as accident, admission to a hospital due to illness, etc. by a committee constituted by the Dean of School for that purpose.

14.2 A student who misses any assessment in a course shall apply in a prescribed form to the Head of the department / Dean within a week from the date of missed assessment. However the substitute tests and examination for a course will be conducted within two weeks after the last day of the semester-end examinations.

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 University 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. If the course is a core course, the candidate should register for 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. Thereupon, the Dean (Academic Affairs) shall announce, course-wise, the names of such students prevented from writing the semester end examination in each course.

15.3 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.

15.4 A student who is awarded "U" grade in a course will have the option of either to write semester end arrear examination at the end of the subsequent semesters, or to redo the course during summer term / regular semester. Marks earned during the redo period in the continuous assessment for the course, will be used for grading along with the marks earned in the semester-end (redo) examination. If any student obtained "U" grade during summer term course, the marks earned during the redo period for the continuous assessment for that course will be considered for further appearance as arrears.

15.5 If a student with "U" grade prefers to redo any particular course fails to earn the minimum 75% attendance while doing that course, then he/she will be awarded "I" grade in that course.

15.6 The students who have not attended a single hour in all courses in a semester and awarded 'I' grade are not permitted to write the examination and also not permitted move to next higher semester. Such students should repeat all the courses of the semester in the next Academic year.

16.0 SUMMER TERM COURSES

16.1 A student can register for a maximum of three courses during summer term, if such courses are offered by the concerned department during the summer term. Students may also opt to redo such courses during regular semesters.

16.2 The Head of the Department, in consultation with the department consultative committee may arrange for the conduct of a few courses during the summer term, depending on the availability of faculty members during summer and subject to a specified minimum number of students registering for each of such courses.

16.3 However, in the case of students who have completed eighth semester, but having arrears in the earlier semesters in a maximum of two courses, summer courses may be offered, even if less than minimum students may register for the course.

16.4 The number of contact hours and the assessment procedure for any course during summer term will be the same as those during regular semesters except that there is no provision either for withdrawal from a summer term course or for substitute examination.

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 10 days after the semester-end examination and analyze the performance of students in all assessments of a course and award letter grade. 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	--
I	--
AB	--

"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.

17.3 The results, after awarding of grades, shall be signed by the Chairman of the Class Committee and Head of the Department and 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 courses, on payment of prescribed fee, through proper application to Dean (Academic Affairs), who 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 Summer term (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 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, including summer courses if any.

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

$$GPA = \frac{\sum_{i=1}^{n}(C_i)(GPi)}{\sum_{i=1}^{n} C_i} \qquad Where\ \ n = number\ of\ courses$$

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

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 an completing the programme within the normal 8 or 6 (for lateral entry) semesters
First Class	6.50 and above and completing the programme within a maximum of 10 or 8 (for lateral entry) semesters.
Second Class	All others

However, to be eligible for First Class with Distinction, a student should not have obtained U and I grade in any course during his/her study and should have completed the U.G. programme within a minimum period covered by the minimum duration plus authorized break of study, if any (clause 11). To be eligible for First Class, a student should have passed the examination in all courses within the specified minimum number of semesters reckoned from his/her commencement of study plus two semesters. 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: OPTION TO DO PROJECT ALONE IN FINAL SEMESTER

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 In the curriculum of eighth Semester, along with the project work, if two elective courses alone are listed, then the Dean (Academic Affairs) may permit a student, as per approved guidelines, on the recommendation of the Head of the department, to do a full semester major industrial project work. In such a case, the above two elective courses or any other two elective courses in lieu thereof have to be enrolled during any semester preceding or succeeding the project work, if offered.

19.0 PERSONALITY AND CHARACTER DEVELOPMENT

19.1 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.

20.0 DISCIPLINE

20.1 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 bring down the prestige of the University.

20.2 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.

21.0 ELIGIBILITY FOR THE AWARD OF DEGREE

21.1 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.

21.2 The award of the degree must have been approved by the University.

22.0 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.

CURRICULUM AND SYLLABI FOR B.TECH. MECHANICAL ENGINEERING

(Eight Semesters / Full Time)

CURRICULUM

SEMESTER I

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1	BS	MAB1181	Algebra, Geometry and Calculus	3	1	0	4
2	HS	ENB1181	English*				
		FRB1181	French*				
		ISB1181	Arabic*	3	0	0	3
3	BS	PHB1181	Physics	3	0	0	3
4	BS	CHB1181	Chemistry	3	0	0	3
5	ESF	GEB1101	Engineering Graphics	2	0	3	3
6	HS	SSB1182	Sociology, Ethics & Human Values	3	0	0	3
7	BS	PHB1182	Physics Lab	0	0	2	1
8	BS	CHB1182	Chemistry Lab	0	0	2	1
9	ESF	GEB1102	Basic Engineering Practices Laboratory	0	0	2	1
10	ESF	GEB1103	Computer Programming & Applications	2	0	2	3
							25

* Any one language

SEMESTER II

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1	BS	MAB1282	Advanced Calculus	3	1	0	4
2	BS	CHB1285	Chemistry of Materials and Coating	3	0	0	3
3	HS	SSB1181	Introduction to Economics	3	0	0	3
4	ESF	GEB1211	Basic Engineering Mechanics	3	1	0	4

5	ESF	EEB1283	Basic Electrical Engineering	3	0	0	3
6	EC	MEB1211	Material Science	3	0	0	3
7	BS	CHB1286	Chemistry of Materials and Coating Laboratory	0	0	2	1
8	HS	ENB1282	Written Communication	0	0	2	1
9	EC	MEB1212	Design Appreciation Lab	0	0	3	1
10	ESF	EEB1284	Electrical Engineering lab	0	0	3	1
							24

SEMESTER III

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1	BS	MAB2181	Transforms and Applications	3	1	0	4
2	BS	LSB2181	Biology for Engineers	3	0	0	3
3	EC	MEB2101	Applied Materials Engineering	3	0	0	3
4	EC	MEB2102	Solid Mechanics	3	1	0	4
5	EC	MEB2103	Thermodynamics	3	1	0	4
6	EC	ECB2181	Electronics for Mechanical Systems	3	0	0	3
7	HS	ENB2181	Oral Communication	0	0	2	1
8	EC	MEB2104	Material Testing Lab	0	0	2	1
9	EC	MEB2105	Drafting & Modeling Lab	0	0	3	1
10	EC	ECB2182	Electronics & Microprocessor Lab	0	0	3	1
							25

SEMESTER IV

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1	BS	MAB2283	Applied Numerical Methods	3	1	0	4
2	EC	MEB2211	Machine Component Design	3	1	0	4

3	EC	MEB2212	Kinematics of Machinery	3	0	0	3
4	EC	MEB2213	Basic Manufacturing Processes	3	0	0	3
5	EC	MEB2214	Fluid Mechanics	3	1	0	4
6	HS	SSB2181	Law for Engineers	3	0	0	3
7	HS	ENB2282	Confidence Building & Behavioral Skill	0	0	2	1
8	EC	MEB2215	Mechanics Lab	0	0	3	1
9	EC	MEB2216	Manufacturing Processes Lab	0	0	3	1
10	EC	MEB2217	Fluid Mechanics and Machinery Lab	0	0	2	1
							25

SEMESTER V

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1	EC	MEB3101	Metal Cutting and Machine Tools	3	0	0	3
2	EC	MEB3102	Transmission Systems Design	3	0	0	3
3	EC	MEB3103	Thermal Engineering	3	0	0	3
4	EC	MEB3104	Machine Dynamics	3	1	0	4
5	BS	GEB3201	Environmental Science and Engineering	3	0	0	3
6	PE		Professional Elective I	3	0	0	3
7	HS	ENB3181	Career Building & People Skill	0	0	2	1
8	EC	MEB3105	Advanced Machine Tool Lab	0	0	3	1
9	EC	MEB3106	Thermal Engineering Lab	0	0	3	1
10	EC	MEB3107	Simulation Lab	0	0	3	1
							23

SEMESTER VI

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1	EC	MEB3211	Heat and Mass Transfer	3	1	0	4
2	MS	MSB3181	Management of Business organization	3	0	0	3
3	EC	MEB3212	Mechatronics	3	0	0	3
4 3	EC	MEB3213	Metrology and Mechanical Measurements	3	0	0	
5	PE		Professional Elective II	3	0	0	3
6	PE		Professional Elective III	3	0	0	3
7	EC	MEB3214	Heat Transfer Lab	0	0	2	1
8	EC	MEB3215	Mechatronics Lab	0	0	3	1
9	EC	MEB3216	Metrology and Mechanical Measurements Lab	0	0	3	1
10	EC	MEB3217	Product Design Lab	1	0	3	2
							24

SEMESTER VII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1	EC	MEB4101	Energy Conversion Systems	3	0	0	3
2	EC	MEB4102	Finite Element Analysis	3	1	0	4
3	EC	MEB4103	Gas Dynamics and Jet Propulsion	3	1	0	4
4	PE		Professional Elective IV	3	0	0	3
5	PE		Professional Elective V	3	0	0	3
6	GE		General Elective I	3	0	0	3
7	EC	MEB4104	Mini Project	0	0	3	1
8	EC	MEB4105	FEA Lab	0	0	3	1
9	EC	MEB4106	CNC Lab	0	0	2	1
10	EC	MEB4107	Automobile Engineering Lab	0	0	3	1
							24

SEMESTER VIII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1	PE		Professional Elective VI	3	0	0	3
2	GE		General Elective II	3	0	0	3
3	EC	MEB4211	Project	0	0	18	9
							15

Total Credits: 185

PROFESSIONAL ELECTIVES

DESIGN ELECTIVES

Sl. No.	Course Group	Course Code	Course Title
1.	PE	MEBX01	Noise, Vibration and Harshness
2.	PE	MEBX02	Geometric Modelling
3.	PE	MEBX03	Design of Jigs, Fixtures and Press Tools
4.	PE	MEBX04	Modern Concepts in Engineering Design
5.	PE	MEBX05	Advanced Strength of Materials
6.	PE	MEBX06	Composite Materials for Manufacture
7.	PE	MEBX07	Nano Materials & Fabrications
8.	PE	MEBX08	Design of Hydraulics and Pneumatics
9.	PE	MEBX09	Micro Electro Mechanical Systems (MEMS)

MANUFACTURING ELECTIVES

1.	PE	MEBX10	Modern Manufacturing Systems
2.	PE	MEBX11	Reliabilty Engineering and Maintenance
3.	PE	MEBX12	Process Planning and Cost Estimation
4.	PE	MEBX13	Production Planning and Control
5.	PE	MEBX14	Statistics and Quality Control
6.	PE	MEBX15	Industrial Marketing
7.	PE	MEBX16	Robotics and Automation
8.	PE	MEBX17	Entrepreneurial Development
9.	PE	MEBX18	Modern Production Management
10.	PE	MEBX19	Advanced Optimisation Techniques
11.	PE	MEBX20	Advanced Production Processes for Automotive Components
12.	PE	MEBX21	Plant Layout and Material Handling
13.	PE	MEBX22	Industrial Safety Engineering
14.	PE	MEBX23	Operations Research and System Analysis

THERMAL ELECTIVES

1.	PE	MEBX24	Refrigeration and Air Conditioning
2.	PE	MEBX25	Advanced I.C. Engines
3.	PE	MEBX26	Nuclear Engineering
4.	PE	MEBX27	Energy Conservation and Management
5.	PE	MEBX28	Computational Flow and Heat Transfer
6.	PE	MEBX29	Renewable Sources of Energy
7.	PE	MEBX30	Solar Engineering
8.	PE	MEBX31	Design of Thermal Systems
9.	PE	MEBX32	Fuels and Combustion
10.	PE	MEBX33	Automobile Engineering

GENERAL ELECTIVES

Sl. No.	Course Group	Course Code	Course Title	Offering Department
1.	GE	GEBX01	Disaster Management	Civil
2.	GE	GEBX02	Nano Technology	Physics
3.	GE	GEBX03	Control Systems	EEE
4.	GE	GEBX04	Green Design and Sustainability	Civil
5.	GE	GEBX05	Knowledge Management	CSE
6.	GE	GEBX06	Appropriate Technology	Civil / Mechanical
7.	GE	GEBX07	System Analysis and Design	Mechanical
8.	GE	GEBX08	Value Analysis and Engineering	Mechanical
9.	GE	GEBX09	Optimization Techniques	Mathematics
10.	GE	GEBX10	Engineering System Modeling and Simulation	Mechanical
11.	GE	GEBX11	Supply Chain Management	CBS
12.	GE	GEBX12	Total Quality Management	Mechanical
13.	GE	GEBX13	Energy Studies	Mechanical
14.	GE	GEBX14	Robotics	Mechanical
15.	GE	GEBX15	Cyber security	IT
16.	GE	GEBX16	Usability Engineering	CSE
17.	GE	GEBX17	Industrial Safety	Mechanical
18.	GE	GEBX18	Transport Management	Auto
19.	GE	GEBX19	Advanced Optimization Techniques	Mechanical
20.	GE	GEBX20	Plant Engineering	EIE
21.	GE	GEBX22	National Service Scheme	

SEMESTER I

MAB1181	ALGEBRA, GEOMETRY AND CALCULUS	L	T	P	C
		3	1	0	4

OBJECTIVES:

The course is aimed at

- developing the skills of engineering students in the basics of chosen topics of Mathematics that are imperative for effective understanding of engineering subjects.
- laying the foundation for learning further topics of Mathematics in higher semesters in a graded manner.
- enabling the learners to appreciate the important role of mathematical concepts in engineering applications.

MODULE I MATRICES **8**

Eigenvalue Problems – Eigenvalues and Eigenvectors of a real matrix, Engineering Applications –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 VECTOR ALGEBRA **6**

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

MODULE III THREE DIMENSIONAL ANALYTICAL GEOMETRY **8**

Direction cosines & 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 IV DIFFERENTIAL GEOMETRY **7**

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

MODULE V MULTI-VARIATE FUNCTIONS 8

Functions of two variables – partial derivatives – total differential – Implicit Functions – Jacobians - Taylor's series expansion – maxima and minima – Lagrange's multiplier method.

MODULE VI ORDINARY DIFFERENTIAL EQUATIONS 8

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 co-efficients, method of variation of parameters.

L – 45; T – 15; Total Hours– 60

TEXT BOOKS:

- Veerarajan.T., "Engineering Mathematics" (5th edition) Tata Mc Graw Hill Publishing Co. New Delhi, 2012.
- Grewal B.S., "Higher Engineering Mathematics" (42nd edition), Khanna Publishers, New Delhi, 2012.

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 I, 2nd edition, National Publishing Co., Chennai, 2003.

OUTCOMES:

On completion of the course the students will be able to

- solve Eigenvalue and Eigenvector problems
- solve three dimensional geometry problems.
- use differential calculus for solving problems pertaining to engineering applications.

ENB1181	ENGLISH	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose students to the concept of flipped learning.
- To discuss a range of vocabulary and enable students to use it in academic and technical contexts.
- To facilitate students' effective use of speaking skill while exchanging ideas and making presentations.
- To help students develop listening skill for identifying accent and intonation and comprehending and analyzing the information.
- To develop reading comprehension skill and help them to infer explicit and implicit meanings.
- To hone their creative and academic writing skills.
- To expose them to the correct usage of language and help them to apply it appropriately.

MODULE I **8**

L: Listening for specific information – Note-taking

S: Self introduction – Introducing one another

R: Skimming Technical passages

W: Process of writing – Writing short paragraphs

Language focus: Use of prefixes and suffixes ,Simple tense forms

MODULE II **8**

L: Guessing the meaning through Intonation

S: Exchanging opinions & Agreeing and disagreeing

R: Scanning – reading news paper articles for specific information

W: Argumentative writing – Letter to the editor

Language focus: Modals, Continuous and perfect tenses, Framing questions & Question tags

MODULE III **7**

L- Listening to a specific topic & predicting the content

S – Getting into conversation- Gathering information

R - Reading between lines

W - Letter inviting a dignitary-Expository Writing

Language Focus: Homonyms & Collocation

MODULE IV **7**

L: Listening to telephonic conversation, listening for specific information (Intensive)

S: Short presentations

R: Referential and Inferential reading

W:– Letter seeking permission for industrial visit

Language focus: Subject, Verb agreement & Euphemism

MODULE V **8**

L: Listening to scientific podcasts – Cloze exercises

S: Personal narrations

R: Intensive reading – Interpreting graphical data.

W: Describing a process, Flow chart, Bar chart

Language focus: Passive forms, Connectives & Prepositions

MODULE VI **7**

L: Appreciation and critical review of popular movie--The Incredibles

S: Discussion in groups - Three Idiots

R: Extensive reading – APJ Abdul Kalam's Wings of Fire - Reading for critical appreciation

W: Writing slogans – Rewriting a story with a different ending

Language focus: If clause, Phrasal verbs & Idiomatic expressions

Total Hours: 45

REFERENCES:

1. Carol Rosenblum Perry (2011). The Fine Art of Technical Writing. CreateSpace Independent Publishing Platform, New Delhi.
2. Dutt,P.K Rajeevan.G and Prakash,C.L.N (2007). A Course in Communication Skills. Cambridge University Press, India.
3. Kalam,Abdul &Arun Tiwari (2004). Wings of Fire: An Autobiography (Simplified and Abridged by Mukul Chowdhri). Hyderabad University 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

- Explore new information from various sources and perform communicative tasks.
- Demonstrate their range of vocabulary in academic and technical contexts.
- Exchange ideas and make presentations.
- Identify, comprehend and respond to different intonation patterns.
- Infer meaning from reading texts.
- Create and construct different kinds of academic documents.
- Communicate effectively using grammatically correct expressions.

FRB1181	FRENCH	L	T	P	C
		3	0	0	3

OBJECTIVES:

1 To improve their proficiency in French language.

2 To empower them for successful communication in their professional contexts.

DOSSIER 0 FENÊTRE SUR… 7

Contenus –l'alphabet - se présenter – les langues – les nationalités – les nombres de 0 à 60 – les adjectifs de nationalités – les verbes : s'appeler, être.

L'acte de parole

DOSSIER 1 LES UNS, LES AUTRES…. 12

Contenus - Les salutations (formelles et informelles) - les jours de la semaine – Les articles définis – les adjectifs possessifs – la négation (ne…..pas) – les verbes : avoir.

Demander quelque chose – les mois de l'année – les nombres de 70 à 99 – les articles indéfinis – l'adjectif interrogatif (quel, quelle)

Quelques événements culturels – donner des informations personnelles – indiquer ses gouts – l'expression des gouts – les prépositions (les noms de pays).

L'acte de parole

DOSSIER 2 ICI /AILLEURS 12

Contenus – Parler de sa ville – Donner/ Demander des explications – les prépositions de lieu – articles contractés – pourquoi / parce que

Auberges de jeunesse et hôtels – s'informer sur un hébérgement- quelques verbes et indications de direction – quelques formules de politesse.

Le code postal et les départements le libellé d'une adresse en France – Ecrire une carte postale – Dire le temps qu'il fait – les adjectifs démonstratifs - Formules pour commencer / terminer.

L'acte de parole

DOSSIER 3 SOLO OU DUO **14**

Contenus – Les animaux de compagnie les animaux préférés des Français - parler de sa profession – les professions - les activités sportifs - les noms animaux – les verbes : aimer, adorer, détester, faire, aller.

Nouveaux mode de rencontres – caractériser une personne (physique et psychologique) – les adjectifs qualificatifs – les pronoms toniques.

Les sorties – proposer, refuser, accepter une sortie – fixer un rendez-vous – inviter – Donner des instructions – L'impératif : 2e personne – Le pronom on=nous – Les verbes : Pouvoir, vouloir, devoir.

L'acte de parole

L'examen oral

Total Hours: 45

TEXT BOOK:

- Alter EGO I – Goyal – Langers (0 – 5 Lessons)

OUTCOMES:

On completion of the course,

1. The students will be able to deal with their clients effectively at global level.
2. Their proficiency in French Language will have improved.

ISB1181	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 equipments..

Computer, internet browsing.

Banking, Exercises.

Total Hours: 45

TEXT BOOK:

- 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:

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

PHB1181	PHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce basic physics concepts relevant to Engineering and Technology students.
- To get familiarize with solving problems in basic physics.
- To acquaint applications of physics for Engineering issues.

MODULE I PROPERTIES OF MATTER **7**

Elasticity – Stress strain diagram – Factors affecting elasticity – Twisting couple on a wire – Shaft – Torsion pendulum – Depression on a cantilever – Young's modulus by cantilever – Uniform and non-uniform bending – Viscosity.

MODULE II CRYSTAL PHYSICS **6**

Introduction – Space lattice – unit cell – Bravais lattices – Miller Indices for cubic crystals – Inter planar spacing in cubic lattice – Simple crystal structures – SC, BCC, FCC and HCP structures – Atomic radius, coordination number, Packing factor calculation – Crystal imperfections.

MODULE III QUANTUM PHYSICS **7**

Black body radiation – Planck's theory of radiation – Deduction of Wien's displacement law and Rayleigh – Jeans law from Planck's theory – Compton effect – Theory and experimental verification – Dual nature of matter – de Broglie's wavelength- Physical significance of wave function – Schroedinger wave equation – Time independent and time dependent wave equation – Particle in one dimensional box.

MODULE IV WAVE OPTICS **9**

Interference theory – Air wedge – Michelson interferometer – Diffraction – Fresnel and Fraunhofer diffraction - Polarization – Double refraction – Theory of plane polarized, circularly polarized and elliptically polarized light – Quarter wave plate, Half wave plate – Production and detection of plane, circularly and elliptically polarized lights – Photoelasticity – Photo elastic effect – Stress optic law – Effect of stressed model in a plane polariscope (qualitative) – Photo elastic bench.

MODULE V LASER & FIBRE OPTICS **9**

Principle of spontaneous emission and stimulated emission - Characteristics of laser light -Einstein's A & B coefficients (derivation) – Population inversion - pumping - Nd:YAG laser – CO2 laser – Applications – Material processing and holography (construction and reconstruction of hologram)- Optical fibre – Principle and propagation of light in optical fibers – Numerical aperture and acceptance angle – Types of optical fibers - applications – Fibre optic communication system (block diagram only)- Fibre optic sensors (displacement and pressure sensors (qualitative), Medical endoscope.

MODULE VI ULTROSONICS AND NDT **7**

Ultrasonics – Production – Magnetostriction and piezo electric methods – Properties of ultrasonic waves – Detection of ultrasonic waves – Applications –Ultrasonic interferometer- Acoustical grating – SONAR – Depth of sea – Measurement of velocity of blood flow – Non Destructive Testing (NDT) methods – Ultrasonic flaw detector – A,B & C scanning methods.

Total Hours: 45

TEXT BOOKS:

1. Gaur R.K. and Gupta S.L., Engineering Physics, 8th edition, Dhanpat Rai Publications (P) Ltd., New Delhi, 2003.
2. Palanisamy P.K., Physics for Engineers, Vol1 & Vol2, 2nd Edition, Scitech Publications, 2003.

REFERENCES:

1. Uma Mukherji, "Engineering Physics", Narosa Publishing House, New Delhi, 2007.
2. Charles Kittel, "Introduction to solid state physics", 7th Edition, John Wiley & sons (ASIA) Pvt. Ltd, 2008.
3. Avadhanulu M.N., "Engineering Physics", 1st Edition, S.Chand & Company Ltd., New Delhi, 2007.
4. Schiff, "Quantum Mechanics", 3rd Edition, Tata McGraw-Hill Education, 2010.
5. Rajendran V. and Marikani A., "Applied Physics for Engineers", 3rd Edition, Tata McGraw Hill Pub. Co. Ltd, New Delhi, 2003.

2 William T. Silfvast, “Laser Fundamentals”, 2nd edition, Cambridge University Press, 2004.

3 Arumugam M., “Engineering Physics”, 5th Edition, Anuradha Agencies, 2003.

OUTCOMES:

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

- Apply the knowledge of properties of matter in Engineering Mechanics and Fluid Dynamics.
- Characterize Engineering materials
- Use Lasers for Fiber Optics Technology and Material Processing
- Do non-destrictive testing using Ultrasonic Techniques

CHB 1181	CHEMISTRY	L	T	P	C
	(Common to all branches)	3	0	0	3

OBJECTIVES:

To make students conversant with the

- Water specification for potable and industrial purposes and various treatment methods.
- Different engineering materials, their physico-chemical properties and specific applications.
- Concept of electrochemistry, corrosion and theories of corrosion.
- Principles of spectroscopy and applications.
- Basic principles of green chemistry and the need for green processes in industries.

MODULE I WATER TECHNOLOGY 8

Introduction – Impurities present in water – Hardness, Types of Hardness, Estimation of Hardness (EDTA method) (Problems) – Alkalinity, Estimation of Alkalinity – Disadvantages of hard water in industries – Conditioning methods: external treatment method: Ion exchange method – internal treatment: colloidal, phosphate, calgon, carbonate methods – drinking water standards (BIS) – treatment of domestic water: screening, sedimentation, coagulation, filtration, disinfection: by chlorination, UV treatment, ozonization – desalination and reverse osmosis (principle only).

MODULE II ENGINEERING MATERIALS 8

Abrasives: Moh's scale of hardness – natural abrasives: diamond, corundum, emery, garnets and quartz – artificial abrasives: silicon carbide, boron carbide.

Refractories: characteristics, classification – acid, basic and neutral refractories, properties – refractoriness, refractoriness under load, dimensional stability, porosity, thermal spalling – general method of manufacture of refractories, properties and uses of high alumina bricks, magnesite and zirconia bricks.

Nanomaterials: Definition – types of Nanomaterials; nanofilms, nanowires, carbon nanotubes, quantum dots and fullerenes (C60) – Size and shape

dependent optical, electrical, thermal and mechanical properties; Synthesis of nanomaterials – Top down and bottom up approach; Applications of nanomaterials – Catalysis, Electronics and Telecommunication, Medicines, Composites and Energy.

MODULE III ELECTROCHEMISTRY AND CORROSION 9

Construction of a cell – Standard and single electrode potential – electrochemical series – EMF and its measurement – Nernst equation, application and problems – Types of electrodes: standard hydrogen electrode, calomel electrode, ion selective electrode - glass electrode and determination of pH using glass electrode – polarization, overvoltage, decomposition potential (statements only) – Conductometric and potentiometric titrations.

Corrosion: Definition – Dry corrosion and Wet corrosion with mechanisms – Factors influencing corrosion.

MODULE IV CHEMISTRY OF POLYMERS 6

Monomers – functionality – polymer – degree of polymerization – classification – Polymerization techniques: addition, condensation and co-polymerization with example – mechanism of polymerization: free radical, cationic and anionic mechanism – thermoplastics and thermosetting plastics with examples – compounding and moulding of plastics: injection moulding and compression moulding.

MODULE V SPECTROSCOPY 9

Electromagnetic spectrum – absorption of radiation – electronic, vibrational, translational and rotational – intensities of spectral lines – Beer-Lambert's Law (Problems) – Colorimetric analysis: estimation of concentration of a solution – Flame photometry: theory, instrumentation (block diagram only) and application – UV-Visible spectroscopy: Principle, instrumentation (block diagram only) and simple applications – IR spectroscopy – simple applications only.

MODULE VI GREEN CHEMISTRY 5

Introduction – Significance – Industrial applications of green chemistry; Green technology – Latest green laboratory technique for saving experimental resources and infrastructural framework; Principles of green chemistry – R4M4

model (Reduce, Reuse, Recycle, Redesign; Multipurpose, Multidimensional, Multitasking, Multi-tracking) – Life cycle analysis technique (cradle to grave approach)

Total Hours: 45

TEXT BOOKS:

1. Jain P.C and Renuka Jain, Physical Chemistry for Engineers, Dhanpat Rai and Sons, New Delhi. 2001.
2. Paul T. Anastas, John C. Warner, Green Chemistry: Theory and Practice, Oxford University Press, 1998.

REFERENCES:

1. Bahl B.S., Tuli and Arun Bahl, Essentials of Physical Chemistry, S. Chand and Company Ltd., New Delhi, 2004.
2. Kuriacose J.C. and Rajaram J, Chemistry in Engineering and Technology, Volume1, Tata McGraw- Hill publishing company, New Delhi, 1996.
3. Puri B.R., Sharma L.R. and Madan S. Pathania, Principles of Physical Chemistry, Shoban Lal Nagin Chand and Co., Jalandhar, 2000.

OUTCOMES:

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

- estimate the degree of hardness and alkalinity in water and describe treatment methods for potable water.
- summarise the properties and uses of various engineering materials and choose the appropriate material for a given application.
- illustrate the different types of electrodes, calculate the emf and apply the electrochemistry principles to explain the mechanism of corrosion.
- describe the mechanism of polymerization and moulding techniques.
- explain the principles and instrumentation of various analytical techniques and adopt the suitable techniques for analysis of compounds / elements.
- outline the principles and significance of green chemistry.

GEB1101	ENGINEERING GRAPHICS	L	T	P	C
	(Common to All Branches)	2	0	3	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 an exposure to the appropriate standards for technical drawings
- To provide practical exposure on important aspects like drawing analytic curves, orthographic projections, section of solids, development of surfaces, pictorial views 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, involutes, helix

MODULE II ORTHOGRAPHIC PROJECTION 08

Orthographic projection – first angle, third angle projection methods, free hand sketching of orthographic views of simple machine parts as per first angle projection. Projection of points. Commands and demonstration of drafting packages.

MODULE III PROJECTION OF STRAIGHT LINES AND PLANES 10

Straight lines in first quadrant – true length and true inclinations, traces – rotating line and trapezoidal methods. Projection of plane lamina in first quadrant – trace of plane.

MODULE IV PROJECTION OF SOLIDS 10

Projection of solids: 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 10

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

Development of surfaces: truncated solids - prism, pyramid, cone, cylinder, frustum of cone and pyramid.

MODULE VI PICTORIAL PROJECTIONS 12

Isometric projection: isometric scale - isometric projection and view of prism, pyramid, cylinder, cone, frustums and truncated solids.

Perspective projection: prism, pyramid, cylinder, frustums – visual ray and vanishing point methods.

Total Hours: 60

TEXT BOOK:

1. N.D. Bhatt, 'Engineering Drawing' Charotar Publishing house, 46th Edition, (2003)

REFERENCES:

1. K.V. Natarajan, 'A text book of Engineering Graphics', Dhanalakshmi publishers, Chennai.(2006)
2. Venugopal. K, and V. Prabhu Raja, Engineering Graphics, New Age International (P) Ltd., Publication, Chennai. (2011)

OUTCOMES:

Students who complete this course will be able to

- draw various views of engineering components
- graphically communicate their concepts and ideas on new designs

SSB1182 SOCIOLOGY, ETHICS AND HUMAN VALUES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To describe the fundamental and basic concepts of Sociology.
- To illustrate how society evolved in India with changes in social strata.
- To explain the importance of groups, teams in industrial spheres.
- To develop the knowledge of social impact of economic liberalization and technology.
- To state some basic concepts on ethics, values and human rights.
- To develop social responsibility &human professional ethics.
- To recognize and determine the role of engineers in the economic and social development of the society.

MODULE I FUNDAMENTALS OF SOCIOLOGY 8

Sociology - definition, evolution, scope- Basic concepts-Social Process- Sociological theories, Social Institutions – family, economic, politics, religion, education, culture, Social Stratification , Socialization & Social Control.

MODULE II SOCIOLOGY IN INDIAN CONTEXT 7

Development in India– Caste & Classes – Women and Society – impact of social laws, Social Change in contemporary India – Secularism and Communalism – Social Exclusion and Inclusion.

MODULE III INDUSTRIAL SOCIOLOGY 7

Definition and perspectives – Industry in India – Social groups in industry – Behavior pattern, Group Dynamics – team, enhancing group behaviour. Industrial Organization - formal and informal organizations, Line and staff organizations - functions.

MODULE IV INDUSTRIAL – SOCIETY INTERFACE 8

Perspectives – Social responsibilities – Sociological effect on industrialization – urbanization, child labour, psychological impact, Impact of technology, Modernization – Globalization – challenges, Role of engineers.

MODULE V ETHICS AND HUMAN VALUES **8**

Ethics and values – Organizational values – personal worth, ethical behavior, Professional ethics-professional rights and responsibilities, Whistle blowing, International ethics, Corruption.

MODULE VI ENGINEERS AND SOCIETY **8**

Quality of life and society – engineer in economic development, Technology development – invention, innovation and diffusion, Appropriate Technology– Engineer's contribution, Ecology and environment –Sustainable development– Role of engineers.

Total Hours: 45

REFERENCES:

1. Samir Das Gupta and Paulomi Saha, An Introduction to Sociology, Pearson, Delhi, 2012.
2. Narender Singh, Industrial Sociology, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2012.
3. Vidya Bhushan and D.R. Sachdeva, Fundamentals of Sociology, Pearson, Delhi, 2012.
4. Deshpande, Satish, Contemporary India : A Sociological view, Viking (2002)
5. Thopar, Romila, Early India, Penguin (2003).
6. Mike Martin and Roland Schinzinger, Ethics in Engineering, McGraw Hill, New York, 1996.
7. Haralambos, Heald R.M, Sociology Themes and Perspectives, Oxford, New Delhi-92
8. Ram Ahuja, Social Problems in India,Rawat Publications ,New Delhi

OUTCOMES:

On successful completion of this course,

- Students will have exposure to the fundamentals and the basic concepts of Sociology.
- Students will have gained knowledge about the reality of the society.

- Students will be able to positively respond to the forces of change.
- Students will inculcate common interests of the group and adopt legitimate means to achieve them.
- Students will have knowledge about the impact of technology, modernization, and globalization.
- Students will be able to conform to the rules of the society and communicate effectively with the engineering community and with the society at large
- Students will work effectively as individuals, in teams and in multi-disciplinary settings together with the capacity to undertake holistic development of the society.

PHB1182	PHYSICS LABORATORY	L	T	P	C
	(Common to all B.Tech Programmes)	0	0	2	1

OBJECTIVES:

- To understand the basic concepts of properties of matter ,wave optics
- To understand the properties of ultrasonic and Laser.
- To understand the crystal growth technique.
- To correlate the experimental results with the theoretical values.

LIST OF EXPERIMENTS:

1. Torsional Pendulum- Determination of rigidity modulus of a given wire.
2. Determination of coefficient of viscosity of a liquid by Poiseuille's method .
3. Determination of Young's modulus of a beam using non – uniform bending method.
4. Determination of a thickness of a given wire – Air wedge.
5. Spectrometer- determination of wavelength of given source by using grating.
6. Determination of velocity of ultra sonic waves – Ultrasonic Interferometer.
7. Determination of numerical aperture and acceptance angle of an optical fiber.
8. Determination of particle size using Laser.
9. Growth of crystal by slow evaporation technique.
10. Determination of angle of divergence of Laser beam.
11. Photo electric effect experiment.

OUTCOMES :

On completion of this course, the student will know

- Properties of matter, wave optics and quantum physics
- Properties and application of Ultrasonic and Laser
- Principle and concept of crystal growth technique.

CHB 1182	CHEMISTRY LABORATORY	L	T	P	C
	(Common for All Branches)	0	0	2	1

OBJECTIVES:

To make students conversant with the

- estimation of hardness and TDS in water samples.
- construction of cell and determination of EMF.
- estimation of pH of solutions.
- verification of Beer Lambert's law.

LIST OF EXPERIMENTS:

1. Estimation of hardness in domestic water.
2. Estimation of total dissolved solids (TDS) in domestic water
3. Construction and determination of emf of a cell.
4. Determination of single electrode potential.
5. Estimation of strong acid in the industrial effluents
6. Estimation of Fe2+ present in unknown sample by Potentiometry
7. Verification of Beer-Lamberts law and estimation of Cu2+ present in unknown sample.
8. Estimation of Na and K present in the agricultural field.
9. Study of effect of inhibitors in free radical polymerization (Demo)

OUTCOMES:

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

- estimate the degree of hardness and TDS in water samples.
- construct and calculate EMF of cell.
- apply the concept of Beer lamberts law.

GEB1102	BASIC ENGINEERING PRACTICES	L	T	P	C
	LABORATORY	0	0	2	1

(Common to All Branches)

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

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. Mould 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.

ELECTRONIC ENGINEERING PRACTICE

1. Identifications symbolic representation of active and passive electronic components
2. Solderingand 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

OUTCOMES:

Students who complete this course

- Should be able to appreciate the practical skills needed even in making of simple objects, assemblies and circuits
- Should be able to attend minor defects especially in items used in day to day life
- Should be aware of the safety aspects involved in using tools and instruments

GEB1103	COMPUTER PROGRAMMING & APPLICATIONS	L	T	P	C
		2	0	2	3

OBJECTIVES:

- Expose fundamental concepts and techniques in computer programming
- Give coverage on application logic in programming
- Focus on solving practical problems based on analyzing, designing, and implementing computer programs

MODULE I FUNDAMENTALS OF COMPUTERS **5**

Evolution – Generations - Classifications – Applications – Computer organization –Hardware in a typical computer Identification - Booting – Booting error messages - Number system - Number system conversions

MODULE II BASIC PROGRAMMING AND DEBUGGING **5**

Software types – Types of Operating systems - Software development steps – Information technology and internet - The programming tool - Structure of a basic program - Hello world program – Debugging it – Character set – Delimiters – Keywords, identifiers – Constants – Variables –- Tools and help features – Comments in a program

MODULE III INPUT AND OUTPUT **5**

Data types - Type conversions - Input/Output: Formatted functions – Unformatted functions – Library functions – Debugging the code – Systems software: Compiler – interpreter- linker – loader - Finding the correct answer given a code snippet and justifying it

MODULE IV PROBLEM SOLVING **5**

Problem solving techniques: Algorithm, flowchart – Pseudo-code – Examples of simple problems in algorithms and flowcharts – Sorting and Searching - Characteristics of a good program – Generations of programming language

MODULE V OPERATORS AND DECISION STATEMENTS **5**

Properties of operators – Priority of operators – Arithmetic relational logical and bitwise operators – 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

MODULE VI ARRAYS AND LOOP CONTROL STATEMENTS 5

Arrays – Initialization – Definition – Characteristics – One dimensional array – Two dimensional arrays - Multi dimensional arrays – Predefined streams - Operation with arrays – Sorting and searching – Structures – Operations on structures

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

Total Hours: 60

TEXTBOOKS:

1. Ashok N Kamthane, “Computer Programming”, 2nd Edition, Pearson Education, 2012.
2. Paul J. Deitel, Deitel & Associates, “C How to Program”, 7th Edition, Pearson, Education, 2012.

OUTCOMES:

Students who complete this course will be able to

- Apply Modular design, logic flow and data abstraction in programming paradigm.
- Use the concepts of constructs, functions, I/O and algorithms in the programming environment.
- Develop simple real time applications using the programming constructs and algorithms

SEMESTER II

MAB1282	**ADVANCED CALCULUS**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

OBJECTIVE:

The aim of the course is to

- train the students in additional areas of Engineering Mathematics, necessary for grooming them into successful engineers. The topics will serve as basic tools for specialized studies in many engineering fields, significantly in fluid mechanics, field theory and communication engineering.

MODULE I DOUBLE INTEGRALS **7**

Double integration – Cartesian and Polar coordinates – change of order of integration – area as a double integral –– change of variables between Cartesian and polar coordinates.

MODULE II TRIPLE INTEGRALS AND SPECIAL FUNCTIONS **7**

Triple integration in Cartesian coordinates - change of variables between cartesian, cylindrical and spherical polar coordinates - Beta and Gamma functions.

MODULE III VECTOR INTEGRATION **7**

Line, surface and volume integrals – Green's, Gauss Divergence and Stoke's theorems (without proof) – verification and evaluation of integrals using them.

MODULE IV ANALYTIC FUNCTION **8**

Analytic function - Necessary and Sufficient condition (Proof not included) – 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 V COMPLEX INTEGRATION **8**

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).

MODULE VI PARTIAL DIFFERENTIAL EQUATIONS **8**

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.

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" (42nd edition), Khanna Publishers, New Delhi, 2012.

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.

OUTCOMES:

On completion of the course the students will be able to

- solve integrals of higher orders.
- apply vector calculus for solving engineering problems.
- solve complex differentiation and integration problems related to engineering.
- formulate practical problems in terms of partial differential equations, solve them and physically interpret the results.

CHB1285	CHEMISTRY OF MATERIALS AND COATING	L	T	P	C
	(FOR MECHANICAL ENGINEERING)	3	0	0	3

OBJECTIVES:

To make the students conversant with

- The three types of fuels available and the different processes involved in it and the calculations involved in calorific values and minimum air requirement for complete combustion.
- The classification, functions, mechanism and properties of lubricants.
- The five types of corrosion and four methods to control it.
- The different types of surface coatings
- The nuclear fission reactor and nuclear energy. The classification and description of different types of batteries.
- The polymeric materials used in engineering applications.

MODULE I FUELS AND COMBUSTION 8

Classification of fuels – Solid, Liquid and Gaseous fuel (comparison) – petroleum (refining, fractions, composition and uses) – synthetic petrol: Fischer-Tropsch – knocking: octane number, improvement of octane number (antiknocking) – diesel engine fuel: cetane number, improvement of cetane number, biodiesel (trans-esterification) – CNG – LPG – biogas – Combustion: calculation of minimum requirement of air (problems) – Gross and net calorific values (definition and relationship) – theoretical calculation of calorific values (Dulong's formula, problems) – flue gas analysis by Orsat apparatus.

MODULE II LUBRICANTS 7

Lubricants and lubrication: definition, functions and classification with examples – properties: viscosity index, flash and fire point, cloud and pour point, oiliness, carbon residue, aniline point – greases: calcium, sodium and lithium based – solid lubricants – graphite and molybdenum disulphide, graphene, CNT and nanolubricants.

MODULE III CORROSION 7

Introduction – Galvanic series – types of corrosion: galvanic corrosion, differential aeration corrosion, pitting corrosion and stress corrosion – corrosion

control: cathodic protection (sacrificial anode protection method) – selection of materials and proper designing – corrosion inhibitors

MODULE IV SURFACE COATINGS 8

Treatment of metal surface – Inorganic coatings: Hot dipping (galvanizing and tinning), Electroplating: process, applications of copper, zinc, tin and gold, Electroless plating (Nickel) – Chemical conversion coatings(Chromate, phosphate, oxide coating, Anodizing) – Organic Coatings: Paints (constituents, functions and mechanism of drying) – varnishes and lacquers – special paints – fire retardant, water repellant, temperature indicating and luminous paints.

MODULE V ENERGY AND ITS STORAGE 8

Nuclear fission process – characteristics of nuclear fission – chain reactions – nuclear energy – nuclear reactors – light water nuclear power plant – Batteries: types (primary, secondary and flow cell) – primary batteries: dry cells, alkaline batteries – secondary batteries; lead acid storage cell, nickel - cadmium cell – flow cell: hydrogen-oxygen fuel cell – lithium battery – solar cell – dye sensitized solar cell.

MODULE VI POLYMERIC MATERIALS 7

Engineering plastics: Introduction and advantages – preparation, properties and applications of polycarbonates, TEFLON, polyurethane, nylon-6,6, Kevlar – Thermosetting resins: bakelite – polyester- vulcanization of rubber - rubber blended plastics: ABS plastics – laminated plastics: process – polymer blends and polymer alloys, FRP: glass, carbon, aramid- properties and uses.

Total Hours : 45

TEXT BOOKS:

1. Jain P.C. and Renuka Jain, Engineering Chemistry, Dhanpat Rai Publication Co. (P) Ltd., New Delhi, 2002.

2. Puri B.R., Sharma C.R. and Madan S. Pathania, Principles of Physical Chemistry, Shoban Lal Nagin Chand and Co., 2000.

REFERENCES:

1. Wang M.N., Polymers for electronic and photonic applications, Wiley New York, 1994.

2. Bahl B.S., Tuli G.D. and Arun Bhal, Essentials of Physical Chemistry, S. Chand & Co. Ltd., New Delhi, 2003.

3. Ray G.D., Nonconventional Energy Sources.

OUTCOMES:

The students will be able to

- Compare and contrast the solid, liquid and gaseous fuels and also describe the processes involved in liquid and gaseous fuels. They will also be able to calculate minimum air required for complete combustion and calorific values of fuels.
- Categorize different lubricants into three types and determine its properties.
- Explain and recognize five types of corrosion, when the situation is given. They will also be able to describe the corrosion inhibition methods and apply a few in their daily life.
- Choose and describe the appropriate surface coating based on the application.
- Illustrate eight types of batteries with the aid of a diagram and also calculate nuclear energy.
- Identify eleven types of polymeric materials and relate it to their application in daily use

SSB1181	INTRODUCTION TO ECONOMICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To identify and present the basic concepts of demand, supply and equilibrium.
- To explain the types and concepts of national income and inflation.
- To illustrate the fundamental concepts of money, banking and exchange.
- To create an awareness about the industrial sector, markets and trade and their contribution to economic development.
- To describe the five year plans, budget, fiscal policy and taxation.
- To discuss Indian economy and justify the role of engineers in economic development.

MODULE I INTRODUCTION **8**

Classification of economy – open and closed economy – Sectors of economy – Basic principles of Microeconomics – supply, demand and equilibrium, Elasticity of demand – Pricing models.

MODULE II NATIONAL INCOME DETERMINATION **7**

National income concepts – GNP, GDP, disposable income; Aggregate demand and aggregate supply, Macroeconomic equilibrium - Concepts of MPS, APS, MPC APC, Inflation – Price indices - WPI, CPI and Inflation control.

MODULE III MONEY AND BANKING **7**

Role and functions of money - Monetary System - Money market - Role of Central Bank - Monetary policy - Commercial banks - Development banks - Capital market and Debt market.

MODULE IV INDUSTRY, LABOUR MARKET AND TRADE **7**

Public and Private sectors, Contribution to the National economy - Industrial policy - Labour market - Trade: Domestic and International trade.

MODULE V BUDGET, POLICIES AND INDICATORS **8**

Economic development – Five year plans, Macroeconomic indicators - Central budget - Government tax- revenue and non-tax revenue, Government

expenditures - plan and non-plan expenditures – Fiscal policy – The impact of the budget on the economy.

MODULE VI ECONOMIC GROWTH AND THE ROLE OF ENGINEERS 8

Indian Economy – Development in the post independence era – Growth of the economy, Economic reforms – Liberalization, Privatization and Globalization - challenges and opportunities, Engineers – Contribution of engineers to the economic growth.

Total Hours: 45

REFERENCES:

1. Vanitha Agarwal, Macroeconomics: Theory and Practice, Pearson, 2010.
2. Dwivedi D.N, Macroeconomics: Theory and Policies, 3rd edn; McGraw Hill, 2010.
3. Samuelson, Paul A., Macroeconomics, 19th edn., TMH, 2009.
4. Gupta G.S, Macroeconomics: Theory and Applications, 3rd edn; TMH, 2007.
5. R.K. Lekhi, Public Finance, Kalyani Publishers.
6. D. M. Mithani, Money, Banking, International Trade and Public Finance, Himalaya Publishing House.
7. R.R. Paul, Monetary Economics, Kalyani Publishers.
8. Benson Kunjukunju and S. Mohanan, Financial System and Financial Institutions in India, New Century Publications.
9. Raddar Datt, K.P.M. Sundharam, Indian Economy, S. Chand.
10. Gregory Mankiw, Principles of Economics, Cengage Learning.
11. Gregory Mankiw, Principles of Microeconomics, Cengage Learning.
12. Uma Kapila, Indian Economy since Independence, Academic Foundation.
13. Andrew Gillespie, Business Economics, Oxford University Press.
14. Pindyck, Rubinfeld and Mehta, Microeconomics, Pearson.
15. C.B. Gupta, Business Environment, Sultan Chand and Sons.

OUTCOMES:

On successful completion of this course,

- Students will have an exposure to the basic concepts of microeconomics and macroeconomics.
- Students will be able to identify the concepts of national income and inflation.
- Students will be able to apply the knowledge of money, banking and exchange in their real life situations.
- Students will have gained knowledge in government budget, economic planning and its implementation.
- Students will have an overview of the economic reforms introduced in Indian economy.
- Students will be able to analyze the importance of economics and apply the knowledge they have gained in their professional pursuits.

GEB1211 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 7

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

MODULE II EQUILIBRIUM OF PARTICLE 6

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 6

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 8

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

MODULE V LAWS OF MOTION **10**

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

MODULE VI FRICTION **8**

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

Lecture 45 Tutorial :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 to resolve forces, moments and solve problems using various principles and laws
- Should be able to understand the concept of equilibrium, kinetics and kinematics and capable of formulating the governing equations to practical problems and provide solutions for those equations

EEB1283	BASIC ELECTRICAL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

To impart knowledge on

- Basic concepts of electrical circuits and their solutions
- Principle of operation, characteristics and applications of various D.C. and A.C. machines
- Usage of the machines as drives
- Concepts of control systems and its components

MODULE I DC AND AC CIRCUITS **10**

Introduction to DC circuits: Ohm's law - Kirchoff's law - series and parallel connections - branch currents and voltages across elements - star-delta and delta-star transformation. Introduction to AC circuits: phasor representation – real, reactive and apparent powers - 3 phase circuits - star and delta connections – simple problems.

MODULE II DC MACHINES **9**

DC generators and DC motors: Construction – types – principle of operation - characteristics – starting and speed control – load test and performance characteristics – efficiency – applications – simple problems.

MODULE III TRANSFORMERS **6**

Transformers: Construction – types – principle of operation - Ideal transformers – loading of transformers – equivalent circuit - voltage regulation –efficiency - simple problems.

MODULE IV INDUCTION MOTORS **6**

Three phase Induction motor: Construction – types - principle of operation – starting and running torques – torque Vs slip characteristic – starting and speed control - simple problems.

MODULE V INTRODUCTION TO CONTROL SYSTEMS 8

Differential equations and transfer function of mechanical and electrical systems – time response of first and second order systems - errors – components: servo motors and stepper motors.

MODULE VI SOLID STATE DRIVES 6

Introduction to thyristors – types – principle of operation – speed control of DC motors and Induction motors using SCRs - PWM drives – variable voltage variable frequency drives.

Total Hours : 45

REFERENCES:

1. William H.Hayt Jr, Jack E. Kemmerley, and Steven M. Durbin, “Engineering Circuit Analysis”, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2002.
2. Sudhakar A and Shyam Mohan S P, “Circuit and Network Analysis and Synthesis”, McGraw Hill Publishing Co. Ltd., 2007.
3. Edward Hughes, “Electrical and Electronics Technology”, Pearson India, 9th Edition, 2007.
4. D P Kothari and I J Nagrath, “Basic Electrical Engineering”, McGraw Hill Publishing Co. Ltd., 2nd Edition, 2002.
5. Cotton H, Electrical Technology, Pitman, 2004.
6. B L Theraja and A K Theraja, “A textbook of Electrical Technology”, S.Chand, 2005.

OUTCOMES:

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

- The basics of electrical circuits and their solution methods
- Usage of various DC and AC machines as drives
- Concepts of control systems.

MEB1211 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 the structure, properties, testing and applications of materials so as to identify and select suitable materials for various engineering applications.

MODULE I CRYSTALLOGRAPHY AND SOLID SOLUTIONS 9

Review of crystal structure, space lattice, crystal planes and crystal directions, Numerical related to crystallography. 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.

Introduction to single and multiphase solid solutions and types of solid solutions, importance and objectives of phase diagram, systems, phase and structural constituents, cooling curves, unary & binary phase diagrams, Gibbs's phase rule, Lever rule, eutectic and eutectoid systems, peritectic and peritectoid systems, iron carbon equilibrium diagram and TTT diagram.

MODULE II HEAT TREATMENT 9

Heat Treatment: Principles, purpose, classification of heat treatment processes, annealing, normalizing, stress relieving, hardening, tempering, carburizing, nitriding, cyaniding, flame and induction hardening. Allotropic transformation of iron and steel, Properties of austenite, ferrite, pearlite, martensite. Heat treatment of steels, cast iron, stainless steel, aluminum , copper, , magnesium and titanium.

MODULE III TESTING OF OF METALS 9

Testing of materials under tension, compression and shear loads – Hardness tests (Brinnell, Vickers and Rockwell) Impact test - Izod and Charpy. Tests for creep and fatigue .

MODULE IV NEWER MATERIALS **7**

Ferrous and Non ferrous metals, Engineering Ceramics – Properties and applications, Composites, Shape Memory Alloys, Smart materials, Nanocrystalline Materials, Super alloys, Intermetallics, Biomaterials.

MODULE V MATERIAL SELECTION **6**

Factors influencing materials selection: mechanical properties, physical properties, manufacturing techniques, cost, Case studies.

MODULE VI FAILURE ANALYSIS **5**

Wear and Corrosion Failures- Factors Influencing Failures, Analysis of Failures. Failure Analysis Techniques, simple case studies.

Total Hours: 45

REFERENCES:

1. Elements of Material Science and Engineering: VanVlack, Wesley Pub. Comp.
2. Williams D Callister, “Material Science and Engineering” Wiley India Pvt Ltd, Revised, Indian edition 2007.
3. Materials Selection in Mechanical Design Fourth Edition Michael F. Ashby Butterworth-Heinemann 2011.
4. Engineering Materials 1 An Introduction to their Properties and Applications Second Edition by Michael F. Ashby and David R. H. Jones Butterworth-Heinemann Reprint 2002.
5. Kenneth G. Budinski, Michael K. Budinski, “Engineering Materials, Properties and Selection”, Pearson Education, 8th Edition, 2005
6. Introduction to Physical Metallurgy by Sydney Avner, Mc Graw Hill Ltd

OUTCOMES:

On completion of this course students should

- Be able to describe the structure and classify engineering materials.
- Understand properties and behavior of engineering materials.
- Know about the modes of failure (ductile/brittle fracture, fatigue, creep and corrosion) of engineering materials.
- Know how to use information sources to select materials for engineering uses.

CHB 1286	CHEMISTRY OF MATERIALS & COATING LABORATORY (FOR MECHANICAL ENGINEERING)	L	T	P	C
		0	0	2	1

OBJECTIVE:

- To make the students conversant with the practical experiments relevant to the theory

LIST OF EXPERIMENTS:

1. Determination of dissolved oxygen in the given water sample
2. Study of corrosion of a metal in different corrosive mediums
3. Electrodeposition of a metal over an article
4. Determination of flash and fire point of a lubricant using Pensky-Marten's apparatus
5. Determination of cloud and pour point of a lubricant.
6. Preparation of biodiesel using trans-esterification method.
7. Determination of calorific value of a fuel using Bomb calorimeter
8. Preparation of a polymer (Nylon6,6/Bakelite)
9. Determination of viscosity average molecular weight of polymer

OUTCOMES:

The students will be able to

- calculate the dissolved oxygen present in water sample, molecular weight of the polymer and calorific value of a fuel.
- determine flash, fire, cloud and pour point for lubricants
- prepare biodiesel and a polymer.
- plate a metal over the given article

ENB1282	WRITTEN COMMUNICATION	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To help students identify content specific vocabulary and learn its usage.
- To teach them formal and informal expressions in business communication.
- To expose them to reading for specific purposes, especially in business contexts.
- To expose them to the process of different kinds of formal writing.
- To train them in using the nuances of writing in corporate correspondence.
- To train them in writing effective applications with résumé and reports.

MODULE I **4**

Introduction - process of writing – ABC of academic and professional writing – Instructions and recommendations Reading business related texts for specific information.

MODULE II **4**

Format and conventions of writing email, memo & fax.

Writing email (Case study), memo, fax, agenda and minutes of the meeting (using mobile applications)

MODULE III **6**

Format and conventions of writing agenda and minutes of the meeting

Letter Writing--Calling for an interview & letter of inquiry

MODULE IV **6**

Writing letter of application and Résumé - Different types – Functional, Chronological

Writing one's résumé using Wikispaces

MODULE V **6**

Reporting an incident, writing a feasibility report, and progress report & discipline specific reports

Reading a case study (industry specific) – collaborative writing using Wikispaces

MODULE VI **4**

Writing Statement of purpose– Assessing one's strengths and weaknesses & self and peer evaluation of strengths.

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

- create different types of academic and professional documents by using the three stages of writing.
- identify content specific vocabulary and also use them in appropriate contexts.
- use formal and informal expressions in real life situations.
- demonstrate reading skills with reference to business related texts.
- compose written correspondence effectively in work place contexts.
- write effective letter of applications, résumé and reports.

MEB1212	DESIGN APPRECIATION LABORATORY	L	T	P	C
	(Common for Mechanical, Aeronautical and Automobile Engineering)	0	0	3	1

OBJECTIVES:

- To appreciate the use of various mechanisms involved in engineering products
- To gain the knowledge through experience of handling of engineering products
- To understand reinforcement of specific knowledge from other courses through practice and reflection in an action-oriented setting
- To know the importance of team working skills

STUDY EXERCISE:

1. Study of Standard Components

PRACTICAL EXERCISE:

Do the teardown process on following Engineering products, and also can be aware of

- Identification of the components
- Functions of the components
- Mechanisms involved
- Material and manufacturing process involved

1. 2 Stroke petrol engine
2. 4 Stroke petrol engine
3. Reciprocating Compressor / blower/ Rotary Compressor
4. Axial and radial piston pump
5. Gear pump and vane pump
6. Reciprocating pump (single and multi acting)
7. Centrifugal pump (Mono block, Coupled type) and submersible pump
8. Fixed reduction gear box
9. Valves
10. Work holding devices

11. Mechanical components in electronic devices (CDD, HDD and printer)
12. Fuel feed pump and carburetor
13. Transmission system for diesel engine
14. Front axle and Steering
15. Rear axle and Differential

OUTCOMES:

On completion of the course, the students

- Would have understood the importance of design features in various engineering components.
- Will have awareness about single product meets multiple functions.
- Would have gained confidence in abilities to handle various engineering products and kindle own creativity and ideation.
- Enhanced team working skills.

EEB1284	ELECTRICAL ENGINEERING LAB	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To understand,simulate and verify Thevenin's and Norton's theorem.
- To understand and verify the characteristics of various Electrical Machines
- To understand the three phase Power Measurement in AC circuits.

LIST OF EXPERIMENTS:

1. Verification of Thevenin's theorem and Norton's theorem using MATLAB
2. Open circuit characteristics and Load Characteristics of Self Excited DC Generator
3. Load Test on DC Shunt and DC Series Motor
4. Load Test on Single Phase Transformer
5. Load Test on Three Phase Induction Motor
6. Measurement of 3 phase power using 2 wattmeter method

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
- Measure the three phase power.

SEMESTER III

MAB2181	**TRANSFORMS AND APPLICATIONS**	**L T P C**
	(Common to all branches)	**3 1 0 4**

OBJECTIVES:

The course aims to

- Develop the skills of the students in the areas of boundary value problems and transform techniques.
- Acquire knowledge on different transforms like Laplace Transform, Fourier Transform and Z-Transform.

MODULE I LAPLACE TRANSFORM 8

Laplace transform – sufficient condition – Transforms of elementary functions - Properties – Transforms of Derivatives and Integrals – Initial and Final Value Theorem - Transform of Periodic functions - Inverse transforms - Convolution Theorem.

MODULE II FOURIER SERIES 7

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

MODULE III BOUNDARY VALUE PROBLEMS 8

Classification of second order quasi linear partial differential equations – Solutions of one dimensional wave equation – One dimensional heat equation – Steady state solution of two-dimensional heat equation (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates.

MODULE IV FOURIER TRANSFORM 7

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

MODULE V Z -TRANSFORM AND DIFFERENCE EQUATIONS 7

Z-transform - properties – Inverse Z–transform – Convolution theorem - Formation of difference equations.

MODULE VI APPLICATIONS OF TRANSFORMS 8

Applications of Laplace Transform in solving linear ordinary differential equations - Second order with constant coefficients, Simultaneous First order equations – Applications of Z–transform in solving difference equations using Z–transform.

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”, 42nd edition, Khanna Publishers, New Delhi, 2012.

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.

OUTCOMES:

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

- solve engineering problems in the area of heat conduction, communication systems, electro-optics and electromagnetic theory using different transforms.
- solve boundary value problems encountered in engineering practices.

LSB2181	BIOLOGY FOR ENGINEERS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide an overview of cell structure and function.
- To give basic idea on biochemistry related to biological aspects.
- To introduce genes, their structure, inheritance and about living organisms.
- To give an understanding on metabolism, respiration, etc.
- To inform students of engineering about the interface of biology and engineering.

MODULE I BASICS OF CELL STRUCTURE AND FUNCTION 7

Cells as unit of life – basic chemistry of cell – physical and chemical principles involved in maintenance of life processes, cell structure and functions – Prokaryotic and Eukaryotic cells, cell wall, plasma membrane, endoplasmic reticulum, nucleus, chromosomes- cell division – mitosis, meiosis – molecules controlling cell cycle.

MODULE II BIOCHEMISTRY 8

Biomolecules – introduction – basic principles of organic chemistry, types of functional groups, chemical nature, pH and biological buffers – carbohydrates- mono, di, oligo and polysaccharides, lipids- phospholipids, glycolipids, sphinglipids, cholesterol, steroids, prostaglandms – aminoacids, peptides, proteins – structures- primary, secondary, tertiary and quaternary, glycoproteins, lipoproteins – Nucleic acids – purines, pyrimidines, nucleoside, nucleotide, RNA, DNA.

MODULE III GENETICS 7

Genes – structure and functions – behavior, dominance and epigenetics, evolution – inheritance – reproduction and gene distribution – genome of living organisms – plants – bacteria and viruses – animals – humans, genetic engineering.

MODULE IV MICROBIOLOGY 8

Microbiology – basis of microbial existence – microbial diversity – classification

and nomenclature of micro-organisms- impact of microorganisms on industry, agriculture and health, industrial microbiology – primary and secondary screening of micro-organisms, fermentation processes, bioreactors, microbial ecology – microbial bio-remediation – epidemiology and public health.

MODULE V METABOLISM 7

Metabolic processes – bio-membranes, diffusion, absorption, osmo-regulation, photosynthesis, respiration, dialysis, nutrition, digestion and excretion.

MODULE VI BIOLOGY AND ENGINEERS 8

Application of biology in engineering– living things as the solutions (bionics) – living things as models (biometrics) – bio-technology – biomedical engineering – effect of human action on living things – right balance – bioinformatics – bionanotechnology – sensors, biosensors, biochips-ethics in biology.

Total Hours: 45

REFERENCES:

1 Johnson, Arthur T., Biology for Engineers, CRC Press, FL, 2011.

2 Campbell and Recee, Biology, Pearson, Benjamin Cummins Pub. 8th edition, 2008.

3 Scott Freeman, Biological Sciences, Printice Hall, 2002.

OUTCOMES:

- Able to understand the engineering of life processes.
- Capable of pursuing tissue engineering, biomedical engineering and biotechnology at master level programme.
- Able to apply the knowledge of biology for engineering applications.
- Able to understand the engineering of life processes.

MEB2101 APPLIED MATERIALS ENGINEERING L T P C

3 0 0 3

OBJECTIVES:

- To expose the students with various constitutions of alloys and their effects on steel and processing of materials.
- To impart the ability to investigate, analyze and provide solutions to problems arising from metallurgical and materials engineering.

MODULE I PLASTIC BEHAVIOR AND STRENGTHENING 7

Mechanism of Plastic deformation, role of dislocations, yield stress, shear strength of perfect and real crystals –Strengthening mechanism, work, hardening, solid solutioning,grain boundary strengthening, Poly phase mixture, precipitation, particle fibre and dispersion strengthening. Effect of temperature, strain and strain rate on plastic behavior –Superplasticity.

MODULE II FRACTURE AND ITS BEHAVIOR 7

Griffith's theory on fracture ,stress intensity factor and fracture toughness-Toughening Mechanisms – Ductile and Brittle fracture, Creep and Fatigue. Low and high cycle fatigue test, Effect of surface and metallurgical parameters on fatigue – fracture of non metallic materials.

MODULE III MATERIAL PROCESSING 7

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

MODULE IV FERROUS AND NON FERROUS METALS 9

Effect of alloying additions on steel (Mn, Si, Cr, Mo, V Ti & W) - stainless and tool steels – HSLA - maraging steels – cast Irons- Gray, White malleable, Spheroidal Graphite. Copper and its alloys– Aluminium, Titanium, Magnesium and its alloys - microstructure, properties and its industrial applications.

MODULE V MODERN MATERIALS AND ITS APPLICATIONS 9

Dual phase steels, high strength low alloy (HSLA) Steel transformation included plasticity (TRIP), Steel, maraging steel, shape memory alloys, properties

applications of engineering plastics and composites materials advanced structural ceramics – WC, Tic, c, Al2o3, Sic, Si3N4, CBN diamond, functionally graded materials, intermetallics and its applications in industries.

MODULE VI POWDER METALLURGY 6

Powder production, blending, compaction, sintering, sintering theory and practise, powder rolling, powder forging and extrusion, warm compaction, finishing operations – sizing, coining, repressing and heat treatment, processing of nano materials by powder metallurgy.

Total Hours: 45

REFERENCES:

1 Williams D Callister, “Material Science and Engineering” Wiley India Pvt Ltd, Revised Indian edition 2007.

2 Raghavan. V. “Materials Science and Engineering”, Prentice Hall of India Pvt. Ltd, 5th edition, 2007.

3 Kenneth G. Budinski and Michael K. Budinski “Engineering Materials”, PHI / Pearson Educations, 8th Edition, 2007.

4 George E. Dieter, “Mechanical Metallurgy”, McGraw Hill, 2007.

5 Syndney H Avner, “Introduction to Physical Metallurgy”, 2/E Tata McGraw Hill Book Company, 2007.

OUTCOME:

The student should be able to

- understand the various constitutions of alloys and their effects on material processing.
- investigate, analyze and provide solutions to problems arising from metallurgical and materials engineering.

MEB2102	SOLID MECHANICS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To provide knowledge on stresses, strains and deformation of deformable solids.
- To provide the capability to analyze simplified mechanical elements like beams, shafts, columns and shells.
- To provide an understanding about the combined influence of multiple stresses.

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 shape of beam section on stress induced – Shear stresses in beams – Shear flow.

MODULE III TORSION 8

Analysis of torsion of 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 BEAM DEFLECTION 10

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

MODULE V APPLICATION OF TORSION AND BEAM DEFLECTION 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 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.

Total Hours: 60

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", McGraw-Hill Book Co, Third Edition, 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 Ryder G.H, "Strength of Materials", Macmillan India Ltd., Third Edition, 2002.

6 Ray Hulse, Keith Sherwin & Jack Cain, "Solid Mechanics", Palgrave ANE Books, 2004.

7 Singh D.K "Mechanics of Solids" Pearson Education 2002.

8 Kazimi S.M.A, "Solid Mechanics", Tata McGraw-Hill Publishing Co, New Delhi, 1981.

OUTCOMES:

The student should be able to

- Analyze stresses, strains and deformation in machine components like axially loaded members, beams, shafts, columns and shells.
- Analyze various stresses acting on a stress element

MEB2103	THERMODYNAMICS	L	T	P	C
	(Use of standard Steam tables, Mollier diagram, Psychrometric chart is permitted)	3	1	0	4

OBJECTIVES:

- To gain knowledge on the concept of systems and energy transfer.
- To understand, analyze and apply the basic laws of thermodynamics.
- To understand 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 CONCEPT AND FIRST LAW 12

Basic concepts - concept of continuum, macroscopic approach, types of thermodynamic systems. Property, state, path and process, quasi-static process, work, modes of work, Zeroth law of thermodynamics – concept of temperature and heat. Concept of ideal and real gases. First law of thermodynamics – application to closed and open systems, internal energy, specific heat capacities, enthalpy, steady flow process with reference to various thermal equipment.

MODULE II SECOND LAW, ENTROPY AND AVAILABILITY 12

Second law of thermodynamics – Kelvin's and Clausius 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 gas, principle of increase of entropy – Carnot theorem, absolute entropy, availability, Concept of Exergy analysis.

MODULE III PROPERTIES OF PURE SUBSTANCE AND VAPOUR PROCESSES 10

Properties of pure substances – Thermodynamic properties of pure substances in solid, liquid and vapour phases, phase rule, P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces, thermodynamic properties of steam. Calculations of work done and heat transfer in non-flow and flow processes.

MODULE IV STEAM POWER CYCLES **8**

Standard Rankine cycle, Modified Rankine 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 law, T-ds equations, Maxwell's relations, Clausius Clapeyron equations, Joule – Thomson coefficient.

MODULE VI PSYCHROMETRY **10**

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

Total Hours: 60

TEXT BOOKS:

1 Nag.P.K., "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi, 1998.

2 Cengel, "Thermodynamics" An Engineering Approach, Third Edition – 2003, Tata Mc Graw Hill, New Delhi.

REFERENCES:

1. Holman.J.P., "Thermodynamics", 3rd Ed. McGraw-Hill, 1995.

2. Natarajan. E., "Engineering Thermodynamics" Anuragam Publications, Chennai, 2012.

3. Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.

4. Merala C, Pother, Craig W, Somerton, "Thermodynamics for Engineers", Schaum Outline Series, Tata McGraw-Hill, New Delhi, 2004.

5. Sri Vastava R.C, Saha S. K, Jan A. K, "Thermodynamics" Prentice Hall of India, New Delhi, 2004.

OUTCOMES:

The student should be able to

- conceptualize and apply the laws of thermodynamics to any real life situation.
- design and analyze steam power cycles.
- synthesize and utilize thermodynamic relations for practical problems solving.
- design and analyze air- conditioning problems.

ECB2181 ELECTRONICS FOR MECHANICAL SYSTEMS **L T P C**

3 0 0 3

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 **6**

Classification of solids based on energy band theory-Intrinsic semiconductors-Extrinsic semiconductors-P type and N type-PN junction and its application - Zener diode.

MODULE II SEMICONDUCTORS AND RECTIFIERS **8**

Bipolar junction transistor- CB, CE, CC configuration and characteristics- Field effect transistor:Configuration and characteristic-SCR, DIAC, TRIAC, UJT-Characteristics and simple applications.

MODULE III DIGITAL ELECTRONICS **9**

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

MODULE IV 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 V 8085 MICROPROCESSOR **7**

Architecture of 8085-Pin configuration - Instruction set-Addressing modes-Simple programs using arithmetic and logical operations.

MODULE VI INTERFACING AND APPLICATIONS OF MICRO PROCESSOR **7**

Architecture of 8085-Pin configuration- Instruction set-Addressing modes-Simple programs using arithmetic and logical operations.

Total Hours: 45

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.

ENB2181	ORAL COMMUNICATION	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To empower students with soft skills for employability.
- To help students speak effectively.
- To expose them to a range of business contexts through podcasts for learning appropriate expressions and using them effectively.
- To enable them to make effective presentations.
- To help them learn persuasive and negotiating skills.
- To train them in deliberating on current affairs efficiently by participating in group discussions.
- To prepare them for job interviews.

MODULE I **4**

Training in soft skills-Importance of Oral Communication, rubrics for evaluation, Verbal and non-verbal communication, One-minute presentations & Just a minute (JAM)

Paralinguistic features - Listening to short conversations and monologues for relevant information.

MODULE II **6**

Role-play, Selling a product , marketing skills (Case study on advertisements)

Listening to Business English podcast, Negotiation, persuasion and marketing skills.

MODULE III **4**

Deliberation on social and scientific issues & Debates (Peer and Faculty feedback)

Viewing video samples on debates, TED Talks

MODULE IV **4**

Pair work- Think, pair and share activity-analyzing & Problem solving

Listening for specific information and taking short notes

MODULE V **6**

Discussion etiquette -Assigning different roles in a GD (Peer and Faculty feedback)

Goal setting, Assessing one's strengths and weaknesses & SWOC Analysis

MODULE VI **6**

Mock interview (Peer and Faculty feedback) - Types of Job Interview – Telephone Interview, Stress Interview (Case study)

Listening to interviews for understanding speakers' opinions

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

- apply various soft skills to deal with any professional situation.
- speak English intelligibly, fluently and accurately.
- use a range of expressions appropriate to the situations.

- make effective presentations.
- use persuasive and negotiating skills for marketing products.
- deliberate on current affairs with confidence.
- participate effectively in group discussions and interviews.

MEB2104	MATERIAL TESTING LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To study the microstructure of various materials.
- To study and record various test methods.
- To correlate the results for application.

METALLURGY LAB EXPERIMENTS

1. Metallographic Examination-Demonstration and Practice

a. Study of metallurgical microscope.

b. Specimen preparation for micro structural examination-cutting, grinding, polishing, etching.

c. Selections of etchants for various metals and alloys.

2. Identification of microstructures of Plain Carbon Steel, Tool Steel, Gray C.I, SG Iron, Aluminium, Brass, Bronze.

3. Heat treatment: Annealing, normalizing, hardening and tempering of steel-Hardness and its microstructure.

4. Study of microstructure of welded (HAZ) and cast component. Hardenability test - Jominy End quench test.

MATERIAL TESTING LAB EXPERIMENTS

1. Tension test.
2. Compression test.
3. Torsion test.
5. Deflection test.
6. Impact test.
7. Double shear test.

REFERENCES:

1 ASTM E3 - 01(2007) e1 Standard Guide for Preparation of Metallographic Specimens.

2 ASTM E407 - 07 Standard Practice for Microetching Metals and Alloys.

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

OUTCOME:

- To gain practical exposure in interpretation and analysis of microstructure of various materials.

MEB2105 DRAFTING AND MODELING LAB L T P C

0 0 3 1

OBJECTIVES:

- To familiarize with the codes and specifications of BIS.
- To learn 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

Code of practice for Engineering Drawing, BIS specifications – Welding symbols, riveted joints, keys, fasteners – Reference to hand book for the selection of standard components like bolts, nuts, screws, keys etc.

INTRODUCTION TO DRAFTING SOFTWARE

Drawing, Editing, Dimensioning, Plotting Commands, Layering concepts, Limits, Fits and Tolerances.

PREPARATION OF 2-D DRAWINGS

Orthographic views of standard machine components: Brackets, V Blocks, Stop Block, Screw threads and Threaded fasteners.

ASSEMBLY DRAWING

Shaft Couplings: rigid, flexible

Joints - Cotter joints, knuckle joints, Hook's joints.

Bearings - Journal - Footstep thrust or Collar bearing, Plummer block.

Engine parts - Stuffing box, Connecting rod.

Valves safety valve, relief valve, non-return valve.

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

OUTCOMES:

Students will be able to

- be familiar with codes, standards, limits, fits and tolerances.
- interpret complex drawings of machine parts and assembly.
- generate components and assembly drawings of actual products.

ECB2182	ELECTRONICS & MICROPROCESSOR LAB	L	T	P	C
	(Common to Mechanical & Automobile)	0	0	3	1

OBJECTIVES:

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

NAME OF THE EXPERIMENT

i. VI characteristics of PN Junction Diode
ii. VI characteristics of Zener Diode
iii. Characteristic of CE Transistor
iv. Characteristics of JFET
v. Characteristics of Uni Junction Transistor
vi. Study of Logic Gates (Basic Gates)
vii. Half Adder and Full Adder
viii. Shift Register
ix. Ripple counter
x. bit addition, subtraction
xi. Multiplication and division
xii. Maximum and Minimum of block of data
xiii. Sorting and block transfer
xiv. Stepper Motor Interfacing
xv. Traffic light controller

OBJECTIVES:

Students will be able to

- analyze the characteristics of various electronic devices.
- apply microprocessors and controllers for various operations.

SEMESTER IV

MAB2283	**APPLIED NUMERICAL METHODS**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

OBJECTIVE:

- This course gives a complete procedure to solve problems in engineering numerically, where analytical method fails to give solution.

MODULE I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS **7**

Linear interpolation methods (method of false position) – Newton's method – Statement of Fixed Point Theorem – Fixed point iteration: x=g(x) method – Solution of linear system by Gaussian elimination and Gauss-Jordon methods- Iterative methods: Gauss Jacobi and Gauss-Seidel methods- Inverse of a matrix by Gauss Jordon method – Eigenvalue of a matrix by power method.

MODULE II INTERPOLATION AND APPROXIMATION **7**

Lagrangian Polynomials – Divided differences – Interpolating with a cubic spline – Newton's forward and backward difference formulas.- Relations between operators $(E, \Delta, \mu, \nabla, \nabla)$

MODULE III NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION **8**

Derivatives from difference tables – Divided differences and finite differences –Numerical integration by trapezoidal and Simpson's 1/3 and 3/8 rules – Romberg's method – Two and Three point Gaussian quadrature formulas – Double integrals using trapezoidal and Simpson's rules.

MODULE IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS **8**

Numerical solution of first and second order ordinary differential equations by Taylor series method - Euler Method - Modified Euler's Method - Runge – Kutta Method of order four.

MODULE V NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS 8

Milne's Predictor and Corrector Method – Adam's Predictor-Corrector Method - Finite difference methods for two – point Boundary Value problems for Ordinary Differential Equations.

MODULE VI BOUNDARY VALUE PROBLEMS FOR PARTIAL DIFFERENTIAL EQUATIONS 7

Finite difference solution of one dimensional heat equation by explicit and implicit methods – One dimensional wave equation and two dimensional Laplace and Poisson equations.

Total Hours: 60

TEXT BOOK:

1. M.K.Jain, S.R.K.Iyengar, R.K.Jain, "Numerical methods for Scientific and Engineering Computation", New Age International Publishers, New Delhi, 2003.

REFERENCES:

1. Grewal, B.S., "Numerical methods in Engineering and Science", 7th edition, Khanna Publishers, 2007
2. C.F.Gerald, P.O.Wheatley, "Applied Numerical Analysis" Pearson Education, New Delhi 2002.
3. P. Dechaumphai, N. Wansophark, "Numerical Methods in Engineering", Narosa Publications, 2012.

OUTCOMES:

At the end of the course students will be able to

- solve system of equations and eigen value problem of a matrix numerically.
- use interpolation and find intermediate values for given data.
- find numerical solution of differential equations in engineering problems.

MEB2211	MACHINE COMPONENTS DESIGN	L	T	P	C
	Note: (Use of P S G Design Data Book is permitted in the University examination)	3	1	0	4

OBJECTIVES:

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

MODULE I STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS 12

Introduction to the design process - factors influencing machine design, selection of materials based on mechanical properties -- Preferred numbers, fits and tolerances –Direct, Bending and torsional stress equations – Impact and shock loading – 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– Soderberg, Goodman and Gerber relations.

MODULE II DESIGN OF SHAFTS AND COUPLINGS 12

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

MODULE III DESIGN OF TEMPORARY AND PERMANENT JOINTS 10

Threaded fasteners - Design of bolted joints including eccentric loading, Knuckle joints, Cotter Joints – Design of welded joints, riveted joints for structures - theory of bonded joints.

MODULE IV DESIGN OF ENERGY STORING ELEMENTS 10

Design of various types of springs, optimization of helical springs -- rubber springs -- Design of flywheels considering stresses in rims and arms for engines and punching machines.

MODULE V DESIGN OF BEARINGS **8**

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

MODULE VI DESIGN OF MISCELLANEOUS ELEMENTS **8**

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

Total Hours: 60

TEXT BOOKS:

1. Shigley J.E and Mischke C. R., “Mechanical Engineering Design”, Sixth Edition, Tata McGraw-Hill , 2003.
2. Bhandari V.B, “Design of Machine Elements”, Second Edition, Tata McGraw-Hill Book Co, 2007.

REFERENCES:

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

STANDARDS:

1. IS 10260 : Part 1 : 1982 Terms, definitions and classification of Plain bearings Part 1 Construction.
2. IS 10260 : Part 1 : 1982 Terms, definitions and classification of Plain bearings Part 2 Friction and Wear.
3. 3. IS 10260 : Part 1 : 1982 Terms, definitions and classification of Plain bearings Part 3 Lubrication.

OUTCOMES:

Students will be able to

- be familiar with various design standards.
- design various machine components to suit industrial needs.

MEB2212	KINEMATICS OF MACHINERY	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To understand the layout of linkages in the assembly of mechanisms and machines.
- To study the principles involved in assessing the displacement, velocity and acceleration at any point in a link of a mechanism.
- To analyze the kinematics of machineries such as cam toothed gearing and gear trains.
- To understand the kinematic aspects of friction involved in machineries such as belts, clutches and brakes.

MODULE I BASICS OF MECHANISMS 7

Terminology and Definitions- Description of common Mechanisms-Four Bar Mechanism-Single, double and offset slider mechanisms - Kinematic Inversions of 4-bar and slider crank chains- Ratchets and escapements – Indexing Mechanisms - Rocking Mechanisms - Straight line generators-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 and acceleration 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 (Basicsonly)-Gear trains-Parallel axis gear trains-Epicyclic gear trains-Differentials

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:

Students will be able to

- understand the fundamentals of mechanisms and their applications.
- analyze the kinematic properties of mechanism such as displacement, velocity and acceleration.
- study and analyze machinery such as cams and gears kinematically.
- understand the influence of friction in machines such as belt drives, clutches and brakes.

MEB2213 BASIC MANUFACTURING PROCESSES L T P C

3 0 0 3

OBJECTIVE:

- To introduce the concepts of basic manufacturing processes and fabrication techniques, such as metal casting, metal joining, metal forming and plastics component manufacture.

MODULE I METAL CASTING PROCESSES 8

Sand casting – Sand moulds - Type of patterns – Pattern materials – Pattern allowances – Types of Moulding sand – Properties – Core making – Methods of Sand testing – Moulding machines – Types of moulding machines - Melting furnaces – Working principle of Special casting processes – Shell, investment casting — Lost Wax process – Pressure die casting – Centrifugal casting — Sand Casting defects - Inspection methods.

MODULE II FABRICATION PROCESS 8

Fusion welding processes – Types of Gas welding – Equipment used – Flame characteristics – Filler and Flux materials - Arc welding equipment - Electrodes – Coating and specifications – Principles of Resistance welding – Spot/butt, seam welding – Percusion welding - Gas metal arc welding – Flux cored – Submerged arc welding – Electro slag welding – Tig welding – Principle and application of special welding processes - Plasma arc welding – Thermit welding – Electron beam welding — Flame cutting – Weld defects – Brazing and soldering process — Filler materials and fluxes

MODULE III BULK DEFORMATION PROCESSES 7

Hot working and cold working of metals – Forging processes – Open and close die forging – Characteristics of the process – Types of Forging Machines – Typical forging operations – Rolling of metals – Flat strip rolling – Types of Rolling mills – Shape rolling operations – Tube piercing – Principles of Extrusion – Types of Extrusion – Hot and Cold extrusion – Principle of rod and wire drawing – Equipment used.

MODULE IV SHEET METAL FORMING PROCESSES 7

Sheet metal characteristics - Typical shearing operations, bending and drawing operations – Stretch forming operations — Formability of sheet metal – Test

methods – Working principle and application of special forming processes - Hydro forming – Rubber pad forming – Metal spinning – Explosive forming – Magnetic pulse forming – Peen forming – Super plastic forming – Process characteristics.

MODULE V POWDER METALLURGY 7

Introduction – Methods of powder production – Compaction of metal powders – Equipment – Compaction – Sintering- Secondary and finishing operation – Application – Selective Laser Sintering – Economics of powder metallurgy.

MODULE VI FORMING AND SHAPING OF PLASTICS 8

Types of plastics - Characteristics of the forming and shaping processes – Moulding of Thermoplastics – Working principles and typical applications of - Injection moulding – Plunger and screw machines – Blow moulding – Rotational moulding – Film blowing – Extrusion - Typical industrial applications – Thermoforming – Processing of Thermosets – Working principles and typical applications - Compression moulding – Transfer moulding – Bonding of Thermoplastics – Fusion and solvent methods – Induction and Ultrasonic methods.

Total Hours: 45

REFERENCES:

1 Hajra Choudhury, Elements of Workshop Technology, Vol. I and II, Media Promotors Pvt Ltd., Mumbai, 2007.

2 Serope Kalpajian, 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.

OUTCOMES:

Students will be able to

- gain comprehensive knowledge about different manufacturing processes.
- understand and analyze different fabrication techniques.

MEB2214	FLUID MECHANICS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To introduce the basic concepts of fluid mechanics and properties of the fluids.
- To impart knowledge about the behavior of fluids under static and dynamic conditions.
- To impart knowledge of design and analysis of fluid machineries such as turbines and pumps.

MODULE I BASIC FUNDAMENTAL 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 stream line – Bernoulli's equation – applications- Venturimeter , Orificemeter, Pitot tube

MODULE III DIMENSIONAL ANALYSIS 8

Buckingham's p- Theorem- applications- similiarity laws and models. INTRODUCTION TO CFD: Necessity, limitations, philosophy behind CFD, applications.

MODULE IV 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 – Boundary layer separation – drag and lift coefficients.

MODULE V HYDRAULIC TURBINES 10

Fluid 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 : definition and classifications – Pelton turbine – Francis turbines – propeller turbines – Kaplan turbine – 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 working principle, velocity triangles, specific speed, efficiency and performance curves. Reciprocating pumps: Classification, working principle, indicator diagram, work saved by air vessels and performance curves- cavitation in pumps – rotary pumps: working principles of gear and vane pumps.

Total Hours: 60

REFERENCES:

1 Bansal R.K "Fluid Mechanics and hydraulics Machines", (5th edition), Laxmi Publications (P) Ltd, New Delhi, 1995.

2 Kumar K.L., "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd, New delhi, (7th edition), 1995.

3 Vasandani V.P " Hydraulic Machines – Theory and design ", Khanna Publishers

4 Kumar D S, "Fluid Mechanics and Fluid Power Engineering ", Kataria S K and Sons, New Delhi, 1997.

5 Streeter V.L and Wylie , E.B " Fluid Mechanics ", Mc.Grath- Hill, 1983.

6 White, F.M., Fluid Mechanics", Tata Mc Graw hill, 5th Edition, New Delhi.-2003.

7 John D Anderson, "Computational Fluid Dynamics – The Basics with Applications", McGraw Hill, New Delhi, 1995.

8 Robert W Fox, "Introduction to Fluid Mechanics", Fourth Edition, John Wiley and sons, Singapore, 1994.

OUTCOMES:

Student will be able to

- conceptualize the behavior of fluids and fluid flows.
- recognize the behavior of fluids under static and dynamic conditions.
- apply knowledge in the design and analysis of hydraulic turbines and pumps.

SSB2181	LAW FOR ENGINEERS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To describe the Indian Constitution and Governance of our country.
- To explain human rights, local and International and redressal mechanism.
- To discuss the important aspects of Corporate laws.
- To state the importance of industrial and labour laws of our country.
- To present the laws on contracts and arbitration.
- To state the importance of laws related to intellectual property.

MODULE I INDIAN CONSTITUTION **7**

Constitution – meaning and history – making of constitution – salient features, Preamble, Citizenship, Fundamental rights, Fundamental duties, Equality and social justice, Directive principles, Constitutional amendments.

MODULE II GOVERNANCE AND POWERS VESTED **7**

Union executive, Legislature – Union – State and union territories, Union and state relations, powers vested with parliament and state legislature, emergency provisions - People's Representations Act – Election Commission – Election for parliament and state legislature, Judiciary.

MODULE III HUMAN RIGHTS **7**

Human rights – meaning and significance, International law on human rights, Covenant on civil and political rights; Covenant on Economic, social and cultural rights – protocol, UN mechanism and agencies, watch on human rights and enforcement – role of judiciary and commission, Right to information Act 2005 – evolution – concept – practice.

MODULE IV CORPORATE AND LABOUR LAWS **7**

Corporate laws – meaning and scope – laws relating to companies, Companies Act 1956 – collaboration agreement for Technology transfer, Corporate liability – Civil and criminal – Industrial employment (standing orders) Act 1946, Industrial Disputes Act, 1947, Workmen's Compensation Act 1923, The Factories Act, 1948 – Industry related other specific laws.

MODULE V CONTRACTS AND ARBITRATION 9

Types of contract – standard form of contracts - General principles under Indian Contract Act, 1872 – protection against exploitation – judicial approach to contracts, Arbitration and conciliation – meaning, scope and types, model law, judicial intervention, International commercial arbitration – arbitration agreement, arbitration tribunal – powers and jurisdiction, enforcement and revision, Geneva Convention, Awards, Confidentiality.

MODULE VI LAWS RELATED TO IPR 8

IPR – meaning and scope, International Convention – Berne and Parrys Conventions, International organization – WIPO – TRIPS, Major Indian IPR Acts – Copyright laws, Patent and Design Act, Trademarks Act, Trade Secret Act, Geographical Indicator, Securing of International patents.

Total Hours: 45

REFERENCES:

1. Jain M.P, Indian Constitutional Law, Wadhwa & Co., (2005)
2. Subhash G. & Kashyap, Our Constitution : An introduction to India's Constitution and Constitutional Law, National Book Trust, 3rd edn., India (2001)
3. Agarwal H.D., International Law and Human Rights, Central Law Publications, (2008).
4. Meena Rao, Fundamental Concepts in Law of Contract, 3rd edn., Professional offset, (2006).
5. Ramappa, Intellectual Property Rights Law in India, Asia Law House (2010)
6. Avtar Singh, Company Law, Eastern Book Co., (2007).
7. Rustamji R.F., Introduction to the Law of Industrial Disputes, Asia Publishing House.
8. Acts : Right to Information Act, Industrial Employees (standing order) Act, Factories Act, Workmen Compensate Act.

OUTCOMES:

On successful completion of the course

- students will `be able to apply the basic concepts of Indian Constitution, Governance and power in their real life situation.
- students will have developed knowledge in judiciary, human rights, cultural, social and political rights.
- students will have synthesized knowledge about the corporate and labour laws, contracts, arbitration and laws related to Intellectual Property Rights.

ENB2282	CONFIDENCE BUILDING AND BEHAVIORAL SKILLS (Common to all Branches)	L	T	P	C
		0	0	2	1

OBJECTIVE:

- To enable the students to develop communication skills for verbal communication in the work place.

TOPICS OUTLINE:

This course is practical oriented one and exercises will be given to the students group users /individually depending upon the aspect considered. The following aspect will form the broad outline content of the syllabi. The exercises will be designed by the faculty member and coordinated by the overall course coordinator.

LAB ACTIVITIES:

- Introduction: Soft skills definition, examples
- Verbal communication: Case study, communication and discussion
- Prepared speech
- Impromptu speech
- Debate: Case studies - Attitude and Behavior: role play and exploration
- Ability to ask for help – communication and team work
- Manners and etiquette
- Organization and Planning
- Time keeping
- Conduct in workplace
- Conscientiousness
- Work output
- Professionalism
- Motivation
- Ownership of tasks
- Adaptability/flexibility

ASSESSMENT:

The assessment will be continuous and portfolio based. The students must produce the record of the work done through the course of the semester in the individual classes. The portfolio may consist of a) the individual task outline and activities, b) worked out activities c) Pre-designed sheets which may be provided by the Faculty member. The portfolio will be used by the Faculty member for assessment. The course coordinator in consultation with the course committee shall decide at the beginning of the semester, the number of exercises, method of assessment of each and the weightage for the end semester assessment.

OUTCOMES:

The students should be able to

- develop verbal communication skills.
- debate with other students confidently.
- communicate effectively their ideas.

MEB2215	MECHANICS LAB	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.
2. Motorised Gyroscope-Verification of law's -Determination of gyroscopic couple.
3. Whirling of shaft-Determination of critical speed of shaft with concentrated loads.
4. Balancing of reciprocating masses.
5. Balancing of rotating masses.
6. Determination of Moment of inertia by oscillation method for connecting rod and flywheel.
7. Vibrating system Spring mass-system-Determination of damping co-efficient of single degree of freedom system.
8. Determination of influence co-efficients for multidegree freedom suspension system.
9. Determination of transmissibility ratio - vibrating table.
10. Determination of torsional frequencies for compound pendulum and flywheel –system with lumped Moment of inertia
11. Transverse vibration –free- Beam. Determination of natural frequency and deflection of beam.

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.

MEB2216 MANUFACTURING PROCESSES LAB L T P C

0 0 3 1

OBJECTIVES:

- To study the various mechanisms and tools.
- To practice the various operations of machine tools like lathe, shaper and drilling machines.
- To practice simple sheet metal, moulding and metals forming operations.
- To fabricate simple components through the acquired skill.

LIST OF EXPERIMENTS

LATHE

1. Facing, Plain turning and step turning and Taper Turning
2. Single start V thread and knurling operation.
3. Drilling, Boring and internal thread cutting.

SHAPER

4. Machining V Block and Slotting internal keyway cutting

DRILLING

5. Five holes at a given pitch circle on a plate (Boring center hole, drilling and tapping in five holes)

SHEET METAL

6. Making of tray and funnel from sheet metal

MOULDING

7. Preparation of sand mould of dumble and flange

SMITHY PRACTICES

8. Round to hexagon and making a U bend from a straight rod.

PROJECT WORK

9. Combined Skill (Each team has to make two components.)

OUTCOMES:

The students should be able to

- posses knowledge on basic machining operations.
- satisfy the practical skill required in the core industries.

MEB2217 FLUID MECHANICS AND MACINERY LAB L T P C

0 0 2 1

OBJECTIVES:

- To learn about the various measurements of fluid parameters.
- 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 venturimeter.
2. Calibration of Rota meter.
3. Determination of friction factor 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.

OUTCOMES:

The students should be able to:

- apply the laws of fluid mechanics and measure parameters of fluid flow.
- study and analyze the performance of pumps and turbines.

SEMESTER V

MEB3101	METAL CUTTING AND MACHINE TOOLS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the mechanisms involved in the working of lathe, shaper, planer, milling, drilling, grinding and broaching machines.
- To introduce the basic concepts of (CNC) Computer Numerical Control of Machine tools and CNC Programming.

MODULE I THEORY OF METAL CUTTING 8

Introduction: material removal processes, types of machine tools – theory of metal cutting: chip formation, Types of chips, orthogonal metal cutting, cutting tool materials, tool wear, tool life, surface finish, cutting fluids.

MODULE II CENTRE LATHE AND SPECIAL PURPOSE LATHES 8

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

MODULE III RECIPROCATING AND MILLING MACHINES 8

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 7

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

MODULE VI CNC MACHINE TOOLS AND PART PROGRAMMING 7

Numerical control (NC) machine tools – CNC: types, constructional details, special features - Part programming fundamentals – G codes and M codes, Programming using G codes & M codes, – Computer aided part programming.

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:

The students should be able to

- understand the mechanism involved in various special machine tools.
- write CNC part programmes and be familiar with CNC machines.

MEB3102 TRANSMISSION SYSTEM DESIGN L T P C

3 0 0 3

OBJECTIVES:

- To gain knowledge on the principles and procedure for the design of power transmission components.
- To understand the standard procedure available for Design of Transmission systems.
- To learn to use standard data and catalogues.

MODULE I DESIGN OF BELT AND CHAIN DRIVES 8

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 9

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. 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

- use standard design data and catalogues.
- design different types of power transfer devices.
- design gear box assembly, Cams, brakes etc..

MEB3103 THERMAL ENGINEERING L T P C

3 0 0 3

(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, steam turbines and air compressors.
- To understand the cycles and systems of refrigeration and air conditioning.

MODULE I I.C. ENGINES 8

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 8

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 8

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 7

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 **7**

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 **7**

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.

Total Hours: 45

TEXT BOOK:

- 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

- analyse air standard cycles and performance of I.C engines
- posses the knowledge of compressor, steam nozzle and turbines
- analyze refrigeration and air conditioning cycles and systems.

MEB3104	MACHINE DYNAMICS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To understand the basics of Dynamics of mechanisms and machinery.
- To understand the basics of balancing of moving parts.
- To understand the basics of free and forced vibrations.
- To understand the basics 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.

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 will be able to

- analyze conceptual fundamentals of mechanisms for static and dynamic conditions.
- analyze and solve balancing and vibration problems.
- understand and apply control mechanisms.

GEB3201 ENVIRONMENTAL SCIENCE AND ENGINEERING **L T P C**

(Common for all branches) **3 0 0 3**

OBJECTIVES:

- To explore the salient features and processes that characterise the rocks, soils, water and their interconnectivity with the atmosphere through bioelement cycling
- To rationalise the biological environment at the level of cell, the population, the community, ecosystem and the biome
- To get sensitized with the impacts of human activity on the natural environment and with the methods to conserve it
- To study the impacts of human activity on water and air and to identify the steps to conserve
- To find out an unique solution for the environmental crisis in the developing and developed countries
- To learn about the assessments of the impacts with the help of NGOs and public and to proceed to a sustainable living

MODULE I PHYSICAL ENVIRONMENT **8**

Earth's surface - the Interior of Earth – Plate Tectonics – Composition of the Crust: Rocks – formation and types, Soils – formation and components – soil profile.

Atmosphere – structure and composition – weather and climate – tropospheric airflow

Hydrosphere – water budget – hydrological cycle – Rainwater and precipitation, River Water and solids, Lake Water and stratification, Seawater and solids, soil moisture and groundwater.

Bioelement cycling – The Oxygen cycles – the carbon cycle – the nitrogen cycle – the phosphorous cycle – the sulfur cycle sodium, potassium and magnesium cycles.

MODULE II BIOLOGICAL ENVIRONMENT 7

Cellular basis of life – prokaryotes and eukaryotes – cell respiration – photosynthesis – DNA and RNA – genetically modified life

Population dynamics – population – population growth – survival and growth curves – population regulation – future of human population

Biological communities - Five major interactions: competition, predation, parasitism, mutualism and commensalism – Concepts of habitat and niche – natural selection – species richness and species diversity – ecological succession and climax.

Ecosystem and Biomes – Food Chains and food webs – biomagnifications – ecological pyramids - Trophic levels – Energy flow in ecosystem – ecosystem stability – Terrestrial and aquatic biomes.

MODULE III IMPACTS ON NATURAL RESOURCES AND CONSERVATION 9

Biological resources – nature and importance – direct damage – introduced species – Habitat degradation, loss and fragmentation – Values of biodiversity – hotspots of biodiversity, threats to biodiversity- endangered and endemic species of India- conservation of biodiversity, in-situ and ex-situ conservation

Land Utilization – past patterns of land use – Urban and Industrial development – deforestation, salinisation, soil erosion, and desertification – Modern Agriculture and Impacts

Waste management – types of solid wastes: domestic, municipal, industrial and e-wastes - disposal options – reduce, recovery, reuse – waste minimization, cleaner production technology.

MODULE IV IMPACTS ON WATER AND AIR AND CONSERVATION 8

Water pollution – organic oxygen demanding wastes – anthropogenic phosphate and eutrophication - Ground water contamination – Usage of fertilizer and pesticides– acid rain –acid mine discharges – toxic metals – organochlorines – endocrine disrupting substances- treatment process – Rain water harvesting and watershed management- manmade radionuclide's – thermal pollution

Atmospheric pollution – primary and secondary pollutants – anthropogenic, xenobiotic, synergism, sources and sink, residence time, levels and impacts of major pollutants – processes leading to smog, acid rain, global warming, stratospheric ozone depletion - Noise pollution and abatement.

MODULE V IMPACTS ON ENERGY AND CONSERVATION, ENVIRONMENTAL CRISIS 8

Energy – Renewable and non renewable energy resources – thermal power plants – nuclear fuels, fossil fuels, solar energy, wind energy, wave energy, tidal energy, ocean thermal energy, hydropower, geothermal energy, biomass energy

Environment crisis – state of environment in developed and developing countries- managing environmental challenges for future – disaster management, floods, earthquake, cyclone and landslides.

MODULE VI ENVIRONMENTAL IMPACT ASSESSMENT AND SUSTAINABILITY 5

Environmental Impact Assessment – Impacts: magnitude and significance – steps in EIA – methods – precautionary principle and polluter pays principle – role of NGOs and Public – value education –Environment protection act (air, water, wild life) and forest Conservation act

Concept of Sustainability – Sustainable Development – Gaia Hypothesis - Traditional Knowledge for sustainability.

Total Hours: 45

TEXT BOOKS:

1. Environmental Science (The Natural Environment and Human Impact), Andrew R. W. Jackson and Julie M. Jackson, Pearson Education Limited, Harlow, Essex, England, 2000.
2. Environmental Science (Working with the Earth), G Tyler Miller, Jr., Thomson Brooks/Cole, 2006.

REFERENCES:

1. Physical Geology, Earth Revealed, David McGeary and Charles C Plummer, WCB McGraw Hill, 1998.

2. Sustainability: A Philosophy of Adaptive Ecosystem Management, Bryan G. Norton, 2005.

3. Environmental Impact Assessment, Larry W. Canter, McGraw-Hill, 1996.

4. The Revenge of Gaia: Why the Earth is Fighting Back and How We Can Still Save Humanity, James Lovelock, Penguin UK, 2007.

OUTCOMES:

After the completion of the course the student should be able

- to differentiate the rock and the soil and to recognise the pivotal importance of bioelement cycling
- to examine the biological environment both at the microscopic and biome levels
- to analyse the role played by the urban and industrial development that change the pattern of land use
- to judge the level of air and water pollution
- to discriminate renewable energy from non renewable energy and to discuss about the environmental crisis prevailing
- to assess the human impacts on environment and to appreciate the sustainable living

ENB3181	CAREER BUILDING & PEOPLE SKILLS	L	T	P	C
	(Common to all branches)	0	0	2	1

OBJECTIVE:

- To prepare the students for building their competencies and career building skills.

COURSE OUTLINE:

This course is practical oriented one and exercises will be given to the students group users /individually depending upon the aspect considered. The following aspect will form the broad outline content of the syllabi. The exercises will be designed by the faculty member and coordinated by the overall course coordinator.

LAB ACTIVITIES:

- Preparation for the placement
- Group discussions: Do's and Don'ts – handling of Group discussions – What evaluators look for.
- Interview – awareness of facing questions – Do's and Don'ts of personal interview.
- Selection of appropriate field vis-à-vis personality / interest.
- Preparation of Resume–Objectives, profiles vis-à-vis companies requirement.
- Enabling students to prepare for different procedures / levels to enter into any company – books / websites to help for further preparation.
- Technical interview – how to prepare and face it.
- Workplace skills
- Presentation skills
- Oral presentations
- Technical presentations
- Business presentations
- Interpersonal relationships – with colleagues - clients – understanding one's own behavior – perception by others.

ASSESSMENT:

As the course is practical one, it will be assessed using a portfolio based assessment. The students must in consultation with the Faculty member, plan a portfolio of evidence for the above mentioned activities. The students must develop a résumé or résumés that promote own ability to meet specific job requirements and plan their portfolio in a format appropriate to industry they wish to target. The case studies will contain direct observation of the candidate developing career plans, résumés and skills portfolio, reflect written or oral questioning to assess knowledge and problem-solving activities to assess ability to align career aspirations with realistic career goals. The course coordinator in consultation with the course committee will decide the number of exercises and mark to be awarded for each beside the weightage for the end semester assessment.

OUTCOMES:

The course will help the students to

- develop team work skills.
- take part effectively in various selection procedures followed by the recruiters.

MEB3105	ADVANCED MACHINE TOOL LAB	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To practice advanced machining operations such as milling, grinding and gear hobbing.
- To practice machining of assembly components such as bushes, shafts, bolts and nuts.

INTRODUCTION OF MILLING, GEAR HOBBING AND GRINDING MACHINES

LIST OF EXPERIMENTS

MILLING MACHINES

1. Milling Polygon Surfaces
2. Keyway Milling
3. Grinding / Polishing
4. Surface Grinding
5. Cylindrical Grinding
6. Lapping

MACHINING COMPONENTS FOR ASSEMBLY OF DIFFERENT FITS.

10. Bush and Shaft
11. Bolt and Nut
12. Tongue and Groove
13. Capstan or Turret Lathes
14. Step turning with drilling
15. Gear Machining
16. Gear Hobbing
17. Gear Milling
18. Hexagonal milling

PROJECT WORK

- Combined Skill (Each team has to make a working system.)

OUTCOMES:

The students should be able to

- be familiar with common special machining operations.
- equip with the practical skill required in the core industries.

MEB3106	THERMAL ENGINEERING LAB	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To know the working Principles of IC engines.
- To understand the performance of various engines under different loadings.
- To learn and measure the various heat transactions within and outside the engines.
- To study the properties of fuels and exhaust gases.

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) Redwood Viscometer
   (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 Refrigeration tutor.
12. Experiment on Vapour absorption refrigeration unit.

OUTCOMES:

The students should be able to

- run and analyze the performance and emission of IC engines.
- understand and analyze the working of air compressors and refrigeration and air conditioning systems.

MEB3107	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.

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

SEMESTER VI

MEB3211	**HEAT AND MASS TRANSFER**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

OBJECTIVES:

- To study the different modes of heat transfer and their application in engineering.
- To study and design various types of heat exchangers.
- To learn the basic concepts of mass transfer.

MODULE I BASIC OF HEAT TRANSFER & GOVERNING EQUATIONS 12

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 10

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 10

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 8

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

MODULE V HEAT EXCHANGERS 12

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 **8**

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: 60

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

- conceptualize and apply the different modes of heat transfer to real applications.
- solve the real time problems with the help of HMT data book.
- design heat exchangers to suit specific requirements.

MSB3181	MANAGEMENT OF BUSINESS ORGANISATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To give an exposure to principles of management and organizational structures.
- To introduce concepts of operation and material management.
- To provide an understanding of management of human resources.
- To impart some basic knowledge on marketing, pricing and selling.
- To give an overview of accounting and management of finance.

MODULE I PRINCIPLES OF MANAGEMENT 7

Functions of management - Planning - Organizing - Staffing - Direction - Motivation - Communication - Coordination - Control, organizational structures - Line - Line and staff - Matrix type, functional relationships - Span of control, Management by Objectives (MBO) - Forms of Industrial ownership.

MODULE II OPERATIONS MANAGEMENT 8

Introduction to operations management - Functions of production/operations management - Types of production, Overview of facility location - Lay out planning, introduction to production planning and control, work study, quality assurance, lean manufacturing and six sigma, plant maintenance and management.

MODULE III MATERIALS MANAGEMENT 8

Materials Planning - Types of inventory, Purchasing function - Source selection - Negotiation - Ordering, Stores management - Functions - Types of stores - Overview of inventory control, Introduction to newer concepts: MRP-I – MRPII - ERP - JIT.

MODULE IV HUMAN RESOURCE MANAGEMENT 7

Human Resource Management - Objectives - Role of Human Resource Manager -Manpower planning - Selection and placement - Training – Motivation - Performance assessment - Introduction to grievances handling and labour welfare.

MODULE V MARKETING MANAGEMENT 7

Marketing - Concept and definition - Elements of marketing mix - PLC – Steps in new product development - Pricing objectives and methods – Advertising types/media - Steps in personal selling - Sales promotion methods – Distribution channels: functions, types.

MODULE VI FINANCIAL MANAGEMENT 8

Financial management functions - Introduction to financial accounts, financial performance - Profit and loss account statement - Balance sheet, budgetary control - Meaning - Uses - limitations - Types of costs - Basics of depreciation methods -Break-even analysis - Meaning - Assumption - Uses and limitations, working capital - Meaning and relevance - Use of operating ratios.

Total Hours: 45

REFERENCES:

1. Bhushan Y.K., "Fundamentals of Business Organisation and Management", Sultan Chand & Co., 2003.
2. Banga & Sharma "Industrial Engineering & Management", 11th Edition, Khanna Publications, 2007.
3. Khanna, O.P., "Industrial Engineering & Management", Dhanpat Rai Publications, 2004.
4. S.N.Maheswari "Principles of Management Accounting", 16th Edition, S.Chand & Company Ltd, 2007.

OUTCOMES:

After doing the course,

- the students would have gained basic knowledge of the concepts of management and the functions of management.
- the students would have learnt fundamentals of the functional areas of management viz., operations management, materials management, marketing management, human resources management and financial management.

MEB3212	MECHATRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the interdisciplinary applications of electronics, electrical, mechanical and computer systems for the control of mechanical and electronic systems.
- To impart knowledge on the role of sensors, actuators, control, and machine intelligence in mechanical engineering.
- To gain knowledge on the concepts and techniques involved in mechatronic systems which are widely used in various industries.

MODULE I INTRODUCTION 8

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.

MODULE II PNEUMATIC AND HYDRAULIC SYSTEMS 9

Review of Pneumatic and Hydraulic Systems - Control Valves, Actuators.

Review of Mechanical Actuation Systems – Cams, Gear Trains, Ratchet and pawl, Belt and Chain Drives, Bearings. 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 motors.

MODULE III SYSTEM MODELS 7

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

MODULE IV SYSTEM CONTROLLERS 7

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.

MODULE V PLC SYSTEMS 7

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.

MODULE VI MECHATRONIC SYSTEMS 7

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

Introduction to data acquisition and control systems, virtual instrumentation, interfacing of various sensors and actuators with PC.

Total Hours: 45

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.

8 Nitaigour Premchand Mahadik, “Mechatronics”, Tata McGraw-Hill publishing Company Ltd, 2003.

OUTCOMES:

Students should be able to

- understand and appreciate the use of electronics and computer control system in mechanical engineering.
- utilize sensors and actuation systems in real life applications.
- design simple Mechatronics systems suitable for manufacturing units.

MEB3213	METROLOGY AND MECHANICAL MEASUREMENTS	L T P C 3 0 0 3

OBJECTIVES:

- To measure experimentally various specifications of engineering components.
- To use modern techniques for acquiring data in the measurements parameters such as temperature, vibration, displacement, force, torque etc.
- To train on modern measuring equipment such as CMM, Machine Vision system and surface roughness tester.

MODULE I CONCEPT OF MEASUREMENT 9

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 a dynamic measurement system and its 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. - Error Analysis

MODULE II LINEAR AND ANGULAR MEASUREMENT 7

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.

MODULE III FORM & FINISH MEASUREMENT 8

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.

MODULE IV LASER AND ADVANCES IN METROLOGY 7

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.

MODULE V MEASUREMENT OF POWER, FLOW AND TEMPERATURE RELATED PROPERTIES 7

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 thermister.

MODULE VI SENSORS AND SENSING SYSTEMS FOR PROCESS, SYSTEM & CONDITION MONITORING 7

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

Total Hours: 45

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

- measure various engineering specifications with appropriate instruments.
- be familiar with Acquisition of data for measurements using modern techniques.
- be familiar with Use of modern equipment like CMM, Machine Vision system and surface roughness tester.

MEB3214	HEAT TRANSFER LAB	L	T	P	C
		0	0	2	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

OUTCOME:

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

MEB3215	MECHATRONICS LAB	L T P C
		0 0 3 1

OBJECTIVES:

- To design and test various fluid power circuits.
- To simulate hydraulic, pneumatic and electric circuits using LAB VIEW.
- To impart knowledge on data acquisition system.

LIST OF EXPERIMENTS

1. Interfacing Seven segment displays
2. Electronic circuits using Operational Amplifiers
3. DC motor control using microcontrollers
4. Stepper motor control using microcontrollers
5. Experiments using PID controllers
6. Characteristics of Hall-effect sensor
7. Line following robot and obstacle avoiding robot.
8. Pick and place robot programming
9. Design of circuits with logic sequence using Electro pneumatic trainer kits
10. Simulation of hydraulic and pneumatic circuits using software
11. Electro pneumatic circuits using PLC
12. Modeling and analysis of basic mechanical, electrical, hydraulic and pneumatic systems using LabVIEW
13. Interfacing sensors like strain, LVDT, thermocouple,etc,. for data acquisition using LabVIEW
14. Interfacing DAC for Control application using LabVIEW
15. Experiments using National Instruments ELVIS prototyping platform.
16. Mini project

OUTCOMES:

Students should be able to

- design various fluid power circuits to suit the requirements.
- simulate and analyze hydraulic, pneumatic and electric circuits using LAB VIEW

MEB3216 METROLOGY AND MEASUREMENT LAB L T P C

0 0 3 1

OBJECTIVES:

- To train in carrying out critical dimensional and geometrical measurements on actual components.
- To train on modern measuring equipments such as CMM, Machine vision system and surface roughness tester.
- To train on modern techniques on measuring parameters like temperature, vibration, displacement, force and torque.

LIST OF EXPERIMENTS

1. Calibration and Error analysis of measuring Instruments.
2. Measuring Instrument Fabrication:

   Fabrication of 0.2 mm accurate simple vernier caliper.

   Fabrication of 0.2 mm accurate simple micrometer.

   Fabrication of simple strain gauge load cell etc.
3. Complete all measurements including intricate internal details of the given component using standard equipment and by other measuring procedures (Quick setting compounds, moulds etc.).
4. Setting up of comparators for inspection (Mechanical / Pneumatic / Electrical).
5. Measurement of angle using Sine bar / Sine Center / Toolmakers microscope / Slip gauge.
6. Measurement of taper using standard balls / rollers.
7. Measurement of straightness and flatness.
8. Measurement of thread parameters.
9. Measurement of gear parameters.
10. Measurement of Temperature.
11. Measurement of Displacement, Force and Torque.
12. Measurement of Acoustic Emission.
13. Scanning the surface using Coordinate Measuring Machine (CMM).

14. Measurement using vision system.

15. Mini Project

    Performing various measurements for a reengineering component.

OUTCOMES:

Students should be able to

- carryout measurements as per the design requirements.
- appropriately use modern measuring equipments such as CMM, Machine vision system and surface roughness tester.
- identify and implement suitable measuring system for measuring mechanical parameters.

MEB3217	PRODUCT DESIGN LAB	L	T	P	C
		1	0	3	2

OBJECTIVES:

- To provide the experience of designing a Product in its Totality.
- To understand the interlinking between different courses studied and to gain the experience of applying them in problem solving.

  The student has to choose any one real life product (A list of suggested projects enclosed) and Design it in its totality. The design report (in lieu of observation and record) must consist of

  - o A report on the approach adopted for design, elaborating how the required inputs are obtained to facilitate design and assumptions made
  - o Material selection and design calculations of each part of the Product
  - o Production Drawing of Each Part
  - o Assembly drawing with sectional views to elaborate the intricacies of the product
  - o Bill of Material

SUGGESTED LIST OF PRODUCTS

1. Worm Gear Box of to transmit 10 kW power with reduction ratio of 40
2. Two wheeler Disc Brake System for the Bajaj Pulsar Bike
3. Centrifugal pump to deliver 12,000 liters per hour and 10 m head
4. Reciprocating compressor delivering 6 bar pressure air at a rate of 10 kg/hr
5. Air conditioner of 1 ton capacity

OUTCOMES:

By the end of the course, the students

- should be capable of designing a complete product.
- should have exposure to addressing ill-defined problems.

SEMESTER VII

MEB4101 ENERGY CONVERSION SYSTEMS L T P C

3 0 0 3

OBJECTIVES:

- To impart knowledge on power generation from fossil, renewable and nuclear energy sources.
- To impart knowledge on energy conservation opportunities in various sectors of energy usage, concepts of cogeneration and combined cycle plants.

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

TEXT BOOKS :

1. El- 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

REFERENCES :

1. Arora S.C and Domkundwar S, “A course in Power Plant Engineering”, Dhanpatrai, 2001.
2. Nag P.K, “Power plant Engineering”, Tata McGraw-Hill, 1998.
3. R.K.Rajput, “Power Plant Engineering”, Laxmi Publications, 1995.

OUTCOMES:

Students should be able to

- recognize the construction and working of various power plants.
- implement the concepts of cogeneration and combined cycle plants wherever applicable.
- recognize the need and implement the concepts of energy conservation and waste heat recovery wherever applicable

MEB4102	FINITE ELEMENT METHOD	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To introduce the concept of Mathematical Modeling of Engineering problems.
- To understand the principles involved in discretization and finite element approach.
- To learn to form stiffness matrices and force vectors for simple elements.
- To appreciate the use of FEM to a range of engineering problems.

MODULE I INTRODUCTION 12

Basic Concept, comparison with FDM advantages and disadvantages, history of development, application. Mathematical concepts for FEM – Matrix approach – Application to the continuum – Discretisation – Governing equations for continuum – Variational methods - Weighted residual method – Ritz method.

MODULE II ONE DIMENSIONAL ANALYSIS 8

Finite Element Analysis of 1D Problems - One dimensional second order equations, discretisation, weak formulation, element equations, assembly, boundary conditions, solution of equations- post processing, fourth order equations and their solutions – convergence criteria, examples from solid mechanics, heat transfer.

MODULE III TWO DIMENSIONAL ANALYSIS 10

Element Shape Functions: - Classification of C0, C1 continuous problems- Parameter functions, its properties- completeness and compatibility condition, One-dimensional elements, Global coordinates, Two-dimensional elements, three noded triangular elements and four noded quadrilateral elements.

MODULE IV FEA IN STRUCTURAL ANALYSIS 10

Finite Element Analysis of Plane Elasticity 2D Problems - Introduction to Theory of Elasticity – Plane Stress –Plain Strain and Axisymmeteric Formulation – Principle of virtual work –Element matrices using energy approach. -Triangular, Quadrilateral elements - Simple problems using three noded triangular element only.

MODULE V ISOPARAMETRIC FORMULATION AND NUMERICAL INTEGRATION 12

Natural co-ordinate systems –Lagrangian Interpolation Polynomials-Serendipity Formulation- Difference between Superparametric, Subparametric and Isoparametric Elements, Isoparamatric Elements Formulation, length coordinates– 1D bar elements, C0 continuous shape function, beam elements, C1 continuous shape function - 2D Triangular elements, Rectangular elements. – Area coordinates- Numerical integration – simple Problems using Gauss quadrature Technique.

MODULE VI FEA IN THERMAL ANALYSIS 8

Finite Element Analysis of 2D Steady State Thermal Problems - Green-Gauss Theorem-Element equation formulation – Variational calculus approach-Galerkin approach – General Two-Dimensional Heat Conduction – Axisymmetric Heat conduction -Triangular, Quadrilateral elements - Simple problems using three noded triangular element only.

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

- understand the principles involved in discretization and finite element approach.
- form stiffness matrices and force vectors for simple elements.
- apply the concepts of FEM to a range of engineering problems.

MEB4103 GAS DYNAMICS AND JET PROPULSION L T P C

3 1 0 4

OBJECTIVES:

- To provide an insight into the applications of compressible flows and the fundamentals of jet and space propulsion system.
- To enable the student formulate and solve problems in steady compressible flow in constant and variable area ducts.
- To understand the phenomenon of shock waves and its effect.

MODULE I COMPRESSIBLE FLOW – FUNDAMENTALS 9

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 11

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 11

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 11

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 **9**

Aircraft propulsion- types of jet engines- energy flow through jet engines, study of turbo jet engine components- diffuser, compressor, combustion chamber, turbine and exhaust sytems, performance of turbo jet engines- thrust, thrust power, propulsive and overall efficiencies, thrust augmentation in turbo jet engines, Ram jet and pulse jet engines.

MODULE VI SPACE VEHICLES **9**

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: 60

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”, Tata McGraw –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 RadhaKrishnan. 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 and jet propulsion.
- possess the knowledge of jet engines and space propulsion theories.

MEB4105	FINITE ELEMENT ANALYSIS LAB	L	T	P	C
		0	0	3	1

OBJECTIVE:

- To analyze stress distribution and stress concentration of various components under structural and thermal loads.

STATIC STRUCTURAL ANALYSIS

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

TRANSIENT STRUCTURAL ANALYSIS

4. Analysis of truss structure [2D,3D]
5. Analysis of a Plate with a circular hole [plane stress]
6. Analysis of cylindrical pressure vessel under internal pressure [Plane Strain]
7. Analysis of an thick cylinder [Axisymmetric approach]

MODAL AND HARMONIC ANALYSIS

8. Natural frequencies of a beam with different boundary conditions.
9. Harmonic analysis of a beam.

THERMAL ANALYSIS

10. Analysis of cooling fin [conduction and convection]
11. Thermal stress in a composite pipe.

CONTACT ANALYSIS

12. Contact analysis of pin on disk

OUTCOME:

Student should be able to model and analyze stress distribution and stress concentration of various components under structural and thermal loads.

MEB4106	CNC MACHINE TOOLS LAB	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To practice the various modeling and drafting software.
- To practice the part programming of CNC lathe and milling.
- To familiarize generation of NC code using software.

LIST OF EXPERIMENTS:

CNC LATHE

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

CNC MILL

3. Part programming for Linear and Circular interpolation and Contour motions
4. Part programming involving canned cycles for Drilling, Peck drilling, and Boring. Modelling and machining using CAD/CAM software's
5. NC code generation using CAD/ CAM softwares - Post processing for standard CNC Controls like FANUC, Sinumerik etc.

Designing a product and its tooling.

6. To design a product and its required tooling

   Creation of its model in CAD

   Realizing it in a CNC machine tools

OUTCOMES:

Student should be able to

- generate NC code using software.
- do part programming of CNC lathe and milling.
- design and create the model and simulate CNC machining using software.

MEB4107	AUTOMOBILE ENGINEERING LAB	L	T	P	C
		0	0	3	1

OBJECTIVE:

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

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

OUTCOMES:

Student should be able to

- understand the function of various automobile components.
- dismantle and assemble various components of a vehicle.

ELECTIVE COURSES

DESIGN ELECTIVES

MEBX01 NOISE, VIBRATION AND HARSHNESS **L T P C**

3 0 0 3

OBJECTIVES:

- To impart fundamental knowledge in the area of mechanical vibration and noise.
- To understand the fundamental knowledge on vibrating systems.
- To understand how to model the physical vibrating systems mathematically and the basic behavior of vibration measuring instruments and their industrial applications.
- To understand the fundamental of noise and its control.

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

- understand the basic physics of sound and acoustic parameters.
- model and analyze the vibration systems.
- measure and control Noise and vibrations.

MEBX02	GEOMETRIC MODELLING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the modeling tools, algorithm and primitives.
- To know about the standards of computing and Graphics.

MODULE I BASICS **7**

Mathematics Of Projections, Clipping, Hidden LINE Removal, Output Primitives- Line Drawing Algorithm - Circles And Other Curves, Attributes Of Output - Primitives - 2D, 3D Transformations - Translation, Rotation, Scaling - Concatenation.

MODULE II GEOMETRIC MODELING REQUIREMENTS **8**

geometric models, geometric construction - models, curve representation methods, surface representation methods, modeling facilities desired, Raster scans graphics coordinate system.

MODULE III DRAFTING AND MODELING SYSTEMS **7**

Basic geometric commands, layers, display, control commands, editing, dimensioning, solid modeling, constraint based modeling, - Volume modeling, Boundary models - CSG- other modeling techniques.

MODULE IV MODELING OF CURVES **8**

Representation of curves - Bezier curves - cubic spline curve - B – Spline, curves - Rational curves -Surface Modeling techniques - surface patch, Coons patch- bi-cubic patch - Bezier and B-spline surfaces.

MODULE V MODELING STANDARDS **8**

Graphics and computing standards - GKS - Bitmaps - Open GL Data Exchange standards - IGES - STEP - CALS - DXF – PARASOLID.

MODULE VI APPLICATIONS **7**

Graphical aid for preprocessing in FEA - mesh generation techniques - Post processing - Machining from 3D Model - generative machining.

Total Hours : 45

REFERENCES:

1 Ibrahim Zeid "CAD/CAM - Theory and Practice" - McGraw Hill, International Edition, 1998.

2 Donald Hearn and M. Pauline Baker "Computer Graphics", Prentice Hall, Inc., 1992.

3 Chris McMohan and Jimmi Browne, "CAD/CAM principles, practice and manufacturing management, Pearson Education Asia, Ltd., 2000.

4 CAD / CAM Principles and Applications - 2nd edition, P.N. Rao, Tata Mc Graw Hill.

OUTCOMES:

Students will be able to

- use modeling tools, algorithm and primitives.
- use the standards of computing and Graphics.

MEBX03 DESIGN OF JIGS, FIXTURES AND PRESS TOOLS L T P C

(Use of approved design data book is permitted) 3 0 0 3

OBJECTIVES:

- To understand the functions and design principles of Jigs, fixtures and press tools.
- To gain proficiency in the development of the final design.

MODULE I PURPOSE TYPES, FUNCTIONS OF JIGS AND FIXTURES 5

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

MODULE II CLAMPS AND TOLERANCE 3

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 10

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 **9**

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.

OUTCOME:

Students will be able to apply the functions and design principles of Jigs, fixtures and press tools.

MEBX04 MODERN CONCEPTS IN ENGINEERING DESIGN L T P C

(Common to Mechanical and Aeronautical Engineering) 3 0 0 3

OBJECTIVES:

- To understand the importance of product design.
- To understand the conceptual design and design selection.
- To make students familiar with legal issues such as liability and intellectual property.

MODULE I INTRODUCTION TO PRODUCT DEVELOPMENT 7

Introduction to Engineering design - Design as the core engineering activity – Products and Processes –Product Design Methodology – Modern product development process - Concept of Concurrent Engineering – Team Building – Challenges and utilization of emerging technologies.

MODULE II OPPORTUNITY TO ANALYSIS 7

Product Life Cycle- Design by innovation and design by revolution – Journey of new product development - Understanding the opportunity - Product vision –Market opportunity analysis - Customer need analysis – Voice of the Customer – Product specifications - Technical Specifications - Competitive analysis - Product development planning.

MODULE III ASCERTAINMENT OF PRODUCT FUNCTIONS 7

Establishing product function – Functional decomposition - Concept of Reverse engineering - Product Teardown – Competitive benchmarking - Functional Modeling and Analysis – Creating function structure - Establishing engineering specifications.

MODULE IV CONCEPT DEVELOPMENT 8

Concept Engineering – Concept generation – Sources of concepts – Concept development phases - Concept screening and evaluation – Concept testing - Portfolio Planning - Product Architecture and Development – Human Factors in design - Impact of industrial design – Industrial design process.

MODULE V CONCEPT IMPLEMENTATION 7

Implementation of concept - Embodiment engineering - Physical and Analytical

modeling – Material Considerations – Geometrical dimensioning and tolerances - Design for Strength – Design for X - Manufacturing and Assembly - Prototyping.

MODULE VI ROBUSTNESS AND EXPLORATION OF DESIGN 7

House of Quality and QFD - Robust design - Toy design – Design of engineering systems - Automotive sub systems design - Electronic Product Design – Software Design – Product development economics – Patents and Intellectual property

Total Hours: 45

REFERENCES:

1 Kevin.otto, Kristin wood, “Product design”, (2nd edition), Pearson education, New Delhi 2004.

2 Karl.Ulrich and Steven Eppinger, Product Design and Development, (3rd edition) New York-McGraw Hill, 2004. ISBN:9780072471465.

3 D G Ullman, The Mechanical Design Process, McGraw Hill 1997.

4 George E.Dieter, “Engineering design”, 3rd edition, McGraw Hill international edition, 2000.

5 G.Pahl, and W. Beitz, Engineering Design – A Systematic Approach, Springer-Verlag, 1996.

OUTCOMES:

Students will be able to

- analyze the life cycle of Products.
- conceptualize the design requirements and perform product design.
- be familiar with legal issues such as liability and intellectual property.

MEBX05	ADVANCED STRENGTH OF MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the stress strain relations and location of shear centers.
- To understand the stresses in plates, rotary sections and contacts.
- To understand torsional stresses in thin walled tubes.

MODULE I ELASTICITY **8**

Stress-Strain relations and general equations of elasticity in Cartesian, Polar and spherical coordinates, 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.

MODULE II SHEAR CENTRE **7**

Shear Centre – Location of shear centre for various sections –shear flows.

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 TORSION OF NON-CIRCULAR SECTIONS **8**

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

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

- identify the shear centers for different sections.
- calculate the bending stress of complex unsymmetrical sections.
- perform failure analysis of engineering components.

MEBX06 COMPOSITE MATERIALS FOR MANUFACTURE

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the fundamentals of mechanics and manufacturing methods of composites.
- To study and analyze the behavior of 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 behaviour 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

- familiar with the mechanics and manufacturing methods of different types of composites.
- analyze the behavior of composite materials.

MEBX07	NANOTECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the basics of Nano technology and Nano science.
- To Understand Nano fabrication and inspection.
- To study the applications of Nano materials.

MODULE I NANOMATERIAL CLASSES AND FUNDAMENTALS 7

Classification of Nanomaterials– size effects-surface to volume ratio- surface curvature-strain confinement –quantum effects.

MODULE II PROPERTIES OF NANOMATERIALS 8

Mechanical properties-Thermal-electrical-mechanical-optical-acoustic properties-study of carbon Nanotubes and Nano Composites.

MODULE III SYNTHESIS AND CHARACTERIZATION 7

Methods for making 0D,1D,2D and 3D Nanomaterial -Top down process-Intermediate process-Bottom up process-Nano profiling-Characterization of Nanomaterial.

MODULE IV PRODUCTION OF NANOMATERIAL 8

Methods of production-Mechanical alloying-Sol-gel, Electro deposition,Inert gas condensation.

MODULE V INSPECTION OF NANOMATERIAL 8

Electron Microscopy, X- ray Diffraction-Scanning Probe Microscopy-contact mode-tapping mode- Atomic Force Microscopy-Scanning Tunnel Microscopy-Nano Indentation.

MODULE VI APPLICATION OF NANOMATERIAL 7

Nano coatings-Nano films-self cleaning and easy cleaning materials-self healing materials-smart materials-Nano drugs and its delivery-Nano Tribology -Molecular Nanomachines.

Total Hours: 45

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

- fabricate and inspect nonmaterial.
- use nonmaterial for industrial and other applications.

MEBX08 DESIGN OF HYDRAULICS AND PNEUMATICS **L T P C**

3 0 0 3

OBJECTIVES:

- To learn the advantages and applications of fluid power engineering and power transmission system.
- To learn the applications of fluid power system in automation of machine tools and others equipment.

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, 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", Tata McGraw Hill, Fourth Reprint 2003.
4. Majumdar, S.R., "Pneumatic Systems – Principles and Maintenance", Tata McGraw Hill, 2007.
5. Dudelyt, A Pease and John J Pippenger, "Basic Fluid Power", Prentice Hall, 1987.

OUTCOME:

- Students will be able to design pneumatic and hydraulic circuits for industrial automation.

MEBX09 MICRO ELECTRO MECHANICAL SYSTEMS (MEMS) **L T P C 3 0 0 3**

OBJECTIVE:

- To understand the design and fabrication of Micro Electro Mechanical Systems (MEMS).

MODULE I INTRODUCTION TO MEMS **8**

MEMS and Microsystems, Miniaturization, Typical products, Micro sensors, Micro actuation, MEMS with micro actuators, Microaccelorometers and Micro fluidics.

MODULE II MECHANICS FOR MEMS DESIGN **7**

Elasticity, Stress, strain and material properties, Bending of thin plates, Spring configurations, torsional deflection, Mechanical vibration, Resonance, Thermo mechanics – actuators, force and response time, Fracture and thin film mechanics.

MODULE III ELECTRO STATIC DESIGN **7**

Electrostatics: basic theory, electro static instability. Surface tension, gap and finger pull up, Electro static actuators, Comb generators, gap closers, inchworms, Electromagnetic actuators, Bistable actuators.

MODULE IV CIRCUIT AND SYSTEM ISSUES **7**

Electronic Interfaces, Feed back systems, Noise, Circuit and system issues, Case studies – Capacitive accelerometer, Peizo electric pressure sensor.

MODULE V INTRODUCTION TO OPTICAL AND RF MEMS **8**

Optical MEMS, - System design basics – Gaussian optics, matrix operations, resolution. Case studies, Digital Micro mirror devices. RF MEMS – design basics, case study – Capacitive RF MEMS switch, performance issues.

MODULE VI MEMS DESIGN AND FABRICATION **8**

MEMS materials, rotary motors, Micro fabrication, Modeling of MEMS systems, CAD for MEMS. MEMS scanners and retinal scanning display.

Total Hours: 45

TEXTBOOK:

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.

OUTCOME:

- Students will be able to design and fabricate Micro Electro Mechanical Systems for the real time applications.

MANUFACTURING ELECTIVES

MEBX10	MODERN MANUFACTURING SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To understand the concepts and applications of flexible manufacturing systems.

MODULE I PLANNING, SCHEDULING AND CONTROL OF FLEXIBLE MANUFACTURING SYSTEMS 7

Introduction to FMS– development of manufacturing systems – benefits – major elements – types of flexibility – FMS application and flexibility –single product, single batch, n – batch scheduling problem – knowledge based scheduling system.

MODULE II COMPUTER CONTROL AND SOFTWARE 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 – limitation – manufacturing data systems–data flow–FMS database systems–planning for FMS database.

MODULE IV GROUP TECHNOLOGY AND FMS 8

Introduction – matrix formulation – mathematical programming formulation – graph formulation – knowledge based system for group technology – 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 etc,.

MODULE VI FUTURE SCOPE OF FIRMS BY FMS 7

FMS development towards factories of the future – artificial intelligence and expert systems in FMS – design philosophy and characteristics forfuture.

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. Raouf, A. and Ben-Daya, M., Editors, "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. Taiichi Ohno, "Toyota production system: beyond large-scale production", Productivity Press (India) Pvt. Ltd. 1992.

OUTCOME:

- Students will be able to implement FMS in the modernization of manufacturing systems.

MEBX11	RELIABILTY ENGINEERING AND MAINTENANCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To stress the importance of reliability in engineering and products.
- To understand the concept of maintability, failure modes and testing methods.
- To study the maintenance strategies in different types of industries.

MODULE I CONCEPTS OF RELIABILITY, SYSTEM AND MODELS 8

Definition of reliability – reliability Vs quality – reliability function – derivation of the reliability function -MTTF – hazard rate function – constant failure rate model – time dependent failure models – Weibull distribution – Types of system – series, parallel, series parallel, stand by and complex – methods of reliability evaluation¬ – matrix methods, event trees and fault trees methods – reliability evaluation using probability distributions – Markov method – frequency and duration method.

MODULE II DESIGN FOR RELIABILITY AND MAINTAINABILITY 8

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 – OC curves.

MODULE III MAINTENANCE CONCEPT 7

Need for maintenance – Maintenance definition – Maintenance objectives – Challenges of Maintenance management – Tero technology – Scope of maintenance department – Maintenance costs.

MODULE IV MAINTENANCE MODELS 7

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 V MAINTENANCE QUALITY 7

Maintenance excellence –Five Zero concept –FMECA –Root cause analysis – System effectiveness – Design for maintainability – Maintainability allocation – CMMS – Reliability Centered Maintenance.

MODULE VI TOTAL PRODUCTIVE MAINTENANCE 8

TPM features – Chronic and sporadic losses – Equipment defects – Six major losses – Overall Equipment Effectiveness – TPM pillars –TPM implementation – Autonomous maintenance.

Total Hours: 45

REFERENCES:

1. Patrick D T o'connor, "Practical Reliability Engineering", John-Wiley and Sons inc, 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.

OUTCOME:

- Students should be able to effectively implement reliability concepts and maintenance strategies in different types of industries.

MEBX12 PROCESS PLANNING AND COST ESTIMATION

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the concepts of work study and ergonomics.
- To know about the elements of cost, estimation and costing.
- To study and analyze 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-Breakeven analysis

MODULE II WORK STUDY AND ERGONOMICS **9**

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 **7**

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, Labour cost- Determination of Direct Labour 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 COST ESTIMATION IN FORGING AND CASTING SHOPS **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.

MODULE VI COST ESTIMATION IN WELDINGSHOPS 6

Estimation in welding shop-Gas cutting- Electric welding- illustrative examples

Total Hours: 45

REFERENCES:

1. Nanusa Singh, “System approach to coputer Integrated Design and Manufacturing” John Wiley & Sons, Inc., 1996.
2. Joseph G. Monks, “Operations Management, Theory & Problems”, McGraw Hill Book Company, 1982.
3. G.B.S. Narang and V. Kumar, “Production and costing “, Khanna Publishers, 1995.

OUTCOMES:

Students will be able to

- effectively implement process planning concepts.
- implement the concepts of work study and ergonomics in manufacturing.
- estimate cost in different manufacturing units.

MEBX13 PRODUCTION PLANNING AND CONTROL

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the overall decision framework associated with production Planning & Control.
- To learn method study and time study to avoid unwanted movements.
- To study the concepts of scheduling and line balancing.

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; 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 **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 89 computer integrated production planning systems-elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP.

Total Hours: 45

REFERENCES:

1 Plossl, G W Production and Inventory Control: Principles and Techniques, Second Edition, Engle wood Cliffs, NJ, Prentice Hall of India, 1985.

2 Samson Eilon, “Elements of production planning and control”, Universal Book Corpn.1984.

3 Elwood S.Buffa, and Rakesh K.Sarin, “Modern Production / Operations Management”, 8th Ed. John Wiley and Sons, 2000.

4 Melynk, Denzler, “Operations management – A value driven approach” Irwin Mcgrawhill.

5 Norman Gaither, G. Frazier, “ operations management” Thomson learning 9th edition IE, 2007

OUTCOMES:

Students should be able to

- plan the product and processes effectively.
- conduct method study and time study to improve processes.
- implement the concepts of scheduling and line balancing in manufacturing.
- analyze and control inventory.

MEBX14	STATISTICS AND QUALITY CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the various statistical approaches for Quality control.
- To understand the various principles, practices of quality management.
- To understand the various tools for continuous process control and improvement.

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

REFERENCE:

1. Montgomery, Douglas C. (2009). Introduction to Statistical Quality Control, Sixth Edition. John Wiley and Sons, Inc. (ISBN: 978 -0-470-16992-6).

OUTCOMES:

Students should be able to

- apply statistical tools and techniques for quality improvement.
- achieve process control and improvement.

MEXBX15	INDUSTRIAL MARKETING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the concepts of industrial marketing.
- To make the students understand tactical marketing aspects.
- To learn the strategies pertaining to 4Ps of marketing and the emerging trends in industrial marketing.

MODULE I INTRODUCTION 6

Marketing: Definition and Concepts - Marketing Process - Marketing mix - Industrial marketing: Definition, concepts, significance - Classification of Industrial products - Types of Industrial Customers - Characteristics of industrial markets - Nature of Industrial buying

MODULE II INDUSTRIAL BUYER BEHAVIOUR 8

Analysis of micro and macro environment of industrial markets - Nature of Industrial buying - Understanding industrial buying behavior - Buygrid model: Buying situations, phases and strategies - Buying centre - Webster and Wind model - Sheth model

MODULE III INDUSTRIAL MARKETING RESEARCH AND S-T-P STRATEGIES 8

Industrial Marketing research process - Demand forecasting - Marketing Information system - Industrial market Segmentation: Bases, Macro and Micro variables - Target marketing - Industrial Product differentiation strategies - Industrial product positioning.

MODULE IV INDUSTRIAL PRODUCT AND PRICING STRATEGIES 8

Industrial Product life cycle analysis and strategies - New industrial product development - Product line decisions - Packaging and labelling - Industrial product pricing: Factors, Pricing strategies and policies - Commercial terms and conditions in industrial markets

MODULE V INDUSTRIAL DISTRIBUTION AND PROMOTION DECISIONS 10

Distribution Channel for industrial products: Functions, Characteristics, forms, selection - Basic concepts of Supply chain management - Logistics: Warehouse Location and functions, Modes of Physical distribution and Transportation - Promotion Mix for industrial products: Personal selling process - Sales Training - Advertising media for industrial products - Industrial Sales promotion methods and strategies - Publicity for industrial products

MODULE VI RECENT TRENDS IN INDUSTRIAL MARKETING 5

Impact of Information technology on marketing decisions in manufacturing industries - E-Business and Online marketing - Web based marketing programmes - Understanding on-line buying behavior - Building industrial customer relationships - Emerging new trends in industrial marketing and challenges to marketers

Total Hours: 45

REFERENCES:

1. Krishna K. Havaldar, “Industrial Marketing,” Tata Mc Graw 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.
- Apply the strategies for Segmentation, Targeting and Positioning of industrial products in manufacturing industries.

MEBX16 ROBOTICS AND AUTOMATION L T P C

3 0 0 3

OBJECTIVES:

- To learn the basic concepts, parts of robots and types of robots.
- To understand with the various drive systems for robot, sensors and their applications.

MODULE I INTRODUCTION 7

Robot – Definition – Robot Anatomy – Co ordinate 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.

MODULE II DRIVES AND CONTROL 7

Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of all these Drives. End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

MODULE III SENSORS 7

Requirements of a sensor, principles and application of Contact and Non-Contact Sensors. Slip Sensor Camera, Frame Grabber, Sensing and Digitizing Image Data - Signal Conversion, Image Storage, Lighting Techniques. Image Processing and Analysis - Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms. Applications - Inspection, Identification, Visual Serving, Navigation.

MODULE IV ROBOT ANALYSIS 9

Homogeneous Transformation equation – DH representation - Forward kinematics, Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of manipulators with Three Degrees of Freedom, Six Degrees of freedom – Deviations and problems, calculation of jacobian matrix and determining singularity in robotic systems. Static force analysis of robots,

Dynamic analysis of robots using Euler-Lagrangian mechanics for single, two DOF robots.

MODULE V ROBOT PROGRAMMING AND CONTROL 8

Lead Through Programming, Robot Programming Languages – VAL programming – Motion Commands, Sensor Commands, End Effecter commands and simple programs. Trajectory planning – joint space, Cartesian space description and trajectory planning – third order, fifth order - Polynomial based trajectory planning.

MODULE VI APPLICATIONS AND ECONOMY 7

Implementation of Robots in Industries, Industrial application for material handling, machine loading and unloading, assembly, inspection, etc –Various Steps; Safety considerations for Robot Operations; Economic Analysis of Robots – Pay back method, EUAC Method, Rate of Return Method.

Total Hours: 45

REFERENCES:

1 M.P.Groover, “Industrial Robotics – Technology, Programming and Applications”, McGraw Hill, 2001.

2 Robert J schiling, " Fundamentals of Robotics: Analysis and Control" 1st edition, PHI Learning, 2009.

3 John j. Craig, "Introduction to Robotics:Mechanics and Control" 3rd edition, Pearson Education, 2008.

4 Fu, K.S.Gonzaiz R.C., and Lee C.S.G., “Robotics Control, Sensing, Vision and Intelligence”, McGraw Hill Book Co., 1987.

5 Janakiraman, P.A., “Robotics and Image Processing”, Tata McGraw Hill, 1995.

6 S.R.Deb”Robotics Technology and Flexible Automation” Tata McGraw Hill Book Co., 1994.

OUTCOMES:

Students should be able to

- decide the drives, controls and sensors for robotic applications.
- design and implement robotics in industries

MEBX17	ENTREPRENEURIAL DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the concepts of Entrepreneurship.
- To develop skills such as observation, evaluation, communication, Resource mobilization & management, risk assessment, team building.
- To create a multiplier effect on opportunities for self-employment.

MODULE I INTRODUCTION **7**

Entrepreneurship concept – Individual skills - Self assessment – Self Confidence – Self Control-Trust Worthiness- Empathy – Team Skills - Building Bonds –Team capability – Leadership- Collaborative and Cooperative approach

MODULE II BUSINESS FACTORS AND REGULATIONS **8**

Business Environment – Internal factors - Entrepreneurship Development Training and Sources of finance mobilization – External factors - Central and State Government Industrial Policies and Regulations –Taxes - Global Business

MODULE III BUSINESS REQUIIREMENTS **7**

Market Survey and Research - Feasibility Study – Sources and Criteria of Product - Preparation and Evaluation of report – Finance and Accounting – Capital Budgeting.

MODULE IV PRODUCT LAUNCH **8**

Finance and Human Resource Mobilization Operations Planning - Market and Channel Selection - Life cycle of product - Growth Strategies - - Product Launch

MODULE V MONITORING AND EVALUATION **8**

Monitoring and Evaluation of Business - Preventing Sickness and Rehabilitation of Business Units. Business Promotion - Merger and acquisition of sick industries

MODULE VI ENTREPRENEURSHIP AND VENTURE CAPITAL **7**

Family and Non Family Entrepreneur: Role of Professionals, Professionalism

vs family entrepreneurs, Role of Woman entrepreneur. Venture capital, Nature and Overview, Venture capital process, locating venture capitalists.

Total Hours: 45

REFERENCES:

1. Hisrich, 'Entrepreneurship', Tata McGraw Hill, New Delhi, 2006.
2. S.S.Khanka, 'Entrepreneurial Development', S.Chand and Company Limited, New Delhi, 2001.
3. P. Saravanavel, 'Entrepreneurial Development', Ess Pee kay Publishing House, Chennai -1997.
4. Prasama Chandra, 'Projects – 'Planning, Analysis, Selection, Implementation and Reviews', Tata McGraw-Hill Publishing Company Limited 1996.
5. P.C. Jain (ed.), 'Handbook for New Entrepreneurs', EDII, Oxford University Press, New Delhi, 1999.
6. Staff College for Technical Education, Manila and Centre for Research and Industrial Staff Performance, Bhopal, 'Entrepreneurship Development', Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1998.
7. Rabindra N. Kanungo, "Entrepreneurship and Innovation", Sage Publications, New Delhi, 1998.
8. EDII, "Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development", Institute of India, Ahmadabad, 1986.
9. Daniel Goleman, "Working with Emotional Intelligence" Bantam publishers, 2000.

OUTCOMES:

Students should be able to

- develop leadership qualities, business ethics and positive value system.
- acquire all the requirements of entrepreneurship to lead a business successfully.

MEBX18 MODERN PRODUCTION MANAGEMENT L T P C

3 0 0 3

OBJECTIVE:

- To learn the various aspects of Production Management.

MODULE I FACILITY, CAPACITY AND LAYOUT PLANNING 7

Facility planning - factors affecting selection of plant location, plant design, plant layout, criteria for good layout. Capacity planning- analysis of designed capacity, installed capacity, commissioned capacity, utilized capacity, factors affecting productivity. Facility layout planning – Assignment model, load distance analysis, closeness ratings.

MODULE II DEMAND FORECASTING AND PROJECT MANAGEMENT 8

Demand forecasting – Quantitative and qualitative techniques, measurement of forecasting errors, numerical problems. Project management – its role in functional areas of management, network diagrams, CPM and PERT techniques, crashing, resource levelling and resource smoothing – types of production – functions production economics – cost in manufacturing – breakeven analysis – transfer mechanism-buffer storages –analysis of transfer lines – line unbalancing Concepts – management of automated assembly systems

MODULE III PRODUCTION PLANNING AND 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 IV ENTERPRISE RESOURCE PLANNING 8

Principle – ERP framework - Value chain – Supply and Demand chain – Extended supply chain management – Dynamic Models – Process Models - Technology and Architecture - Client/Server architecture - ERP System Packages - Integration of ERP and Internet – ERP Implementation strategies - ERP Procurement Issues.

MODULE V INVENTORY PLANNING AND CONTROL 7

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.

MODULE VI MAINTENANCE SYSTEM AND MANAGEMENT 7

Maintenance strategies and planning – quantitative analysis, optimal number of machines/crew size, Replacement strategies and policies – economic service life, opportunity cost, replacement analysis using specific time period, spares management – TPM.

Total Hours – 45

REFERENCES:

1. Elwood.S.Buffa, “Modern Production and Operations management”. 8th edition, John Wiley & Sons, 2007.
2. S.N.Chary, “Production and Operations management”, 3rd edition, SIE, TMH2007.
3. R.Pannererselvam, “Production and operations management”, 2nd edition PHI, 2008.
4. James.B.Dilworth, “Operations management-Design, planning and control for manufacturing and services”, Mc.Graw hill ,Inc Management series 1992.
5. Melnyk.Denzler, “Operations management-A value drive approach”, Irwin Mcgrawhill 1996.
6. Lee.J.Krajewski, L.P.Ritzman, M.K.Malhothra, “Operations management – Process and value chains” -8th edition,PHI,2007.
7. R.B.Chase, N.J.Aquilano, F.R.Jacobs, “Operations management – for competitive advantage” , 11th edition SIE, TMH 2007.
8. Mohamed Zairi - "Total Quality Management for Engineers" - Woodhead Publications,1991.

OUTCOME:

- Students will be able to effectively manage various production systems.

MEBX19 ADVANCED OPTIMISATION TECHNIQUES L T P C

3 0 0 3

OBJECTIVE:

- To study the techniques required for the optimization of various resources and systems.

MODULE I INTRODUCTION 8

Optimization – Historical Development – Engineering applications of optimization – Statement of an Optimization problem – classification of optimization problems

MODULE II CLASSIC OPTIMIZATION TECHNIQUES 8

Linear programming - Graphical method – simplex method – dual simplex method – revised simplex method – duality in LP – Parametric Linear programming – Goal Programming.

MODULE III NON-LINEAR PROGRAMMING 8

Introduction – Lagrangeon Method – Kuhn-Tucker conditions – Quadratic programming – Separable programming – Stochastic programming – Geometric programming

MODULE IV INTEGER PROGRAMMING 8

Integer programming - Cutting plane algorithm, Branch and bound technique, Zero-one implicit enumeration –

MODULE V DYNAMIC PROGRAMMING AND NET WORKING 8

Dynamic Programming – Formulation, Various applications using Dynamic Programming. Network Techniques – Shortest Path Model – Minimum Spanning Tree Problem – Maximal flow problem.

MODULE VI ADVANCES IN SIMULATION 5

Genetic algorithms – simulated annealing – Neural Network and Fuzzy.

Total Hours: 45

REFERENCES:

1. R. Panneerselvam, “Operations Research”, Prentice Hall of India Private Limited, New Delhi 1 – 2005.
2. P.K. Guptha and Man-Mohan, Problems in Operations Research – Sultan chand & Sons, 1994.
3. Ravindran, Philips and Solberg, Operations Research Principles and Practice, John Wiley & Sons, Singapore, 1992.
4. J.K.Sharma, Operations Research – Theory and Applications – Macmillan India Ltd., 1997.
5. Hamdy A. Taha, Operations Research – An Introduction, Prentice Hall of India, 1997.

OUTCOME:

- Students will be able to apply the various techniques to optimize manufacturing systems and resources.

MEBX20	ADVANCED PRODUCTION PROCESSES FOR AUTOMOTIVE COMPONENTS	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To understand the various manufacturing processes of automobile components.

MODULE I POWDER METALLURGY **7**

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.

MODULE II METAL FORMING **8**

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 **8**

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.

MODULE IV METAL COATING **7**

Chemical Vapour Deposition and Physical Vapour Deposition in ball bearings. Spraying, plating and painting in paint booth for automobile body.

MODULE V GEAR MANUFACTURING **7**

Gear milling, Hobbing and shaping - Gear finishing of automobile gears and inspection.

MODULE VI SPECIAL MANUFACTURING PROCESSES 8

Powder injection moulding - Shotpeen hardening of gears - Production of aluminium MMC liners for engine blocks - Plasma spray coated engine blocks and valves - Recent developments in auto body panel forming - Squeeze casting of pistons - aluminimum composite brake rotors.

Total Hours: 45

REFERENCES:

1 Heldt.P.M., " High Speed Combustion Engines ", Oxford Publishing Co., New York, 1990

2 Haslehurst.S.E., " Manufacturing Technology ", ELBS, London, 1990.

3 Rusinoff, “Forging and Forming of metals ", D.B. Taraporevala 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.

OUTCOME:

- Student should be able to identify and apply the appropriate process to manufacture the automobile components.

MEBX21 PLANT LAYOUT AND MATERIAL HANDLING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn the different types of plant layout, essential requirements and safety aspects.
- To study the need and use of appropriate equipment for effective material handling.

MODULE I PRODUCT LAYOUT **7**

Selection of plant locations, territorial parameters, considerations of land, water, electricity, location for waste treatment and disposal, further expansions Safe location of chemical storages, LPG, LNG, CNG, acetylene, ammonia, chlorine, explosives and propellants

MODULE II PROCESS LAYOUT **8**

Safe layout for process industries, engineering industry, construction sites, pharmaceuticals, pesticides, fertilizers, refineries, food processing, nuclear power stations, thermal power stations, metal powders manufacturing, fireworks 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 III LAYOUT REQUIREMENTS **7**

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 IV LAYOUT SAFETY **8**

Preventing common injuries, lifting by hand, team lifting and carrying, handling specific shape machines and other heavy objects – accessories for manual handling, hand tools, jacks, hand trucks, dollies and wheel barrows – storage of specific materials - problems with hazardous materials, liquids, solids –

storage and handling of cryogenic liquids - shipping and receiving, stock picking, dock boards, machine and tools, steel strapping and sacking, glass and nails, pitch and glue, boxes and cartons and car loading – personal protection – ergonomic considerations.

MODULE V MATERIAL HANDLING 8

Fiber rope, types, strength and working load inspection, rope in use, rope in storage - wire rope, construction, design factors, deterioration causes, sheaves and drums, 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, signals, operating rules, maintenance safety rules, inspection and inspection checklist – conveyors, precautions, types, applications.

MODULE VI MATERIAL HANDLING EQUIPMENT 7

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: 45

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 house keeping”, 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 layout for manufacturing considering safety.
- Select and use appropriate material handling equipment.

MEBX22 INDUSTRIAL SAFETY ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVE:

- To learn various safety Hazards and safety measures in industries.

MODULE I SAFETY SYSTEMS ANALYSIS **7**

Definitions, safety systems; safety information system: basic concept, safety cost / benefit analysis; industrial safety engineering, OSHA regulations.

MODULE II HAZARD ANALYSIS **7**

General hazard analysis: electrical, physical and chemical hazard, detailed hazard analysis. Cost effectiveness in hazard elimination. Logical analysis: map method, tabular method, fault tree analysis and hazop studies.

MODULE III FIRE PROTECTION SYSTEM **8**

Chemistry of fire, water sprinkler, fire hydrant, alarm and detection system. Suppression system: CO2 system, foam system, Dry Chemical Powder (DCP) system, halon system, portable extinguisher

MODULE IV SAFETY IN MACHINE OPERATION **8**

Design for safety; lock out system, work permit system, safety in use of power press, cranes. Safety in foundry, forging, welding, hot working and cold working, electroplating and boiler operation

MODULE V SAFETY IN MATERIAL HANDLING **9**

General safety consideration in material handling - Ropes, Chains, Sling, Hoops, Clamps, Arresting gears –Prime movers. Ergonomic consideration in material handling, design, installation, operation and maintenance of conveying equipment, hoisting, traveling and slewing mechanisms

MODULE VI SAFETY AND LAW **5**

Provisions in factory act for safety, explosive act, workmen compensation act, compensation calculation. Boiler act and pollution control act.

Total Hours: 45

REFERENCES:

1 John Ridley, “Safety at Work”, Butter Worth Publisher, Oxford, 1997.

2 Heinrich H W, “Industrial Accident Prevention”, National Safety Council, Chicago, 1998.

3 “Personal Protective Equipment”, National Safety Council, Bombay, 1998.

4 “Accident Prevention Manual for Industrial Operations”, National Safety Council, Chicago, 1995.

5 Derek James, “Fire Prevention Handbook”, Butter Worth & Co., Oxford, 1991

6 Dan Peterson, “Techniques of Safety Management”, 1990.

OUTCOME:

- Students will be able to identify safety hazards and implement appropriate safety measures.

MEBX23 OPERATIONS RESEARCH & SYSTEM ANALYSIS **L T P C**

3 0 0 3

OBJECTIVES:

- To acquire knowledge and training in optimization techniques.
- To get awareness about optimization in utilization of resources.
- To understand and apply operations research techniques to industrial operations.
- To introduce the advanced OR models and to apply them for Engineering problems.

MODULE I LINEAR PROGRAMMING PROBLEM **9**

Linear programming- formulation of the problem- Simplex method, graphical method, Big M method, Dual simplex method, two phase method.

MODULE II TRANSPORTATION PROBLEM & ASSIGNMENT PROBLEM **8**

Transportation models- Initial Basic feasible solutions, MODI method, Unbalance in transportation, Degeneracy in transportation models. Assignment Problem- Minimization and Maximizations type of problems by Hungarian method.

MODULE III NETWORK ANALYSIS AND SEQUENCING PROBLEMS **8**

PERT and CPM – Network diagram- Probability of achieving completion date - Crash time – Cost analysis. Sequencing N jobs through 2 machines and 3 machines

MODULE IV QUEUING THEORY & INVENTORY CONTROL **8**

Queuing theory- Poisson arrivals and exponential service times – characteristics of Queuing models- single channel and multi channel models. Inventory Control- Deterministic Inventory models & Probabilistic demand models.

MODULE V REPLACEMENT MODELS AND GAME THEORY **7**

Replacement models- Replacement of items that deteriorate with time- value of money changing with time- not changing with time- Individual and group replacement policy. Game theory – simple games.

MODULE VI ANALYSIS & SIMULATION **5**

System Analysis & Simulation- Types of system, elements of system, system analysis, steps involved in system analysis and system design.- simulation basic concepts , advantages and dis advantages- random number generation- Monte carlo simulation.

Total Hours: 45

TEXT BOOK :

1. Taha H.A. Operations Research,Pearson Education, ,sixth Edition, 2003.

REFERENCES :

1. Hira and Gupta, Problems in Operations Research, S.Chand and co.2002.
2. Panneerselvam, Operations Research Prentice Hall of India, 2003.

OUTCOME:

- The students should be able to apply optimization techniques for solving engineering problems.

MEBX24 REFRIGERATION AND AIR CONDITIONING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the principles of refrigeration and air conditioning.
- To learn the principles of psychrometry, cooling and heating load calculations.
- To acquire knowledge of system components of 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”,Tata Mcgraw-Hill New Delhi,1988.

3 Roy.J.Dosaat, “Principles of Refrigeration”,PearsonEducation 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 McGraw Hill, 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.

OUTCOME:

- Student will be able to design refrigeration and air conditioning systems and solve the related issues.

MEBX25	ADVANCED I.C. ENGINES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To acquire an overview about various systems in I C engines.
- To study the combustion process in I C engines.
- To learn about automobile emissions, use of alternate fuels and the recent developments.

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- Monopoint, Multipoint injection - MPFI- Types of Nozzles.

MODULE II COMBUSTION IN I.C. ENGINES 8

combustion phenomena S.I Engine– Normal and abnormal combustion - Factor 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

- understand the various systems of IC engines.
- realize the ill effects of automobile emissions and the use of alternate fuels.

MEBX26	NUCLEAR ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of nuclear physics.
- To learn about nuclear reactions and reaction materials and their reprocessing and disposel.
- To study about various reactors.

MODULE I NUCLEAR PHYSICS 7

Nuclear model of an atom-Equivalence of mass and energy-binding- radio activity-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 of fast breeding reactors-heat transfer techniques in nuclear reactors- reactor shielding. 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 - refinng - 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

TEXT BOOKS :

1. Thomas J.Cannoly, “Fundamentals of nuclear Engineering” John Wiley 1978.

REFERENCES :

1. Collier J.G., and Hewitt G.F, “Introduction to Nuclear power”, Hemisphere publishing, New York. 1987.
2. Wakil M.M.El., “Power Plant Technology” – McGraw-Hill International, 1984.
3. S. Glasstone and A. Sesonske, “Nuclear Reactor Engineering: Reactor Design Basics”, Vol. 1, Ed. 4, Chapman and Hall, London, 1994.
4. 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

- understand the basic concepts of nuclear physics.
- be familiar with different types of nuclear reactions and reactors.
- be aware of fuel reprocessing and disposal of nuclear wastes.

MEBX27 ENERGY CONSERVATION AND MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the basic need for energy conservation and waste heat recovery.
- To gain knowledge on the energy conservation opportunities in various sectors of energy usage.
- To learn the important aspects of energy audit and management.

MODULE I CONCEPTS **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, pay back period, internal rate of return, life cycle costing – energy conservation systems analysis for safety, health and pollution.

Total Hours: 45

TEXT BOOK:

1. S.S. Rao and Parulekar, " Energy Technology"

REFERENCE BOOKS:

1. Archie, W Culp. "Principles of Energy Conservation", McGraw Hill, 1991.
2. Wayne C Turner, "Energy Management Handbook", The Fairmount Press.
3. D Patrick and S W Fardo, "Energy Management and Conservation", PHI,1990
4. P. O'Callaghan: "Energy Management", McGraw - Hill Book Company, 1993.
5. Kenney, W. F., " Energy Conservation in Process Industries", Academic Press, 1983.
6. Tyagi A. K, "Handbook of energy audits and management", TERI.
7. PCRA Booklets.

OUTCOMES:

The student should be able to

- recognize the need and implement the various aspects of energy conservation.
- recognize the scope and implement the concept of waste heat recovery in thermal systems.
- identify the potential to implement energy conservation in industry, transport and other sectors.
- acquire the knowledge and skills requirement of an energy manager.

MEBX28 COMPUTATIONAL FLOW AND HEAT TRANSFER

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn the Governing Equations of viscous fluid flows.
- To study numerical modeling and its role in the field of fluid flow and heat transfer.
- To understand the various discretization methods, solution procedures and turbulence modeling.

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-?) 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”, Tata McGraw 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., “Computationsl Fluid Flow and Heat Transfer”, Narosa Publishing House, NewDelhi, 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.
- solve complex problems in the field of fluid flow and heat transfer.

MEBX29 RENEWABLE SOURCES OF ENERGY L T P C
3 0 0 3

OBJECTIVES:

- To know the Global and National energy scenario of renewable energy resources.
- To study harnessing of energy from various 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-CO2 emmisions 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) – thermoelectric 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.

OUTCOME:

- Students should be able recognize the significance of renewable energy and its harnessing.

MEBX30	SOLAR ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the working and performance of various solar collectors.
- To learn about solar photovoltaic principle and usage.
- To learn about the applications and 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), Paraboloid dish 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

- select suitable solar device for a particular application.
- use solar energy effectively and economically.

MEBX31 DESIGN OF THERMAL SYSTEMS L T P C

3 0 0 3

OBJECTIVES:

- To understand the working and performance of heat transfer equipment.
- To learn design of thermal systems for effective and efficient heat transfer.

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

- be familiar with functions, characteristics and performance of various thermal systems.
- design a heat exchanger for any specific application.

MEBX32 FUELS AND COMBUSTION L T P C
3 0 0 3

OBJECTIVES:

- To learn the characteristics, types and utility of solid, liquid and gaseous fuels.
- To understand the combustion phenomenon of different fuels and equipment for their combustion.

MODULE I FUEL CHARACTERIZATION 7

Fuels - Types and Characteristics of Fuels - Determination of Properties of Fuels – Fuels Analysis - Proximate and Ultimate Analysis - Moisture Determination - Calorific Value – Gross & Net Calorific Values - Calorimetry - DuLong's Formula for CV Estimation – Flue gas Analysis - Orsat Apparatus - Fuel & Ash Storage & Handling - Spontaneous Ignition Temperatures.

MODULE II SOLID FUELS 8

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.

MODULE III LIQUID FUELS 7

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 - Liquefaction of Solid Fuels.

MODULE IV 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 V COMBUSTION STOICHIOMETRY & KINETICS 8

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

MODULE VI COMBUSTION EQUIPMENT 7

Coal Burning Equipment - Types - Pulverized Coal Firing - Fluidized Bed Firing – Fixed Bed & Recycled Bed - Cyclone Firing - Spreader Stokers - Vibrating Grate Stokers - Sprinkler Stokers, Traveling Grate Stokers. Oil Burners - Vaporizing Burners, Atomizing Burners - Design of Burners. Gas Burners - Atmospheric Gas Burners - Air Aspiration Gas Burners – Burners Classification according to Flame Structures - Factors Affecting Burners & Combustion.

Total Hours: 45

REFERENCES:

1 Bhatt, Vora Stoichiometry, 2nd Edition, Tata Mcgraw Hill, 1984.

2 Fuels And Combustion (3rd Edition), Samir Sarkar,Orient BlackSwan.

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 fuels.
- calculate the air – fuel ratio for different fuels under different types of combustion.
- select suitable combustion equipment for different fuels based on nature of combustion.

MEBX33 AUTOMOBILE ENGINEERING L T P C

3 0 0 3

OBJECTIVES:

- To provide a comprehensive view of automobile engineering.
- To provide an overview about different systems in an automobile.
- To impart knowledge on recent 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 of rear 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 suspension 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 McGraw Hill 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,13th edition

5 Advanced Vehicle Technology, Heinz Heisler, Elsevier Ltd, (Second Edition)

OUTCOMES:

Student should be able to

- be familiar with different systems of an automobile.
- be aware of the recent developments in automobile engineering.

GENERAL ELECTIVES

GEBX01	**DISASTER MANAGEMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To give an exposure to various environmental hazards and disasters: and various concepts and principles to manage disaster.
- To give exposure to various environmental policies & programs in India for disaster management.

MODULE I ENVIRONMENTAL HAZARDS **7**

Environmental hazards, Environmental Disasters and Environmental stress-Meaning and concepts. Vulnerability and disaster preparedness.

MODULE II NATURAL DISASTERS **7**

Natural hazards and Disasters - Volcanic Eruption, Earthquakes, Tsunamis, Landslides, Cyclones, Lightning, Hailstorms, Floods, Droughts, Cold waves, Heat waves and Fire.

MODULE III MAN-MADE DISASTERS **7**

Man induced hazards & Disasters - Soil Erosion, Chemical hazards, Population Explosion.

MODULE IV DISASTER MANAGEMENT **8**

Emerging approaches in Disaster Management- Preparing hazard zonation maps, Predictability / forecasting & warning, Preparing disaster preparedness plan, Land use zoning, Communication. Disaster resistant house construction, Population reduction in vulnerable areas, Awareness - Rescue training for search & operation at national & regional level - Immediate relief, Assessment surveys, Political, Administrative, Social, Economic, Environmental Aspects.

MODULE V NATURAL DISASTER REDUCTION & MANAGEMENT **8**

Provision of Immediate relief measures to disaster affected people, Prediction of Hazards & Disasters, Measures of adjustment to natural hazards.

MODULE VI ENVIRONMENTAL POLICIES & PROGRAMMES IN INDIA 8

Regional survey of Land Subsidence, Coastal Disaster, Cyclonic Disaster & Disaster in Hills with particular reference to India. Ecological planning for sustainability & sustainable development in India, Sustainable rural development: A Remedy to Disasters, Role of Panchayats in Disaster mitigations, Environmental policies & programmes in India- Institutions & National Centers for Natural Disaster reduction, Environmental Legislations in India, Awareness, Conservation Movement, Education & training.

Total Hours: 45

REFERENCES:

1. Satender, "Disaster Management in Hills", Concept Publishing Co., New Delhi, 2003.
2. Singh, R.B. (Ed.), "Environmental Geography", Heritage Publishers, New Delhi,1990.
3. Savinder Singh, "Environmental Geography", Prayag Pustak Bhawan,1997.
4. Kates, B.I. and White, G.F., "The Environment as Hazards", Oxford University Press, New York, 1978.
5. Gupta, H.K., (Ed), "Disaster Management", University Press, India, 2003.
6. Singh, R.B.,"Space Technology for Disaster Mitigation in India (INCED)", University of Tokyo, 1994.
7. Bhandani, R.K., "An overview on Natural & Manmade Disaster & their Reduction", IIPA Publication, CSIR, New Delhi, 1994.
8. Gupta, M.C., "Manuals on Natural Disaster management in India", National Centre for Disaster Management, IIPA Publication, New Delhi, 2001.

OUTCOMES:

At the end of the course, the students will

- achieve sufficient knowledge on the disaster prevention strategy, early warning system, disaster preparedness, response and human resource development.
- be familiar with the National Policy on Disaster Management.

GEBX02	NANO TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the basic concepts of Nanoscience relevant to the field of engineering.
- To provide an exposure about the importance of various synthesis method.
- To enrich the knowledge of students in various characterisation techniques.

MODULE I INTRODUCTION & CLASSIFICATION OF NANOMATERIALS 9

Definition - Origin of nanotechnology - Difference between bulk and nanomaterials- Top-down and bottom-up processes - Size dependent properties (magnetic, electronic,transport and optical), Classification based on dimensional property - 0D, 1D, 2D and 3D nanostructures – Kubo gap.

MODULE II TYPES OF NANOMATERIALS 9

Metal oxides and metal nano particles - Ceramic nano particles - Semi conducting quantum dots - Core-shell quantum dots - Nanocomposites - Micellar nanoparticles.

MODULE III PRODUCTION OF NANOPARTICLES 7

Sol-gel, hydrothermal, solvothermal, Plasma Arcing, Electro deposition, RF sputtering, Pulsed laser deposition, Chemical vapour, deposition.

MODULE IV CARBON BASED NANOMATERIALS 6

Carbon nanotubes: Single wall nanotubes (SWNT), Multiwall nanotubes (MWNT) - structures-carbon nanofibre, Fullerenes-Application of carbon nanotubes and Fullerenes.

MODULE V NANOPHOTONICS 7

Light and nanotechnology, Interaction of light and nanotechnology, Nanoholes and photons, nanoparticles and nanostructures; Nanostructured polymers, Photonic Crystals, Solar cells.

MODULE VI CHARACTERISATION TECHNIQUES 7

Basic principles of scanning Electron Microscopy (SEM), Atomic force

microscopy (AFM), Scanning tunneling microscopy (STM), Scanning probe microscopy (SPM) and Transmission electron microscopy (TEM), Particle size analyzer, Luminescence techniques.

Total Hours: 45

TEXTBOOKS:

1. Hari Singh Nalwa, “Handbook of Nanostructured Materials and Nanotechnology”, Academic Press, 2000.
2. Guozhong Cao, “Nanostructures and Nano materials-Synthesis, Properties and Applications”, Imperial College Press (2011).
3. Zhong Lin Wang, “Handbook of Nanophase and Nanomaterials (Vol 1 and II)”, Springer, 2002.
4. Mick Wilson, Kamali Kannangara, Geoff smith, “Nanotechnology: Basic Science and Emerging Technologies”, Overseas press, 2005.

REFERENCES:

1. A. Nabok, “Organic and Inorganic Nanostructures”, Artech House, 2005.
2. C.Dupas, P.Houdy, M.Lahmani, Nanoscience: “Nanotechnologies and Nanophysics”, Springer-Verlag Berlin Heidelberg, 2007.
3. Mick Wilson, Kamali Kannangara, Michells Simmons and Burkhard Raguse, “Nano Technology – Basic Science and Emerging Technologies”, 1st Edition, Overseas Press, New Delhi,2005.
4. M.S. Ramachandra Rao, Shubra SinghH, “Nanoscience and Nanotechnology: Fundamentals to Frontiers”, Wiley, 2013.

OUTCOMES:

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

- Apply the knowledge of different types of nanomaterials for various engineering applications.
- Acquire the knowledge of various methods of production of nanomaterials.
- Familiarize with various characterization techniques.

GEBX03	CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the system modeling and to derive their transfer function.
- To provide adequate knowledge of time response of systems and steady state error analysis.
- To accord basic knowledge in obtaining the open loop and closed–loop frequency responses of Control systems.

MODULE I BASIC CONCEPTS AND SYSTEM REPRESENTATION 8

Control System - Basic elements in control systems – Open and closed loop systems – Electrical analogy of mechanical and thermal systems – Transfer function – Block diagram reduction techniques – Signal flow graphs.

MODULE II TIME RESPONSE ANALYSIS AND DESIGN 8

Time response – Time domain specifications – Types of test input – First and Second order system - Type I and Type II System – Response - Error coefficients – Generalized error series – Steady state error – P, PI, PID modes of feedback control.

MODULE III FREQUENCY RESPONSE ANALYSIS AND DESIGN 7

Performance specifications - correlation to time domain specifications - bode plots and polar plots – gain and phase margin – constant M and N circles and Nichols chart – all pass and non-minimum phase systems.

MODULE IV STABILITY 8

Characteristics equation – Location of roots in s plane for stability – Routh Hurwitz criterion – Root locus construction – Effect of pole, zero addition – Gain margin and phase margin – Nyquist stability criterion.

MODULE V COMPENSATOR DESIGN 8

Performance criteria – Lag, lead and lag-lead networks – Compensator design using bode plots and root locus technique.

MODULE VI CONTROL SYSTEM COMPONENTS AND APPLICATION OF CONTROL SYSTEMS **6**

Synchros – AC servomotors - DC Servo motors - Stepper motors - AC Tacho generator - DC Tacho generator - Typical applications of control system in industry.

Total Hours : 45

REFERENCES:

1. K. Ogata, "Modern Control Engineering", 4th Edition, Pearson Education, New Delhi, 2003.
2. I.J. Nagrath & M. Gopal, "Control Systems Engineering", New Age International Publishers, 2003.
3. C.J.Chesmond, "Basic Control System Technology", Viva student edition, 1998.
4. I.J.Nagarath and M.Gopal, "Control System Engineering", Wiley Eastern Ltd., Reprint, 1995.
5. R.C.Dorf and R.H.Bishop, "Modern Control Systems", Addison-Wesley (MATLAB Reference), 1995.

OUTCOMES:

At the end of the course, the student is expected to possess knowledge and achieve skills on the following:

- proper understanding of basics of Control Systems.
- ability and skill to carry-out time domain and frequency domain analysis.
- capable of determining stability of the system using Routh Hurwitz criterion, Root locus and Nyquist criterion.
- ability to design lag, lead and lag lead compensator networks.

GEBX04	GREEN DESIGN AND SUSTAINABILITY	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To impart knowledge to face challenges, the technology poses for water, energy, and climate change by implementing sustainable design.

MODULE I CONCEPTS OF SUSTAINABLE DEVELOPMENT 7

Objectives of Sustainable Development - Need for sustainable development- Environment and development linkages - Globalisation and environment- Population, poverty and pollution- global, regional and local environment issues-Green house gases and climate change.

MODULE II SUSTAINABLE DEVELOPMENT OF SOCIO ECONOMIC SYSTEMS 8

Demographic dynamics of sustainability- Policies for socio economic development- Sustainable Development through trade- Economic growth- Action Plan for implementing sustainable development- Sustainable Energy and Agriculture.

MODULE III FRAME WORK FOR ACHIEVING SUSTAINBAILITY 7

Sustainability indicators- Hurdles to sustainability- Business and Industry – Science and Technology for Sustainable Development- Performance indicators of sustainability and assessment mechanism- Constraints and barriers of Sustainable Development.

MODULE IV GREEN BUILDINGS 8

Introduction to Green Building- Energy- Water- Materials and Resources - Sustainable Sites and Land Use - Indoor Environmental Quality- Life Cycle Assessment- Energy, water and materials efficiency.

MODULE V ENERGY CONSERVATION AND EFFICIENCY 7

Energy savings- Energy Audit- Requirements- Benefits of Energy conservation- Energy conservation measures for buildings- Energy wastage- impact to the environment.

MODULE VI GREEN BUILDINGS DESIGN **8**

Elements of Green Buildings Design- Foundation, Electrical, Plumbing, flooring, Decking, roofing, insulation, wall coverings, windows, siding, doors and finishing, LEED certification for Green Buildings, Green Buildings for sustainability.

Total Hours: 45

TEXT BOOK:

1. Kirby, J., Okeefe, P., and Timber lake, “Sustainable Development”, Earthscan Publication, London, 1995.

REFERENCE:

1. Charles Kibert, J., “Sustainable Construction: Green Building Design and Delivery”, 2nd Edition, John Wiley and sons, 2007.

OUTCOMES:

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

- explain the relationship between sustainability and emergence of green building practices.
- address the economic, environmental, and social concerns.

GEBX05	KNOWLEDGE MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course

- Focuses on positioning knowledge as a valuable commodity, embedded in products and in the tacit knowledge of highly mobile individual employees.
- Presents KM as a deliberate and systematic approach to cultivating and sharing an organization's knowledge base.
- Brings out the paradigm in terms of information technology and intellectual capital.

MODULE I KNOWLEDGE MANAGEMENT 6

KM Myths – KM Life Cycle – Understanding Knowledge – Knowledge, intelligence – Experience – Common Sense – Cognition and KM – Types of Knowledge – History of Knowledge Management - From Physical assets to Knowledge Assets – Expert knowledge – Human Thinking and Learning.

MODULE II KNOWLEDGE MANAGEMENT SYSTEMS AND MODELS 9

Challenges in Building KM Systems – Conventional Vs KM System Life Cycle (KMSLS) – Knowledge Creation and Knowledge Architecture – KM cycle - Different variants of KM cycle - KM models - Implications and practical implementations.

MODULE III CAPTURING KNOWLEDGE AND SHARING 9

Tacit knowledge capture - Explicit knowledge codification - Knowledge taxonomies - Knowledge sharing - Communities - Obstacles to knowledge capture and sharing.

MODULE IV KNOWLEDGE MANAGEMENT TOOLS 9

KM System tools – Neural Network – Association Rules – Classification Trees – Data Mining and Business Intelligence – Knowledge capture and creation tools - Content creation tools - Data mining and knowledge discovery - Content management tools - Knowledge sharing and dissemination tools - Group ware and Collaboration tools - Intelligent filtering tools.

MODULE V KNOWLEDGE APPLICATION **6**

KM at individual level - Knowledge workers - Task analysis and modeling - Knowledge application at group and organizational levels - Knowledge repositories - Knowledge reuse -Case study: e-learning.

MODULE VI VALUE OF KNOWLEDGE MANAGEMENT **6**

KM return on investment and metrics - Benchmarking method - Balanced scorecard method - House of quality method - Results based assessment method - Measuring success - Future challenges for KM.

Total Hours:45

TEXT BOOKS:

1. Elias M. Awad, Hassan M. Ghaziri, “Knowledge Management”, Prentice Hall, 2nd Edition, 2010.
2. Jay Liebowitz, “Handbooks on Knowledge Management”, 2nd Edition, 2012.
3. Irma Becerra-Fernandez, Rajiv Sabherwal, ”Knowledge Management: Systems and Processes”, 2010.

OUTCOMES:

Students who complete this course will be able to

- describe the fundamental concepts in the study of knowledge and its creation, acquisition, representation, dissemination, use and re-use, and management.
- explains the core concepts, methods, techniques, and tools for computer support of knowledge management.
- critically evaluate current trends in knowledge management and apply it for e-learning

GEBX06 APPROPRIATE TECHNOLOGY L T P C

3 0 0 3

OBJECTIVE:

- To impart students knowledge about the basics and applications of various appropriate technologies in the field of civil engineering.

MODULE I BASICS CONCEPTS 9

Back ground, Tools, Choices and Implications, Appropriate Technology Movement (an overview) - Basic design process, basic financial analysis-discounted cash flow, and energy fundamentals.

MODULE II APPROPRIATE TECHNOLOGY WITH REFERENCE TO BUILDING DESIGN 9

Appropriate Building Materials, Appropriate Energy Saving Techniques, Water Conservation (Indoor), Rain Water Harvesting.

MODULE III WATER, HEALTH AND SANITATION MANAGEMENT 9

Water Storage: Designing Dams and Pipelines, Appropriate Selection for Sanitation Technique, Sewerage, Communal Health and Waste Water Recycling.

MODULE IV WASTE MANAGEMENT 9

Types of Waste - Sources - Collections and On-Site Processing -Transferring Stations - Disposal Systems - Recycling.

MODULE V ENERGY EFFICIENT TECHNIQUES 9

Green building concepts-renewable energy sources- Solar – Steam and wind-Biofuels - Biogas – Electricity.

MODULE VI TECHNOLOGY POLICY 9

Government Policies- Energy Policy-Appropriate technology Development Centre-its function and responsibilities-Building policies-Case Studies.

Total Hours: 45

TEXT BOOKS:

1. Barrett Hazeltine and Christopher Bull, “Appropriate Technology: Tools Choices and Implications”, Academic Press, Orlando, USA, 1998.

2. Ken Darrow and Mike Saxenian, “Appropriate Technology Source Book : A Guide to Practical Books for Village and Small Community Technology”, Stanford, 1986.

REFERENCES:

1. Richard Heeks, “Technology and Developing Countries: Practical Applications Theoretical Issues”, 1995.

2. John Pickford, “The Worth of Water : Technical Briefs on Health, Water and Sanitation”, Intermediate Technology Publications, 1998.

OUTCOME:

- At the end of the course, the students will be able to use suitable technologies for various conditions for sustainable development.

GEBX07 SYSTEM ANALYSIS AND DESIGN L T P C

3 0 0 3

OBJECTIVES:

- To understand the basic principles of systems engineering
- To understand the systems engineering methodology
- To provide a systems viewpoint

MODULE I INTERDICTION TO SYSTEMS ENGINEERING 8

Concept of Systems Engineering – Origin – Systems Approach – Advantages of systems approach – Examples.

The building blocks of modern systems – Systems and environment – Interfaces – Complexity of Modern Systems.

MODULE II SYSTEM DEVELOPMENT PROCESS AND MANAGEMENT 8

System life cycle – the systems engineering method – Role of Testing – Management of system development – Risk Management – Organisation.

MODULE III CONCEPT DEVELOPMENT 8

Need Analysis – Concept Exploration – Performance requirement and validation - Concept selection and validation – systems architecture – Decision making.

MODULE IV ESTABLISHING ENGINEERING SYSTEMS 8

Risk Analysis – Risk Mitigation –System performance Analysis – Simulation Techniques in System Analysis – Validation Methods..

MODULE V DECISION SUPPORT TOOLS IN SYSTEMS ENGINEERING 7

Analytical decision support – Statistical influences on system design – System performance analysis – System Reliability, Availability and Maintainability (RAM) – Analysis of Alternatives.

MODULE VI CASE STUDIES **6**

Case studies in Software Systems Engineering – Systems for Product Design - Manufacturing Systems.

Total Hours: 45

REFERENCES:

1. Charles S. Wasson, “System Analysis, Design, and Development: Concepts, Principles, and Practices”, Wiley Series in Systems Engineering and Management, 2006.
2. Kossiakoff Alexander and William N. Sweet A, “Systems Engineering: Principles And Practice”, Wiley Student Edition, 2009.

OUTCOMES:

At the end of the course the student will have the

- ability to have systems of view of problems and issues at hand.
- ability to comprehend systems in their totality and specific.
- ability to design, build and evaluate simple systems for industrial requirement.
- ability to analyze systems and strengthen them for performance enhancement.

GEBX08 VALUE ANALYSIS AND ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To get acquainted with value analysis and engineering tool for productivity improvement.
- To understand and analyze the theory and methodology of Value Engineering.

MODULE I VALUE ENGINEERING BASICS **8**

Origin of Value Engineering, Meaning of value, Definition of Value Engineering and Value analysis, Difference between Value analysis and Value Engineering, Types of Value, function - Basic and Secondary functions, concept of cost and worth, creativity In Value Engineering.

MODULE II VALUE ENGINEERING JOB PLAN AND PROCESS **6**

Seven phases of job plan, FAST Diagram as Value Engineering Tool, Behavioural and organizational aspects of Value Engineering, Ten principles of Value analysis, Benefits of Value Engineering.

MODULE III ORIENTATION AND INFORMATION PHASES **8**

Launching Value Engineering project work - Objectives and Targets - VE Project work: a time-bound programme - Projects and Teams - Time Schedule - Co-ordination - Consultant. Technical data - Marketing related information - Competition profile - Cost data - Materials Management related information - Quality related information - Manufacturing data.

MODULE IV FUNCTION ANALYSIS AND CREATIVE PHASES **9**

Objectives - Function definition - Classification of functions - Higher level functions – Function – Cost – Function – Worth - Value Gap - Value index - How to carry out Function Analysis? – Fast Diagraming - Cost Modelling.

Creativity - How to improve creativity of an individual? – How to promote creativity in the organisation? - Obstacles to Creativity - Mental road blocks - Creativity killer phrases. Positive thinking - Ideas stimulators - Creativity techniques - Brainstorming.

MODULE V EVALUATION, INVESTIGATION AND RECOMMENDATION 6

Paired comparison and Evaluation Matrix techniques - Criteria for selection of VE solutions. Design – Materials – Quality – Marketing – Manufacturing - Preview session. The report - presentation.

MODULE VI IMPLEMENTATION PHASE AND CASE STUDIES 8

Design department - Materials department - Production Planning & Control - Quality Control – Manufacturing – Marketing - Need for co-ordinated teams - The Action Plan. Value Engineering case studies.

Total Hours: 45

TEXTBOOKS:

1. Mudge, Arthur E. “Value Engineering- A systematic approach”, McGraw Hill, New York, 2000.
2. Kumar S, Singh R K and Jha J K (Ed), “Value Engineering”, Narosa Publishing House, 2005.

REFERENCES:

1. Park RJ, “Value Engineering: A Plan for Invention”, St.Lucie Press, New York, 1999.
2. Lawrence, D.M., “Techniques of Value Analysis and Engineering”, McGraw Hill 1988.
3. George, E.D., “Engineering Design: a Material and Processing Approach”, McGraw Hill, 1991.
4. Heller, D.E., “Value Management, Value Engineering and Cost Reduction”, Addison Wesley, 1988.

OUTCOME:

- The student will be able to realize the value of products, processes and implement value analysis to achieve productivity improvement.

GEBX09 OPTIMIZATION TECHNIQUES L T P C

3 0 0 3

OBJECTIVES:

- Introduce methods of optimization to engineering students, including linear programming, network flow algorithms, integer programming, interior point methods, quadratic programming, nonlinear programming, and heuristic methods.
- The goal is to maintain a balance between theory, numerical computation, problem setup for solution by optimization techniques, and applications to engineering systems.

MODULE I INTRODUCTION 7

Overview of Optimization techniques for Civil Engineering Problems - Introduction to methods of optimization - Classification of Optimization problems - optimality and convexity - General optimization algorithm - necessary and sufficient conditions for optimality.

MODULE II LINEAR PROGRAMMING 8

Introduction to linear programming - a geometric perspective - Standard form in linear programming; basic solutions; fundamental theorem of linear programming - Simplex Algorithm for Solving Linear Programs - Duality; complementary slackness; economic interpretation of the dual;

MODULE III DYNAMIC PROGRAMMING 8

Sequential optimization; Representation of multistage decision process; Types of multistage decision problems; Concept of sub optimization and the principle of optimality; Recursive equations – Forward and backward recursions; Computational procedure in dynamic programming (DP); Discrete versus continuous dynamic programming; Multiple state variables; curse of dimensionality in DP.

MODULE IV APPLICATIONS 8

Regression modeling in engineering; industrial blending problems; dynamic optimal control of engineering systems; optimal estimation in environmental engineering - Water resources; production planning in industrial engineering;

transportation problem - Heuristic optimization methods: genetic algorithms; ecological engineering application; Minimum cost network flow algorithms; out-of-kilter method; primal-dual methods; Dynamic Programming Applications - Water allocation as a sequential process - Capacity expansion and Reservoir operation.

MODULE V INTEGER PROGRAMMING 8

Integer programming - applications in optimal irrigation scheduling in agricultural engineering - Interior point optimization methods - affine scaling method.

MODULE VI NON-LINEAR PROGRAMMING 6

Non-linear programming - Kuhn-Tucker conditions for constrained nonlinear programming problems; necessary and sufficient conditions; quadratic programming; applications.

Total Hours: 45

REFERENCES:

1. Taha, H.A., “Operations Research - An Introduction", 9th Edition, Pearson Prentice Hall, 2011.
2. Winston.W.L. “Operations Research”, 4th Edition, Thomson – Brooks/Cole, 2003.
3. Kreyszig .E., “Advanced Engineering Mathematics“,10th Edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2001.

OUTCOMES:

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

- basic theoretical principles in optimization.
- formulation of optimization models.
- solution methods in optimization.
- methods of sensitivity analysis and post processing of results.
- applications to a wide range of engineering problems.

GEBX10	ENGINEERING SYSTEM MODELLING AND SIMULATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the concepts, techniques, tools for modeling and simulation systems and environments through the use of computers.
- To study the various aspects of discrete dynamic, stochastic systems modeling and conducting experiments with those models on a computer.

MODULE I INTRODUCTION **6**

Systems – Modelling – types – systems components – Steps in model building- Simulation Algorithms and Heuristics; Simulation Languages.

MODULE II RANDOM NUMBERS / VARIATES **7**

Random numbers – methods of generation – random variates for standard distributions like uniform, exponential, Poisson, binomial, normal etc. – Testing of Random variates – Monte Carlo Simulation.

MODULE III MODELLING PROCESS **7**

Primitive Models : Establishing relationships via physical laws; Establishing relationships via curve fitting; Parameters estimation problems; Elementary state transition models.

MODULE IV DESIGN OF SIMULATION EXPERIMENTS **9**

Steps on Design of Simulation Experiments – Development of models using of Highlevel language for systems like Queuing, Inventory, Replacement, Production etc., – Model validation and verification, Output analysis.

MODULE V SIMULATION LANGUAGES **10**

Need for simulation Languages – Comparisons & Selection of Languages – GPSSARENA- EXTEND – Study of any one of the languages.

MODULE VI CASE STUDIES USING SIMULATION LANGUAGES **6**

Total Hours: 45

REFERENCES:

1. Law, A.M., & W.D. Kelton, “Simulation Modelling and Analysis”, McGraw Hill, Singapore, 2000.
2. Harrel, C.R., et. al., “System Improvement Using Simulation”, 3rd Edition, JMI Consulting Group and ProModel Corporation, 1995.
3. Harrel, C.R. & T. Kerim, “Simulation Made Easy, A Manager’s Guide”, IIE Press, 1995.
4. Geoffrey Gordon, “Systems Simulation”, Prentice Hall, 2002.
5. David Kelton, Rondall P Sadowski, David T Sturrock, “Simulation with Arena”, Mc Graw Hill, 2004.

OUTCOMES:

The student should be able to

- Model and simulate systems and environments through the use of computers.
- Conduct experiments with discrete dynamic, stochastic system models on a computer.

GEBX11	SUPPLY CHAIN MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the various decision phases in a supply chain
- To be aware of the Supply Chain and its drivers
- To design Supply Chain Network
- To build a aggregate plan in supply chain
- To understand Sourcing Decisions in Supply Chain
- To comprehend the influence of Information technology in Supply Chain

MODULE I INTRODUCTION TO SUPPLY CHAIN **9**

Understanding Supply Chain - Decision phases - Supply chain performance - Competitive and supply chain strategies - Achieving strategic fit - Expanding strategic scope

MODULE II SUPPLY CHAIN DRIVERS AND DESIGN **9**

Drivers of supply chain performance – Designing distribution network - Network Design in the Supply Chain - Network design in Uncertain Environment

MODULE III AGGREGATE PLANNING AND MANAGING SUPPLY, DEMAND AND INVENTORY **9**

Aggregate Planning in a Supply chain: role - Managing Supply - Managing Demand in Supply Chain – Cycle and Safety inventory in supply chain – Level of product availability.

MODULE IV SOURCING AND TRANSPORTATION **9**

Sourcing decision in supply chain - Third and Fourth – Party Logistics providers - Supplier scoring and assessment - Transportation in a Supply Chain – Risk and Trade-offs in transportation design.

MODULE V INFORMATION TECHNOLOGY IN A SUPPLY CHAIN **9**

Information technology in a supply chain – CRM, ISCM, SRM in supply chain - Over view of recent trends in Supply Chain: e-SRM, e-LRM, e-SCM.

Total Hours: 45

REFERENCES:

1. Sunil Chopra and Peter Meindl, “Supply Chain Management-Strategy Planning and Operation”, Pearson Education, 4th Indian Reprint, 2010.
2. Jananth Shah “Supply Chain Management – Text and Cases“ Pearson Education, 2008.
3. Altekar Rahul V, “Supply Chain Management-Concept and Cases”, Prentice Hall India, 2005.
4. Monczka et al., “Purchasing and Supply Chain Management”, Thomson Learning, 2nd Edition, 2nd Reprint, 2002.

OUTCOMES:

- After taking up the course the student will be able to brighten his prospects of taking up a career on supply chain management.
- The student decision making capability specific to supply chain issues in an industry is improved.
- The student can plan a well defined execution of supply chain strategy in companies.
- The student will be able to design a optimal distribution network as per the demands of the industry.
- The student can also determine the most favorable transportation plan for a company.
- The student will also be able to bring in company from paper environment to paperless environment.

GEBX12 TOTAL QUALITY MANAGEMENT L T P C

3 0 0 3

OBJECTIVES:

- To understand the various principles, practices of TQM to achieve quality.
- To get acquainted with the various statistical tools and approaches for quality control and continuous improvement.
- To get aware of the importance of ISO and Quality Systems.

MODULE I INTRODUCTION 8

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs - Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership – Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

MODULE II TQM PRINCIPLES 7

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits.

MODULE III TQM IMPROVEMENT PROCESS 8

Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure.

MODULE IV STATISTICAL PROCESS CONTROL (SPC) 8

The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools.

MODULE V TQM TOOLS 7

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality

Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

MODULE VI QUALITY SYSTEMS **7**

Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, TS 16949, ISO 14000 – Concept, Requirements and Benefits.

Total Hours: 45

TEXT BOOK:

1. Dale H.Besterfiled, et al., "Total Quality Management", Pearson Education, Inc. 2003.

REFERENCES:

1. James R.Evans & William M.Lidsay, "The Management and Control of Quality", 5th Edition, South-Western (Thomson Learning), 2002.
2. Feigenbaum.A.V., "Total Quality Management", McGraw-Hill, 1991.
3. Oakland.J.S., "Total Quality Management", Butterworth Hcinemann Ltd., Oxford, 1989.
4. Narayana V. and Sreenivasan. N.S., "Quality Management – Concepts and Tasks", New Age International, 1996.
5. Zeiri, "Total Quality Management for Engineers", Wood Head Publishers, 1991.

OUTCOMES:

The student should be able to

- apply the various statistical tools and approaches for Quality control.
- achieve continuous process improvement through TQM.

GEBX13	ENERGY STUDIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the growing demand, supply of energy on global and national levels and the need for renewable energy promotion.
- To understand the basic need for energy conservation and waste heat recovery.
- To learn the important aspects of energy audit and management.
- To get acquainted with the global environmental issues and carbon credits.

MODULE I GLOBAL AND NATIONAL ENERGY SCENARIO 7

Role of energy in economic development, various energy resources - overall energy demand and availability- Energy consumption in various sectors and its changing pattern - Exponential increase in energy consumption and projected future demands. Need for renewable energy.

MODULE II SOLAR ENERGY 8

Solar Radiation – Measurements of Solar Radiation - Flat Plate and Concentrating Collectors – Solar direct Thermal Applications – Solar thermal Power Generation - Fundamentals of Solar Photo Voltaic Conversion – Solar Cells – Solar PV Power Generation – Solar PV Applications.

MODULE III OTHER RENEWABLE ENERGY SOURCES 8

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. MHD power plants – working, types, merits and demerits. Energy from biomass.

MODULE IV COGENERATION, WASTE HEAT RECOVERY AND COMBINED CYCLE PLANTS 8

Cogeneration principles- topping and bottoming cycles, role in process industries. Energy from wastes- waste heat recovery- heat recovery from industrial processes. Heat exchange systems – recuperative and regenerative heat exchangers – commercially available waste heat recovery devices. Combined cycle plants – concept, need and advantages, different combinations and practical scope.

MODULE V ENERGY CONSERVATION AND MANAGEMENT 7

Need for energy conservation – use of energy efficient equipment. Energy conservation opportunities - in educational institutions, residential, transport, municipal, industrial and commercial sectors – concept of green building. Energy audit in industries – need, principle and advantages. Case studies.

MODULE VI GLOBAL ENRGY ISSUES AND CARBON CREDITS 7

Energy crisis, fossil consumption and its impact on environmental climate change. Energy treaties – Montreal and Kyoto protocols - Transition from carbon rich and nuclear to carbon free technologies, carbon foot print – credits – clean development mechanism.

Total Hours: 45

TEXT BOOKS:

1. S.S. Rao and B.B. Parulekar, “Energy Technology”, 3rd Edition, Khanna Publishers, New Delhi, 2011.
2. O. Callaghn. P.W., “Design and Management for Energy Conservation”, Pergamon Press, Oxford, 1981.

REFERENCES:

1. G.D. Rai, “Non Conventional Energy Sources”, Khanna Publishers, New Delhi, 2011.
2. Archie, W Culp. “Principles of Energy Conservation”, McGraw Hill, 1991.
3. D Patrick and S W Fardo, “Energy Management and Conservation”, PHI,1990
4. P. O’Callaghan: “Energy Management”, McGraw - Hill Book Company, 1993.
5. Kenney, W. F., “Energy Conservation in Process Industries”, Academic Press, 1983.

OUTCOMES:

The student should be able to

- Realize the global and national energy status and need to switch over to renewable energy technology.
- Energy audit and suggest methodologies for energy savings.

- Utilize the available resources in an optimal way.
- Concern about the global environmental issues & promote carbon credits.

GEBX14	ROBOTICS	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To learn about the robots, various components, of Robots, programming and their applications.

MODULE I INTRODUCTION **8**

Definition- Need - Application, Types of robots – Classifications – Configuration, work volume, control loops, controls and intelligence- basic parts - functions – specifications. of robot, degrees of freedoms, end effectors – types, selection

MODULE II ROBOT DRIVES AND CONTROL **8**

Controlling the Robot motion – Position and velocity sensing devices – Design of drive systems – Hydraulic and Pneumatic drives – Linear and rotary actuators and control valves – Electro hydraulic servo valves, electric drives – Motors – Designing of end effectors – Vacuum, magnetic and air operated grippers.

MODULE III ROBOT SENSORS **8**

Transducers and Sensors – Tactile sensor – Proximity and range sensors – Sensing joint forces – Robotic vision system – Image Representation - Image Grabbing –Image processing and analysis – Edge Enhancement – Contrast Stretching – Band Rationing - Image segmentation – Pattern recognition – Training of vision system.

MODULE IV ROBOT PROGRAMMING & AI TECHNIQUES **7**

Types of Programming – Teach pendant programming – Basic concepts in AI techniques – Concept of knowledge representations – Expert system and its components.

MODULE V ROBOTIC WORK CELLS AND APPLICATIONS OF ROBOTS **7**

Robotic cell layouts – Inter locks – Humanoid robots – Micro robots – Application of robots in surgery, Manufacturing industries, space and underwater.

MODULE VI ROBOT KINEMATICS AND DYNAMICS **7**

Forward and inverse Kinematic equations, Denvit – Hartenbers representations Fundamental problems with D-H representation, differential motion and velocity

of frames - Dynamic equations for sing, double and multiple DOF robots – static force analysis of robots.

Total Hours: 45

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.
6. Timothy Jordanides et al,"Expert Systems and Robotics", Springer –Verlag, New York, May 1991.

OUTCOMES:

Students would be able to

- Understand about the robots, its various components.
- Design Robots for industrial applications.
- Do programming for robots and apply them in real time applications.

GEBX15	CYBER SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of Cyber Security Standards and Laws.
- To know the legal, ethical and professional issues in Cyber security.
- To understand Cyber Frauds and Abuse and its Security Measures.
- To know the technological aspects of Cyber Security.

MODULE I FUNDAMENTALS OF CYBER SECURITY 8

Security problem in computing – Cryptography Basics – History of Encryption – Modern Methods – Legitimate versus Fraudulent Encryption methods – Encryption used in Internet.

MODULE II TYPES OF THREATS AND SECURITY MEASURES 8

Security Programs – Non-malicious program Errors – Virus and other Malicious Code – Targeted Malicious Code – Control against program threats – Web Attacks – DOS – Online Security Resources.

MODULE III APPLICATION SECURITY 8

Introduction to Databases - Database Security Requirements – Reliability & Integrity – Multilevel Databases - E-Mail and Internet Security – SQL Injection – Cross Site Scripting – Local File Inclusion – Intrusion Detection Software”s.

MODULE IV PHYSICAL SECURITY AND FORENSICS 7

Firewalls – Benefits and Limitations – Firewall Types - Components – Server Room Design and Temperature Maintenance – Cyber Terrorism and Military Operation Attacks- Introduction to Forensics – Finding evidence on PC and Evidence on System Logs – Windows and Linux logs.

MODULE V CYBER STALKING & FRAUD 7

Introduction – Internet Frauds – Auction Frauds – Identity theft – Phishing – Pharming- Cyber Stalking – Laws about Internet Fraud – Protecting against Cyber Crime – Secure Browser settings – Industry Espionage.

MODULE VI CYBER SECURITY STANDARDS AND POLICIES 7

Introduction– ISO 27001– ISO 27002 - PCI DSS – Compliance - IT ACT – Copyright ACT, Patents. Definition of Policy – Types- User Policies- Administrative Policies – Access control – Developmental Policies.

Total Hours: 45

TEXT BOOK:

1. Chuck Easttom, “Computer Security Fundamentals”, 2nd Edition, Pearson Education, 2012.

REFERENCES:

1. Charles B. Pfleeger, Shari Lawrence Pfleeger, “Security in Computing”, 3rd Edition, Pearson Education, 2003.
2. William Stallings, “Cryptography and Network Security – Principles and Practices”, 3rd Edition, Pearson Education, 2003.
3. Atul Kahate, “Cryptography and Network Security”, Tata McGraw Hill, 2000.

OUTCOMES:

Upon completion of this course, attendees should be able to satisfy the critical need for ensuring Cyber Security in Organizations.

- The students attending this course will be able to analyse the attacks and threats.
- They can also provide solutions with Intrusion Detection systems and Softwares.
- They will have knowledge about Cyber Frauds and Cyber Laws.

GEBX16	USABILITY ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The objective of this course is

- To understand the emerging concept of usability, requirements gathering and analysis.
- To learn about human computer interaction with the help of interfaces that has high usability.

MODULE I INTRODUCTION **6**

Cost Savings – Usability Now – Usability Slogans – Discount Usability Engineering – Usability – Definition – Example – Trade-offs – Categories – Interaction Design – Understanding & Conceptualizing Interaction – Cognitive Aspects.

MODULE II USER INTERFACES **8**

Generation of User Interfaces – Batch Systems, Line Oriented Interfaces, Full Screen Interfaces, Graphical User Interfaces, Next Generation Interfaces, Long Term Trends – Usability Engineering Life Cycle – Interfaces – Data Gathering – Data Analysis Interpretation and Presentation.

MODULE III INTERACTION DESIGN **8**

Process of Interaction Design - Establishing Requirements – Design, Prototyping and Construction - Evaluation and Framework.

MODULE IV USABILITY TESTING **8**

Usability Heuristics – Simple and Natural Dialogue, Users' Language, Memory Load, Consistency, Feedback, Clearly Marked Exits, Shortcuts, Error Messages, Prevent Errors, Documentation, Heuristic Evaluation – Usability Testing - Test Goals and Test Plans, Getting Test Users, Choosing Experimenters, Ethical Aspects, Test Tasks, Stages of a Test, Performance Measurement, Thinking Aloud, Usability Laboratories.

MODULE V USABILITY ASSESSMENT METHODS **8**

Observation, Questionnaires and Interviews, Focus Groups, Logging Actual

Use, User Feedback, Usability Methods – Interface Standards - National, International and Vendor Standards, Producing Usable In-House Standards

MODULE VI USER INTERFACES **7**

International Graphical Interfaces, International Usability Engineering, Guidelines for Internationalization, Resource Separation, Multilocale Interfaces – Future Developments – Case Study.

Total Hours : 45

TEXT BOOKS:

1. Yvonne Rogers, Helen Sharp, Jenny Preece, "Interaction Design: Beyond Human - Computer Interaction", John Wiley & Sons, 3rd Edition, 2011 (Module I, II, III).
2. Jakob Nielsen, "Usability Engineering", Morgan Kaufmann Academic Press, 1994. (Module I – VI).

REFERENCES:

1. Ben Shneiderman, Plaisant, Cohen, Jacobs, "Designing the User Interface: Strategies for Effective Human Interaction", Pearson Education, 5th Edition, 2010.
2. Laura M. Leventhal, Julie A. Barnes, "Usability Engineering: Process, Products, and Examples", Pearson/Prentice Hall, 2008

OUTCOMES:

Students who complete this course will be able to

- build effective, flexible and robust user interfaces.
- translate system requirements into appropriate human/computer interaction sequences.
- choose mode, media and device for the application requirements.

GEBX17	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To understand the various safety measures to be taken in different industrial environments.

MODULE I SAFETY MANAGEMENT **7**

Evolution of modern safety concept- Safety policy - Safety Organization - line and staff functions for safety- Safety Committee- budgeting for safety. safety education and training.

MODULE II SAFETY IN MANUFACTURING **7**

Safety in metal working-Machine guarding -Safety in welding and gas cutting - Safety in cold forming and hot working of metals -Safety in finishing, inspection and testing -Regulation.

MODULE III SAFETY IN CONSTRUCTION **8**

General safety consideration in Excavation, foundation and utilities – Cordoning – Demolition – Dismantling –Clearing debris – Types of foundations – Open footings.

Safety in Erection and closing operation - Safety in typical civil structures – Dams-bridges-water Tanks-Retaining walls-Critical factors for failure-Regular Inspection and monitoring.

MODULE IV ELECTRICAL SAFETY **8**

Electrical Hazards – Energy leakage – Clearance and insulation – Excess energy – Current surges – Electrical causes of fire and explosion – National electrical Safety code.

Selection of Environment, Protection and Interlock – Discharge rods and earthing device – Safety in the use of portable tools - Preventive maintenance.

MODULE V SAFETY IN MATERIAL HANDLING **8**

General safety consideration in material handling devices - Ropes, Chains, Sling, Hoops, Clamps, Arresting gears – Prime movers.

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 a big industry.

MODULE VI SAFETY EDUCATION AND TRAINING 7

Importance of training-identification of training needs-training methods – programme, seminars, conferences, competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training.

Total Hours: 45

REFERENCES:

1. Krishnan N.V, “Safety Management in Industry”, Jaico Publishing House, Bombay, 1997.
2. Blake R.B., “Industrial Safety”, Prentice Hall, Inc., New Jersey, 1973.
3. Fulman J.B., “Construction Safety, Security, and Loss Prevention”, John Wiley and Sons, 1979.
4. Fordham Cooper W., “Electrical Safety Engineering”, Butterworths, London, 1986.
5. Alexandrov M.P., “Material Handling Equipment”, Mir Publishers, Moscow, 1981.

OUTCOMES:

Students would be able to

- Acquire knowledge on various safety Hazards.
- Carry out safety measures for different industrial environments.

GEB X18 TRANSPORT MANAGEMENT L T P C

3 0 0 3

OBJECTIVES:

- To understand the transport fleet and their related activities for minimizing operational cost.
- To understand the need of maintenance and its importance.
- To understand the functions and applications of various types of transport system.

MODULE I INTRODUCTION 7

Personnel management; objectives and functions of personnel management, psychology, sociology and their relevance to organization, personality problems. Selection process: job description, employment tests, interviewing, introduction to training objectives, advantages, methods of training, training procedure, psychological tests.

MODULE II ORGANISATION AND MANAGEMENT 7

Forms of Ownership – principle of Transport Management – Staff administration – Recruitment and Training – welfare – health and safety. Basic principles of supervising.

Organizing time and people. Driver and mechanic hiring - Driver checklist - Lists for driver and mechanic - Trip leasing - Vehicle operation and types of operations.

MODULE III TRANSPORT SYSTEMS 9

Introduction to various transport systems. Advantages of motor transport. Principal function of administrative, traffic, secretarial and engineering divisions. chain of responsibility, forms of ownership by state, municipality, public body and private undertakings.

MODULE IV SCHEDULING AND FARE STRUCTURE 8

Principal features of operating costs for transport vehicles with examples of estimating the costs. Fare structure and method of drawing up of a fare table. Various types of fare collecting methods. Basic factors of bus scheduling. Problems on bus scheduling.

MODULE V MOTOR VEHICLE ACT 7

Traffic signs, fitness certificate, registration requirements, permit insurance, constructional regulations, description of vehicle-tankers, tippers, delivery vans, recovery vans, power wagons and fire fighting vehicles. Spread over, running time, test for competence to drive.

MODULE VI MAINTENANCE 7

Preventive maintenance system in transport industry, tyre maintenance procedures. Causes for uneven tyre wear; remedies, maintenance procedure for better fuel economy, Design of bus depot layout.

Total Hours: 45

TEXT BOOKS:

1. John Duke, "Fleet Management", McGraw-Hill Co, USA, 1984.
2. Kitchin.L.D., "Bus Operation", III edition, Illiffee and Sons Co., London, 1992

REFERENCE:

1. Government Motor Vehicle Act, Publication on latest act to be used as on date.

OUTCOMES:

Upon completion of the course, students will

- know about different aspects related to transport system and management.
- features of scheduling, fixing the fares
- know about the motor vehicle act and maintenance aspects of transport.

GEBX19 ADVANCED OPTIMIZATION TECHNIQUES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the various advanced optimization tools.
- To provide an understanding to deal with ill identified and fuzzy problems.

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:

At the end of the course student will be able to

1. Formulate a real life situation as an optimization the problem.
2. Identify the appropriate solution methodology and provide a solution

GEB X20	PLANT ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide in depth knowledge on Plant Engineering
- To introduce detail engineering and P&ID
- To learn about the support to Instrumentation from other disciplines
- To study about the Installation and commissioning

MODULE I INTRODUCTION OF PLANTS 7

General Project Cycle – Feed – Sales - Plant Description, Component / Areas of Plant, Plant Layout, Plant Interfaces, Plant Location

MODULE II ELEMENTS OF PLANT 8

Main Elements of a Plant, Process Flow Scheme (PFD – Process Flow Diagram) P&ID's, Plant Legend Finalization.

MODULE III DETAIL ENGINEERING 10

P& ID Development with PFD's, Major Discipline Involvement & Inter discipline Interaction, Major Instrumentation & Control Systems - Development Phase – Instrument List , I/O Count, Specification Sheets, Instrument Installation (Hook ups) , Control Philosophy – Detail Engineering.

MODULE IV SUPPORT FROM OTHER DISCIPLINE 8

Other Discipline Supports to Instrumentation – Plot Plan, Piping / Equipment Plan, Electrical Area Classification, Fire Hazardous Classification Telecommunication Systems - Control Network architecture

MODULE V INSTALLATION AND COMMISSIONING 7

Plant Construction - Key Drawings for Construction Support Construction Activities, System Testing, Startup / Commissioning, Production.

MODULE VI CASE STUDIES 5

Case studies of Water Treatment Plant - Paper Industry – Power Plant etc.

Total Hours: 45

REFERENCES :

1. Duncan C. Richardson, Plant Equipment and Maintenance Engineering Handbook, McGraw-Hill Education: New York, Chicago, San Francisco, Athens, London, Madrid, Mexico City, Milan, New Delhi, Singapore, Sydney, Toronto, 2014 McGraw-Hill Education
2. Gabriel Salvendy, Handbook of Industrial Engineering - Technology and operations management, John Wiley & Sons, 2001
3. Robert C Rosaler, Standard Handbook of Plant Engineering, McGraw-Hill third edition, 2004.
4. R. Keith Mobley, Plant Engineer's Handbook, Technology and Engineering, 2001

OUTCOMES:

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

- Review and correct P&IDs
- Do installation and commissioning of new plants
- Apply plant engineering in design and maintenance of water treatment plant / power plant etc

GEBX21	PROJECT MANAGEMENT SYSTEM	L	T	P	C
		3	0	0	3

OBJECTIVES:

The students would gain knowledge on

- Technicalities attached to Project Management and Significance of Quality Consideration
- Project management methodologies – tools and techniques, supplemented with examples from case studies
- The importance of Efficient HR team and role of Communication in executing Projects.
- Managing Risks in Project Management

MODULE I INTRODUCTION TO PROJECT MANAGEMENT 9

Introduction to Project and Project Management-Project Management as a Career-Project Management Skill Sets-Project Scope Management: Project Charter, Scope Creep, Scope Validation, Scope Change Control-Type of Organization: Organization Structure-Influence of Organization Structure on Project, Project Stakeholders and Organizational Productivity.

MODULE II PROJECT MANAGEMENT PROCESS, TOOLS AND TECHNIQUES 8

Project life cycle-Initiation, Planning, Execution, Monitoring and Closing Phase; - Link between project management process, process groups and knowledge areas; Project management tools and techniques- Project Stakeholders description and mapping - Stakeholder Management Process

MODULE III PROJECT QUALITY, COST AND SCHEDULE MANAGEMENT 10

Triple constraints of project-quality, cost and schedule-Quality Planning, Quality Assurance and Quality Control, Process Control, Cost of Quality, Seven Tools of Quality Control- Cost Management: Cost Estimating Methods, Estimating Completion Cost, Earned Value Management, Budgeting, Life-Cycle Cost analysis- Project Time Management: Duration Estimation Method, FS/FF/SS/SF Relations, Lead/Lag, Arrow Diagram Method and Precedence Diagram Method for Scheduling-Resource Allocation

MODULE IV PROJECT HR & COMMUNICATION MANAGEMENT 10

Organizational Goals- (MBO/MBE/MBP)-Responsibility Assignment Matrix (RAM)-Types of Powers- Manage or Lead-Conflict management Techniques-Performance Evaluation Process-Motivation Theories and its Application for execution of Projects-Leadership Styles-Project Team Building-Project Staffing Constraints/Policies- Communication Management: Understanding Body languages of Project Personnel-Effective Communications- Interpersonal Skills for project Managers-PMIS-Communicating with the Customer-Communicating with Management- Formal vs. Informal Communications-Written, Verbal and Non-Verbal Communications.

MODULE V PROJECT PROCUREMENT & RISK MANAGEMENT 8

Introduction to Project Procure Management: Soliciting RFQ/RFP-Contract Proposals-Contract Negotiation-Contract Closure-Risk Management: Defining risks-Risk management process-Risk identification-Qualitative and Quantitative Risk-Probability and Decision trees-Risk Response strategies / methods-Expected monetary value-Risk vs. life cycle phases.

Total Hours: 45

REFERENCES:

1. Jack. R. Meredith, Samuel. J. Mantel & Scott. M. Shafer, Project Management in Practice, Fifth Edition, Bangalore: Wiley, 2015
2. Bob Hughes, Mike Cotterrel “Software Project Management”, Tata McGraw-Hill, 2009.

OUTCOMES:

- Learners will be able to identify the Key Knowledge Areas and apply PM process in hypothetical project assignments given as continuous assessment.
- They would be able to suitably recognize tools and techniques required for various phases included in the project.
- They would also be able to manage scope, time, cost and other major components that would help them to execute the project efficiently.

GEBX22	NATIONAL SERVICE SCHEME	L	T	P	C
	(Paper: 01 - As per Ministry of Youth Affairs and Sports)	0	0	3	1

OBJECTIVES:

- understand the community in which they work
- understand themselves in relation to their community
- identify the needs and problems of the community and involve them in problem-solving
- develop among themselves a sense of social and civic responsibility
- utilise their knowledge in finding practical solutions to individual and community problems
- develop competence required for group-living and sharing of responsibilities
- gain skills in mobilising community participation
- acquire leadership qualities and democratic attitudes
- develop capacity to meet emergencies and natural disasters and
- practise national integration and social harmony

MODULE I INTRODUCTION AND BASIC CONCEPTS OF NSS 4

History, philosophy, aims & objectives of NSS – Emblem, flag, motto, song, badge, etc. – Organizational structure, roles and responsibilities of various NSS functionaries.

MODULE II NSS PROGRAMMES AND ACTIVITIES 10

Concept of regular activities, special camping, Day Camps – Basis of adoption of village/slums, Methodology of conducting Survey – Financial pattern of the scheme – Other youth programme/schemes of GOI – Coordination with different agencies – Maintenance of the Diary.

MODULE III UNDERSTANDING YOUTH 5

Definition, profile of youth, categories of youth – Issues, challenges and opportunities for youth – Youth as an agent of social change.

MODULE IV COMMUNITY MOBILISATION **9**

Mapping of community stakeholders – Designing the message in the context of the problem and the culture of the community – Identifying methods of mobilisation – Youth-adult partnership.

MODULE V VOLUNTEERISM AND SHRAMDAN **7**

Indian Tradition of volunteerism – Needs and importance of volunteerism – Motivation and Constraints of Volunteerism – Shramdan as a part of volunteerism.

Total Hours: 35