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
M.Tech. (CAD-CAM)

PROGRAMME EDUCATIONAL OBJECTIVES

- To provide a holistic approach in learning through well designed courses involving fundamental concepts and state-of-the-art techniques in the field of CAD – CAM.
- To equip the graduates, with knowledge and skill to undertake design, analysis, evaluation of systems, processes and components.
- To supplement course work through seminars, workshops, case studies, and through paper presentation.
- To inculcate research culture by way of solving typical problems, Project works from real life situation and innovative assignments.
- To develop team spirit, problem solving skill, and appreciation for ethical and social relevance of the technologies used.

PROGRAMME OUTCOMES

On completion of program, the graduates will

- have sound conceptual knowledge and skill in the area of design and manufacturing.
- be able to design, analyze and manufacture real life systems and components.
- have capability to use latest software in the area of computer aided engineering for modeling, analysis and manufacture.
- be able to undertake academic and applied research and address open ended problems.
- have the ability to discharge professional, social & economic responsibilities ethically.

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
M.TECH. DEGREE PROGRAMMES

B.S. ABDUR RAHMAN UNIVERSITY, CHENNAI 48.
REGULATIONS - 2013 FOR M.TECH / MCA / M.Sc. DEGREE PROGRAMMES

1.0 PRELIMINARY DEFINITIONS AND NOMENCLATURE

In these Regulations, unless the context otherwise requires

i) **"Programme"** means Post Graduate Degree Programme (M.Tech./ MCA / M.Sc.)

ii) **"Course"** means a theory or practical subject that is normally studied in a semester, like Applied Mathematics, Structural Dynamics, Computer Aided Design, etc.

iii) **"University"** means B.S.Abdur Rahman University, Chennai, 600048.

iv) **"Institution"** unless otherwise specifically mentioned as an autonomous or off campus institution means B.S.Abdur Rahman University.

v) **"Academic Council"** means the Academic Council of this University.

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

vii) **"Dean (Student Affairs)"** means Dean(Student Affairs) of B.S.Abdur Rahman University.

viii) **"Controller of Examinations"** means the Controller of Examinations of B.S.Abdur Rahman University who is responsible for conduct of examinations and declaration of results.

2.0 PROGRAMMES OFFERED, MODE OF STUDY AND ADMISSION REQUIREMENTS

2.1 P.G. Programmes Offered

The various P.G. Programmes and their modes of study are as follows:

Degree	Mode of Study
M.Tech.	Full Time
M.Tech.	Part Time – Day / Evening
M.C.A.	Full Time
M. Sc.	Full Time

2.2 MODES OF STUDY

2.2.1 Full-time

Students admitted under "Full-Time" shall be available in the Institution during the complete working hours for curricular, co-curricular and extra-curricular activities assigned to them.

2.2.2 A full time student, who has completed all non-project courses desiring to do the Project work in part-time mode for valid reasons, shall apply to the Dean (Academic Affairs) through the Head of the Department, if the student satisfies the clause 2.3.4 of this Regulation. Permission may be granted based on merits of the case. Such conversion is not permitted in the middle of a semester.

2.2.3 Part time - Day time

In this mode of study, the students are required to attend classes for the courses registered along with full time students.

2.2.4 Part time - Evening

In this mode of study, the students are required to attend normally classes in the evening and on Saturdays, if necessary.

2.2.5 A part time student is not permitted to convert to full time mode of study.

2.3 ADMISSION REQUIREMENTS

2.3.1 Students for admission to the first semester of the Master's Degree Programme shall be required to have passed the appropriate degree examination of this University as specified in the Table shown for eligible entry qualifications for admission to P.G. programmes or any other degree examination of any University or authority accepted by this University as equivalent thereto.

2.3.2 Eligibility conditions for admission such as class obtained, number of attempts in the qualifying examination and physical fitness will be as prescribed by this Institution from time to time.

2.3.3 All part-time students should satisfy other conditions regarding experience, sponsorship etc., which may be prescribed by this Institution from time to time.

2.3.4 A student eligible for admission to M.Tech. Part Time / Day Time programme shall have his/her permanent place of work within a distance of 65km from the campus of this Institution.

2.3.5 Student eligible for admission to M.C.A under lateral entry scheme shall be required to have passed three year degree in B.Sc (Computer Science) / B.C.A / B.Sc (Information Technology)

3.0 DURATION AND STRUCTURE OF THE P.G. PROGRAMME

3.1 The minimum and maximum period for completion of the P.G. Programmes are given below:

Programme	Min.No.of Semesters	Max.No.of Semesters
M.Tech. (Full Time)	4	8
M.Tech. (Part Time)	6	12
M.C.A. (Full Time)	6	12
M.C.A. (Full Time) – (Lateral Entry)	4	8
M.Sc. (Full Time)	4	8

3.2 The PG. programmes consist of the following components as prescribed in the respective curriculum

i. Core courses
ii. Elective courses
iii. Project work / thesis / dissertation
iv. Laboratory Courses
v. Case studies
vi. Seminars
vii. Industrial Internship

3.3 The curriculum and syllabi of all PG. programmes shall be approved by the Academic Council of this University.

3.4 The minimum number of credits to be earned for the successful completion of the programme shall be specified in the curriculum of the respective specialization of the P.G. programme.

3.5 Each academic semester shall normally comprise of 80 working days. Semester-end examinations will follow immediately after the last working day.

ELIGIBLE ENTRY QUALIFICATIONS FOR ADMISSION TO P.G. PROGRAMMES

Sl. No.	Name of the Department	P.G. Programmes offered	Qualifications for admission
01.	Civil Engineering	M.Tech. (Structural Engineering)	B.E / B.Tech. (Civil Engineering) / (Structural Engineering)
		M.Tech. (Construction Engineering and Project Management)	
02.	Mechanical Engineering	M.Tech. (Manufacturing Engineering)	B.E. / B.Tech. (Mechanical / Auto / Manufacturing / Production / Industrial / Mechatronics / Metallurgy / Aerospace /Aeronautical / Material Science / Marine Engineering)
		M.Tech. CAD / CAM	
03.	Polymer Engineering	M.Tech. (Polymer Technology)	B.E./ B.Tech. degree Mech./Production/ Polymer Science or Engg or Tech / Rubber Tech / M.Sc (Polymer Sc./ Chemistry Appl. Chemistry)
04.	Electrical and Electronics Engineering	M.Tech. (Power Systems Engg)	B.E / B.Tech (EEE / ECE / E&I / I&C / Electronics / Instrumentation)
		M.Tech. (Power Electronics & Drives)	
05.	Electronics and Communication Engineering	M.Tech. (Communication Systems)	B.E / B.Tech (EEE/ ECE / E&I / I&C / Electronics / Instrumentation)
		M.Tech.(VLSI and Embedded Systems)	B.E./ B.Tech. in ECE / Electronics / EIE / ICE / EEE
		M.Tech.(Signal Processing)	
06.	ECE Department jointly with Physics Dept	M.Tech. (Optoelectronics and Laser Technology)	B.E./B.Tech. (ECE / EEE / Electronics / EIE / ICE) M.Sc (Physics / Materials Science / Electronics / Photonics)
07.	Electronics and Instrumentation Engineering	M.Tech. (Electronics and Instrumentation Engineering)	B.E./ B.Tech. (EIE/ICE/Electronics/ECE/ EEE)
08.	Computer Science and Engineering	M.Tech. (Computer Science and Engineering)	B.E. /B.Tech. (CSE/IT/ECE/EEE/EIE/ICE/ Electronics) MCA
		M.Tech. (Software Engineering)	B.E. / B.Tech. (CSE / IT) MCA
		M.Tech (Network Security)	B.E. /B.Tech. (CSE/IT/ECE/EEE/EIE/ICE/ Electronics) MCA
		M.Tech (Computer and Predictive Analytics)	
		M.Tech. (Computer Science and Engineering with specialization in Big Data Analytics)	
09	Information Technology	M.Tech. (Information Technology)	B.E /B.Tech. (IT/CSE/ECE/EEE/EIE/ICE/ Electronics) MCA
		M.Tech. (Information Security & Digital Forensics)	

ELIGIBLE ENTRY QUALIFICATIONS FOR ADMISSION TO P.G. PROGRAMMES

Sl. No.	Name of the Department	P.G. Programmes offered	Qualifications for admission
10	Computer Applications	M.C.A.	Bachelor Degree in any discipline with Mathematics as one of the subjects (or) Mathematics at +2 level
		M.C.A. (Full Time) – (Lateral Entry)	B.Sc Computer Science / B.Sc Information Technology / B.C.A
		M.Tech. (Systems Engineering and Operations Research)	BE / B.Tech. (Any Branch) or M.Sc., (Maths / Physics / Statistics / CS / IT / SE) or M.C.A.
		M.Tech. (Data & Storage Management)	
11	Mathematics	M.Sc. (Actuarial Science)	Any Degree with Mathematics / Statistics as one of the Subjects of Study.
		M.Sc. Mathematics	B.Sc. (Mathematics)
12	Physics	M.Sc.(Physics)	B.Sc.(Physics / Applied Science / Electronics / Electronics Science / Electronics & Instrumentation)
		M.Sc. (Material Science)	
13	Chemistry	M.Sc.(Chemistry)	B.Sc (Chemistry) of B.Sc. (Applied Science)
14	Life Sciences	M.Sc. Molecular Biology & Biochemistry	B.Sc. in any branch of Life Sciences
		M.Sc. Genetics	
		M.Sc. Biotechnology	
		M.Sc. Microbiology	
		M.Sc. Bioscience	

3.6 The curriculum of PG programmes shall be so designed that the minimum prescribed credits required for the award of the degree shall be within the limits specified below:

Programme	Minimum prescribed credit range
M.Tech.	75 to 85
M.C.A.	120 to 130
M.Sc.	75 to 85

3.7 Credits will be assigned to the courses for all P.G. programmes as given below:

* One credit for one lecture period per week
* One credit for one tutorial period per week
* One credit each for seminar/practical session/project of two or three periods per week
* One credit for two weeks of industrial internship.

3.8 The number of credits registered by a student in non-project semester and project semester should be within the range specified below:

P.G. Programme	Non-project Semester	Project semester
M.Tech. (Full Time)	15 to 29	12 to 20
M.Tech. (Part Time)	6 to 18	12 to 16
M.C.A. (Full Time)	15 to 29	12 to 20
M.Sc. (Full Time)	15 to 25	12 to 20

3.9 The electives from the curriculum are to be chosen with the approval of the Head of the Department.

3.10 A student may be permitted by the Head of the Department to choose electives offered from other PG programmes either within the Department or from other Departments up to a maximum of three courses during the period of his/her study, provided the Heads of the Departments offering such courses also agree.

3.11 To help the students to take up special research areas in their project work and to enable the department to introduce courses in latest/emerging areas in the curriculum, "Special Electives" may be offered. A student may be permitted to register for a "Special Elective" up to a maximum of three credits during the period of his/her study, provided the syllabus of this course is recommended by the Head of the Department and approved by the Chairman, Academic Council before the commencement of the semester, in which the special elective course is offered. Subsequently, such course shall be ratified by the Board of Studies and Academic Council.

3.12 The medium of instruction, examination, seminar and project/thesis/ dissertation reports will be English.

3.13 Industrial internship, if specified in the curriculum shall be of not less than two weeks duration and shall be organized by the Head of the Department.

3.14 PROJECT WORK/THESIS/DISSERTATION

3.14.1 Project work / Thesis / Dissertation shall be carried out under the supervision of a qualified teacher in the concerned Department.

3.14.2 A student may however, in certain cases, be permitted to work for the project in an Industrial/Research Organization, on the recommendation of the Head of the Department. In such cases, the project work shall be jointly supervised by a faculty of the Department and an Engineer / Scientist from the organization and the student shall be instructed to meet the faculty periodically and to attend the review committee meetings for evaluating the progress.

3.14.3 Project work / Thesis / Dissertation (Phase - II in the case of M.Tech.) shall be pursued for a minimum of 16 weeks during the final semester, following the preliminary work carried out in Phase-1 during the previous semester.

3.14.4 The Project Report/Thesis / Dissertation report / Drawings prepared according to approved guidelines and duly signed by the supervisor(s) and the Head of the Department shall be submitted to the concerned department.

3.14.5 The deadline for submission of final Project Report / Thesis / Dissertation is within 30 calendar days from the last working day of the semester in which Project / Thesis / Dissertation is done.

3.14.6 If a student fails to submit the Project Report / Thesis / Dissertation on or before the specified deadline he / she is deemed to have not completed the Project Work / Thesis / dissertation and shall re-register the same in a subsequent semester.

3.14.7 A student who has acquired the minimum number of total credits prescribed in the Curriculum for the award of Masters Degree will not be permitted to enroll for more courses to improve his/her cumulative grade point average (CGPA).

4.0 CLASS ADVISOR AND FACULTY ADVISOR

4.1 CLASS ADVISOR

A faculty member will be nominated by the HOD as Class Advisor for the whole class.

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

4.2 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.

5.0 CLASS COMMITTEE

5.1 Every class of the PG Programme will have a Class Committee constituted by the Head of the Department as follows:

i. Teachers of all courses of the programme

ii. One senior faculty preferably not offering courses for the class, as Chairperson.

iii. Minimum two students of the class, nominated by the Head of the Department.

iv. Class Advisor / Faculty Advisor of the class - Ex-Officio Member

v. Professor in-charge of the PG Programme - Ex-Officio Member.

5.2 The Class Committee shall be constituted by the respective Head of the Department of the students.

5.3 The basic responsibilities of the Class Committee are to review periodically the progress of the classes to discuss problems concerning curriculum and syllabi and the conduct of classes. The type of assessment for the course will be decided by the teacher in consultation with the Class Committee and will be announced to the students at the beginning of the semester. Each Class Committee will communicate its recommendations to the Head of the Department and Dean (Academic Affairs). The class committee, without the student members, will also be responsible for finalization of the semester results and award of grades.

5.4 The Class Committee is required to meet at least thrice in a semester, first within a week of the commencement of the semester, second, after the first

assessment and the third, after the semester-end examination to finalize the grades.

6.0 COURSE COMMITTEE

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

7.0 REGISTRATION AND ENROLMENT

7.1 For the first semester every student has to register and enroll for all the courses.

7.2 For the subsequent semesters registration for the courses will be done by the student during a specified week before the semester-end examination of the previous semester. The curriculum gives details of the core and elective courses, project and seminar to be taken in different semester with the number of credits. The student should consult his/her Faculty Adviser for the choice of courses. The Registration form shall be filled in and signed by the student and the Faculty Adviser.

7.3 From the second semester onwards all students shall pay the prescribed fees and enroll on a specified day at the beginning of a semester.

7.4 A student will become eligible for enrolment only if he/she satisfies clause 9 and in addition he/she is not debarred from enrolment by a disciplinary action of the Institution. At the time of enrolment a student can drop a course registered earlier and also substitute it by another course for valid reasons with the consent of the Faculty Adviser. Late enrolment will be permitted on payment of a prescribed fine up to two weeks from the date of commencement of the semester.

7.5 Withdrawal from a course registered is permitted up to one week from the date of the completion of the first assessment test.

7.6 Change of a course within a period of 15 days from the commencement of the course, with the approval of Dean (Academic Affairs), on the recommendation of the HOD, is permitted.

7.7 Courses withdrawn will have to be taken when they are offered next if they belong to the list of core courses.

8.0 TEMPORARY BREAK OF STUDY FROM THE PROGRAMME

A student may be permitted by the Dean (Academic Affairs) to avail temporary break of study from the programme up to a maximum of two semesters for reasons of ill health or other valid grounds. Such student has to rejoin only in the same semester from where he left. However the total duration for completion of the programme shall not exceed the prescribed maximum number of semesters (vide clause 3.1).

9.0 MINIMUM REQUIREMENTS TO REGISTER FOR PROJECT / THESIS / DISSERTATION

9.1 A student is permitted to register for project semester, if he/she has earned the minimum number of credits specified below:

Programme	Minimum No. of credits to be earned to enroll for project semester
M.Tech. (Full time)	18 (III semester)
M.Tech. (Part time)	18 (V semester)
M.C.A. (Full time)	45 (V semester)
M.C.A. (Full time) – (Lateral Entry)	22 (V semester)
M.Sc. (Full time)	30 (IV semester) if project is in IV semester 18 (III semester) if project is in III semester

9.2 If the student has not earned minimum number of credits specified, he/she has to earn the required credits, at least to the extent of minimum credits specified in clause 9.1 and then register for the project semester.

10.0 DISCIPLINE

10.1 Every student is required to observe discipline 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 Institution.

10.2 Any act of indiscipline of a student reported to the Head of the Institution will be referred to a Discipline and Welfare Committee for taking appropriate action.

10.3 Every student should have been certified by the HOD that his / her conduct and discipline have been satisfactory.

11.0 ATTENDANCE REQUIREMENT AND SEMESTER / COURSE REPETITION

Attendance rules for all Full-time programme and Part-time – Day-time programmes are given in the following sub-clause.

11.1 A student should secure not less than 75% overall attendance in that semester taking into account the total no. of periods in all courses put together attended by the student as against the total no. of periods in all courses offered during that semester. If a student who could secure overall attendance between 65% and 75% only in a particular semester due to medical reasons (hospitalization / accident / specific illness) or due to participation in the College / University / State / National / International level sports events with prior permission from the Officials concerned shall be given exemption from the prescribed attendance requirement and he / she shall be permitted to appear for the current semester examinations.

The students who do not fulfill the above attendance requirement will not be permitted to write the semester end examination and will not be permitted to move to next semester. Such students should repeat all the courses of the semester in the next Academic year.

11.2 The faculty member of each course shall furnish the cumulative attendance details to the class advisor. The class advisor will consolidate and furnish the list of students who have earned less than 75% overall attendance, to the Dean (Academic Affairs) through the Head of the Department / School Dean. Thereupon, the Dean (Academic Affairs) shall issue orders preventing students from appearing for the semester end examination of all the courses of that semester.

11.3 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 whenever the course is offered. 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 (re-do) examination. If any student obtained "U" grade, the marks earned during the redo period for the continuous assessment for that course will be considered for further appearance as arrears.

11.4 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 not be permitted to write the semester end examination and his / her earlier 'U' grade and continuous assessment marks shall continue.

12.0 ASSESSMENTS AND EXAMINATIONS

12.1 The following rule shall apply to the full-time and part-time PG programmes (M.Tech./ M.C.A. / M.Sc.)

For lecture-based courses, normally a minimum of two assessments will be made during the semester. The assessments may be combination of tests and assignments. The assessment procedure as decided in the Class Committee will be announced to the students right from the beginning of the semester by the course teacher.

12.2 There shall be one examination of three hours duration, at the end of the semester, in each lecture based course.

12.3 The evaluation of the Project work will be based on the project report and a Viva-Voce Examination by a team consisting of the supervisor concerned, an Internal Examiner and External Examiner to be appointed by the Controller of Examinations.

12.4 At the end of industrial internship, the student shall submit a certificate from the organization and also a brief report. The evaluation will be made based on this report and a Viva-Voce Examination, conducted internally by a Departmental Committee constituted by the Head of the Department.

13.0 WEIGHTAGES

13.1 The following shall be the weightages for different courses:

i) Lecture based course

Two continuous assessments	- 50%
Semester-end examination	- 50%

ii) Laboratory based courses

Laboratory work assessment	- 75%
Semester-end examination	- 25%

iii) Project work

Periodic reviews	- 50%
Evaluation of Project Report by External Examiner	- 20%
Viva-Voce Examination	- 30%

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

13.3 The markings for all tests, tutorial, assignments (if any), laboratory work and examinations will be on absolute basis. The final percentage of marks is calculated in each course as per the weightages given in clause 13.1.

14.0 SUBSTITUTE EXAMINATION

14.1 A student who has missed for genuine reasons any one of the three assessments including semester-end examination 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 or admissions to a hospital due to illness, etc.

14.2 A student who misses any assessment in a course shall apply in a prescribed form to the Dean (Academic Affairs) through the Head of the department 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 COURSEWISE GRADING OF STUDENTS AND LETTER GRADES

15.1 Based on the semester performance, each student is awarded a final letter grade at the end of the semester in each course. The letter grades and the corresponding grade points are as follows, but grading has to be relative grading

Letter grade	Grade points
S	10
A	9
B	8
C	7
D	6
E	5
U	0
W	-
AB	-

Flexible range grading system will be adopted

"W" denotes withdrawal from the course.

"U" denotes unsuccessful performance in a course.

"AB" denotes absent for the semester end examination

15.2 A student is considered to have completed a course successfully if he / she secure five grade points or higher. A letter grade 'U' in any course implies unsuccessful performance in that course.

15.3 A course successfully completed cannot be repeated for any reason.

16.0 AWARD OF LETTER GRADE

16.1 A final meeting of the Class Committee without the student member(s) will be convened within ten days after the last day of the semester end examination. The letter grades to be awarded to the students for different courses will be finalized at the meeting.

16.2 After finalization of the grades at the class committee meeting the Chairman will forward the results to the Controller of Examinations, with copies to Head of the Department and Dean (Academic Affairs).

17.0 DECLARATION OF RESULTS

17.1 After finalization by the Class Committee as per clause 16.1 the Letter grades awarded to the students in the each course shall be announced on the

departmental notice board after duly approved by the Controller of Examinations.

17.2 In case any student feels aggrieved about the results, he/she can apply for revaluation after paying the prescribed fee for the purpose, within one week from the announcement of results.

A committee will be constituted by the concerned Head of the Department comprising of the Chairperson of the concerned Class Committee (Convener), the teacher concerned and a teacher of the department who is knowledgeable in the concerned course. If the Committee finds that the case is genuine, it may jointly revalue the answer script and forward the revised marks to the Controller of Examinations with full justification for the revision, if any.

17.3 The “U” and “AB” grade once awarded stays in the grade sheet of the students and is not deleted when he/she completes the course successfully later. The grade acquired by the student later will be indicated in the grade sheet of the appropriate semester.

18.0 COURSE REPETITION AND ARREARS EXAMINATION

18.1 A student should register to re-do a core course wherein "W" grade is awarded. If the student is awarded "W" grade in an elective course either the same elective course may be repeated or a new elective course may be taken.

18.2 A student who is awarded “U” or “AB” grade in a course shall write the semester-end examination as arrear examination, at the end of the next semester, along with the regular examinations of next semester courses.

18.3 A student who is awarded “U” or “AB” 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 whenever the course is offered. 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 end-semester (re-do) examination.

18.4 If any student obtained “U” or “AB” grade, the marks earned during the redo period for the continuous assessment for that course will be considered for further appearance as arrears.

18.5 If a student with “U” or “AB” grade prefers to redo any particular course fails to earn the minimum 75% attendance while doing that course, then he/she

will not be permitted to write the semester end examination and his / her earlier 'U' grade and continuous assessment marks shall continue.

19.0 GRADE SHEET

19.1 The grade sheet issued at the end of the semester to each student will contain the following:

(i) the credits for each course registered for that semester.

(ii) the performance in each course by the letter grade obtained.

(iii) the total credits earned in that semester.

(iv) the Grade Point Average (GPA) of all the courses registered for that semester and the Cumulative Grade Point Average (CGPA) of all the courses taken up to that semester.

19.2 The GPA will be calculated according to the formula

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

where C_i is the number of credits assigned for i^{th} course GP_i - Grade point obtained in the i^{th} course For the cumulative grade point average (CGPA) a similar formula is used except that the sum is over all the courses taken in all the semesters completed up to the point of time.

'W' grade will be excluded for GPA calculations.

'U', 'AB' and 'W' grades will be excluded for CGPA calculations.

19.3 Classification of the award of degree will be as follows:

CGPA	Classification
8.50 and above, having completed all courses in first appearance	First class with Distinction
6.50 and above, having completed within a period of 2 semesters beyond the programme period	First Class
All others	Second Class

However, to be eligible for First Class with Distinction, a student should not have obtained U grade in any course during his/her study and should have completed the PG Programme within a minimum period covered by the minimum duration (clause 3.1) plus authorized break of study, if any (clause 8). 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.

20.0 ELIGIBILITY FOR THE AWARD OF THE MASTERS DEGREE

20.1 A student shall be declared to be eligible for the award of the Masters Degree, if he/she has:

i) successfully acquired the required credits as specified in the Curriculum corresponding to his/her programme within the stipulated time,

ii) no disciplinary action is pending against him/her

20.2 The award of the degree must be approved by the University.

21.0 POWER TO MODIFY

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

CURRICULUM & SYLLABI FOR M.TECH. (COMPUTER AIDED DESIGN)

(FOUR SEMESTERS / FULL TIME)

CURRICULUM

SEMESTER I

Sl. No.	Course Code	Course Title	L	T	P	C
1.	MAB6183	Applied Mathematical Methods	3	1	0	4
2.	MEB6101	Research Methodology	3	0	0	3
3.	MEB6102	Applied Materials Engineering	3	0	0	3
4.	MEB6103	Computer Graphics and Geometric Modeling	3	0	0	3
5.	MEB6104	Finite Element Method	3	1	0	4
6.		Elective I	3	0	0	3
7.	MEB6105	CAD Laboratory	0	0	4	2
8.	MEB6106	Seminar	0	0	2	1
						23

SEMESTER II

Sl. No.	Course Code	Course Title	L	T	P	C
1.	MEB6211	Advanced Metrology and NDT	3	0	0	3
2.	MEB6212	Integrated Product Design	3	0	0	3
3.	MEB6213	Mechanical Vibrations	3	0	0	3
4.	MEB6214	Integrated Manufacturing Systems and Management	3	0	0	3
5.		Elective II	3	0	0	3
6.		Elective III	3	0	0	3
7.	MEB6215	CAM & Metrology lab	0	0	4	2
8.	MEB6216	Design / Fabrication Project	0	0	4	2
						22

SEMESTER III

Sl. No.	Course Code	Course Title	L	T	P	C
1.		Elective IV	3	0	0	3
2.		Elective V	3	0	0	3
3.		Elective VI	3	0	0	3
4.	MEB7102	Project Management	3	0	0	3
5.	MEB7101	Project Work - Phase I	0	0	12	6*
						12

SEMESTER IV

Sl. No.	Course Code	Course Title	L	T	P	C
1.	MEB7101	Project Work - Phase II	0	0	36	18*
		Total				**18 + 6 = 24**
						TOTAL CREDITS : 81

* Credits for Project Work Phase I to be accounted along with Project Work Phase II in IV Semester

LIST OF ELECTIVES

Sl. No.	Course Code	Course Title
1.	MEBY01	Advanced Mechanisms Design and Simulation
2.	MEBY02	Advanced Strength of Materials
3.	MEBY03	Advanced Tool Design
4.	MEBY04	Advances in manufacturing technology
5.	MEBY05	Artificial Intelligence
6.	MEBY06	CNC machines and Computer Aided manufacturing
7.	MEBY07	Computational Fluid Dynamics
8.	MEBY08	Computer Aided Process Planning
9.	MEBY09	Data Communication in CAD/CAM
10.	MEBY10	Design of Hydraulic & Pneumatic Systems
11.	MEBY11	Design of Material Handling Equipments
12.	MEBY12	Flexible Competitive Manufacturing Systems
13.	MEBY13	Industrial Robotics & Flexible Automation
14.	MEBY14	Industrial Safety Management
15.	MEBY15	Manufacturing Information Systems
16.	MEBY16	Mechatronics
17.	MEBY17	Newer Materials
18.	MEBY18	Optimization Techniques in Design
19.	MEBY19	Precision Engineering & Nano Technology
20.	MEBY20	Rapid Prototyping and Tooling
21.	MEBY21	Reliability and Total productive Maintenance
22.	MEBY22	Tribology
23.	SSB7181	Society, Technology & Sustainability

SEMESTER I

MAB6183 APPLIED MATHEMATICAL METHODS

L	T	P	C
3	1	0	4

OBJECTIVES:

- To familiarize students with boundary value problems of partial differential equations in engineering.
- To expose the students to variational formulation and numerical integration techniques.

MODULE I ONE DIMENSIONAL WAVE AND HEAT EQUATIONS 8

Laplace transform methods for one-dimensional wave equation – Displacements in a line string – longitudinal vibration of an elastic bar – Fourier transform methods for one-dimensional heat conduction problems in infinite and semi-infinite rods.

MODULE II ELLIPTIC EQUATION 8

Laplace equation – Properties of harmonic functions – Solution of Laplace's equation by means of Fourier transforms in a half plane, in an infinite strip and in a semi-infinite strip - Solution of Poisson equation by Fourier transform method.

MODULE III CALCULUS OF VARIATIONS 8

Variation and its properties – Euler's equation – Functional dependant on first and higher order derivatives – Functional dependant on functions of several independent variables – Variational problems with moving boundaries – Isoperimetric Problems – Direct methods – Ritz and Kantorovich methods.

MODULE IV NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS 8

Solution of Laplace's and Poisson equation on a rectangular region by Liebmann's method -Diffusion equation by the explicit and Crank Nicolson - Implicit methods - Stability and Convergence criterion - Solution of wave equation by explicit scheme.

MODULE V NUMERICAL INTEGRATION 5

Numerical Integration - Trapezoidal Rule, Simpson's Rule, Newton - Cotes Formula, Gauss Quadrature in one dimension and two dimensions.

MODULE VI CONFORMAL MAPPING AND APPLICATIONS 8

The Schwarz – Christoffel transformation – Transformation of boundaries in parametric form – Physical applications – Fluid flow and heat flow Problems.

Total Hours: 60

REFERENCES:

1. Sneddon, I.N., “Elements of Partial Differential Equations”, Mc Graw-Hill, 1986.
2. Gupta, A.S., “Calculus of Variations with Applications”, Prentice Hall of India Pvt. Ltd, New Delhi (1997)
3. Kreyszig, E., “Advanced Engineering Mathematics”, 8th Edition, John Wiley & Sons, Inc., Singapore (2002).
4. Rogers, D.F. and Adams, J, “Mathematical Elements for Computer Graphics”, 2nd Edition, Tata McGraw Hill Pub. Co. Ltd, New Delhi (2003).
5. Churchill, R.V., “Operational Mathematics”, McGraw Hill Kogakusha Ltd, Tokyo, 1981.
6. L.E. Elsgolts, “Differential equations and calculus of variations”, University Press of the Pacific, 2003.

OUTCOMES:

At the end of the course students will be able to

- Solve engineering problems using the concepts of Laplace transform, Fourier transform, Calculus of Variation and Conformal mapping.
- Solve heat and flow problems of one and two dimensional conditions using numerical methods.

MEB6101 RESEARCH METHODOLOGY L T P C
3 0 0 3

OBJECTIVE:

- To provide a perspective on research to the scholars so as to broaden their conceptions of what research involves.
- To impart knowledge on techniques related to research such as problem formulation, literature survey, information retrieval, use of statistical techniques, writing of research reports and evaluation
- To expose the scholars ethics in research and Intellectual Property Rights.

MODULE I RESEARCH PROBLEM FORMULATION 7

Research – objectives – types, Research process, Solving engineering problems, Identification of research topic, Formulation of research problem, Literature survey and review.

MODULE II RESEARCH DESIGN 8

Research design – meaning and need – basic concepts, Different research designs, Experimental design – principle – important experimental designs, Design of experimental setup, Mathematical modeling, Simulation – validation and experimentation, Dimensional analysis and similitude.

MODULE III USE OF STATISTICAL TOOLS IN RESEARCH 12

Importance of statistics in research – concept of probability – popular distributions – sample design. Hypothesis testing, ANOVA, Design of experiments – factorial designs – orthogonal arrays, Multivariate analysis – Curve fitting, Correlation and regression.

MODULE IV ANALYSIS AND INTERPRETATION OF DATA 10

Research Data analysis – interpretation of results – correlation with scientific facts, Accuracy and precision – error analysis, limitations, Use of optimization techniques – traditional methods – evolutionary optimization techniques.

MODULE V THE RESEARCH REPORT 8

Purpose of written report – audience, synopsis writing, preparing papers for International journals, Thesis writing – organization of contents – style of writing

– graphs and charts – referencing, Oral presentation and defence, Ethics in research, Patenting, Intellectual Property Rights.

Total Hours: 45

REFERENCES:

1. Ganesan R., Research Methodology for Engineers, MJP Publishers, Chennai, 2011.
2. Ernest O., Doebelin, Engineering Experimentation: planning, execution, reporting, McGraw Hill International edition, 1995.
3. George E. Dieter., Engineering Design, McGraw Hill – International edition, 2000.
4. Madhav S. Phadke, Quality Engineering using Robust Design, Printice Hall, Englewood Cliffs, New Jersey, 1989.
5. Kothari C.R., Research Methodology – Methods and Techniques, New Age International (P) Ltd, New Delhi, 2003.
6. Kalyanmoy Deb., "Genetic Algorithms for optimization", KanGAL report, No.2001002.
7. Holeman, J.P., Experimental methods for Engineers, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2007.
8. Govt. of India, Intellectual Property Laws; Acts, Rules & Regulations, Universal Law Publishing Co. Pvt. Ltd., New Delhi 2010.
9. University of New South Wales, "How to write a Ph.D. Thesis" Sydney, Australia, Science @ Unsw.
10. Shannon. R.E., System Simulation: the art and science, Printice Hall Inc, Englewood Cliffs, N.J.1995.
11. Scheffer. R.L. and James T. Mc Clave, Probability and Statistics for Engineers, PWS – Kent Publishers Co., Boston, USA, 1990.

OUTCOMES:

- Students will be able to acquire a perspective on research concepts.
- Students will be able to know the techniques related to research such as problem formulation, literature survey, information retrieval, use of statistical techniques, writing of research reports and evaluation
- Students will be exposed to the ethics in research and Intellectual Property rights

MEB6102 APPLIED MATERIALS ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To study the elastic, plastic and fracture behavior of engineering materials.
- To study the various modern materials, properties and their applications.
- To understand the selection of metallic and non-metallic materials for various engineering applications.

MODULE I ELASTIC AND PLASTIC BEHAVIOUR 12

Elasticity in metals and polymers - Mechanism of plastic deformation, role of dislocations, yield stress, shear strength of perfect and real crystals - Strengthening mechanisms, 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 behaviors -Super plasticity - Deformation of non crystalline material.

MODULE II FRACTURE BEHAVIOUR 15

Griffith's theory, stress intensity factor and fracture toughness - Toughening mechanisms - Ductile, brittle transition in steel - High temperature fracture, creep - Larson-Miller parameter – Deformation and fracture mechanism maps - Fatigue, low and high cycle fatigue test, crack initiation and propagation mechanisms and Paris law - Effect of surface and metallurgical parameters on fatigue - Fracture of non metallic materials – Failure analysis, sources of failure, procedure of failure analysis.

MODULE III SELECTION OF MATERIALS 8

Motivation for selection, cost basis and service requirements - Selection for mechanical properties, strength, toughness, fatigue and creep - Selection for surface durability corrosion and wear resistance – Relationship between materials selection and processing - Case studies in materials selection with relevance to aero, auto, marine, machinery and nuclear applications.

MODULE IV MODERN METALLIC MATERIALS 5

Dual phase steels, Micro alloyed, High strength low alloy (HSLA) steel, Transformation induced plasticity (TRIP) steel, Maraging steel - Intermetallics,

Ni and Ti aluminides - Smart materials, shape memory alloys - Metallic glass - Quasi crystal and nano crystalline materials.

MODULE V NON METALLIC MATERIALS 5

Polymeric materials - Formation of polymer structure - Production techniques of fibres, foams, adhesives and coatings - Structure, properties and applications of engineering polymers -Advanced structural ceramics, WC, TiC, TaC, AI2O3, SiC, Si3N4, CBN and diamond - properties, processing and applications.

Total Hours: 45

REFERENCES:

1. Thomas H.Courtney, “Mechanical Behaviour of Materials”, (2nd Edition), McGraw-Hill, 2000.
2. Charles J.A., Crane, F.A.A and Furness, J.A.G., “Selection and use of EngineeringMaterials ", (3rd Edition), Butterworth-Heiremann, 1977.
3. Flinn, R.A. and Trojan, P.K., “Engineering Materials and their Applications”, (4th Edition),Jaico, 1999.
4. George E.Dieter, “Mechanical Metallurgy”, McGraw Hill, 1988.
5. Metals Hand Book, Vol.10, “Failure Analysis and Prevention”, (10th Edition), 1994.

OUTCOMES:

- Students will be able to study the elastic, plastic and fracture behavior of engineering materials.
- Students will be able to study the various modern materials , properties and their applications.
- Students will be able to understand the selection of metallic and non-metallic materials for various engineering applications.

MEB6103 COMPUTER GRAPHICS AND GEOMETRIC MODELLING **L T P C 3 0 0 3**

OBJECTIVES:

- To acquire knowledge for generating high quality images of massive geometric models in a short time.
- To learn about the concepts of surface modeling, physically based modeling and surface visualization.

MODULE I IMAGE GENERATION AND MANIPULATION 9

Overview of display devices and systems – generation of primitives – 2D & 3D transformation –viewing transformation – projections.

MODULE II IMAGE ENHANCEMENT AND GRAPHICS STANDARDS 9

Clipping – Hidden line/surface removal – shading and rendering; Graphic standards – Computing shades – Data exchange standards – Data Communication Standards.

MODULE III MODELLING OF CURVES AND SURFACES 9

Curves: Parametric representation – Analytic curves; synthetic curves – Bicubic, Bezier, B-spline, NURBS; Surfaces: surface patches – Bicubic – Bezier – B-spline – Coons patch, Sweep surfaces; continuity conditions; manipulation of curves & surfaces.

MODULE IV MODELLING OF SOLIDS 9

Constructive Solid Geometry (CSG) – Boundary Models – Sweeping; Other methods of solid modeling; Constraint based modeling – parametric – variational; Feature based modeling; Data associativity; features of Solid modeling packages – current trends in modeling.

MODULE V GRAPHICS IN DESIGN AND MANUFACTURE 9

Graphical techniques in FEA: preprocessing – mesh generation techniques – error detection; Post processing – display of results – animated shapes; Graphical techniques in manufacture –estimation of material removal quantity – cutter and gauge detection – tool path generation; Rapid prototype – slicing techniques.

Total Hours: 45

REFERENCES:

1. Ibrahim Zeid, CAD / CAM- Theory and Practice, Mc Graw Hill International Edition, 1998.
2. Chris Mc Mahon and Jimmie Browne, CAD CAM – Principles, Practice and Manufacturing Management, 2nd edition, Pearson Education Asia LN, 2005.
3. Donald Hearn and Pauline Baker, Computer Graphics Printice Hall Inc.

OUTCOMES:

- Students would acquire knowledge for generating high quality images of massive geometric models in a short time.
- Students would learn about the concepts of surface modeling, physically based modeling and surface visualization.

MEB6104 FINITE ELEMENT METHOD L T P C
3 1 0 4

OBJECTIVES:

- To study the fundamentals of finite element method.
- To apply finite element method for solving one dimensional and two dimensional structural and thermal problems.
- To apply finite element method for non linear and structural dynamic problem.

MODULE I REVIEW OF ONE DIMENSIONAL FEM 9

FEM Methodology – Modeling and discretization Interpolation, elements, nodes and degrees-of-freedom-applications of FEA. One-Dimensional Elements: Bar element – beam element – assembly of elements – properties of stiffness matrices-boundary conditions-solution of equations-mechanical loads and stresses-thermal loads and stresses-example problems.

MODULE II REVIEW OF TWO AND THREE DIMENSIONAL FEM 9

Interpolation and shape functions - element matrices-linear triangular elements (CST)-quadratic triangular elements – bilinear rectangular elements- solid elements-higher order elements – stress calculations.

MODULE III APPLICATIONS TO FIELD PROBLEMS 9

Solution to problems in linear elasticity- plane problems in elasticity- plates and shells- solution of problems in heat-transfer and fluid mechanics- numerical examples- discussion on error estimates.

MODULE IV NON-LINEAR ANALYSIS 9

Non-linear problems in elasticity- some solution methods- plasticity: introduction, general formulation for small strains- formulation for von Mises theory- computational procedure- geometric non-linearity- modeling considerations.

MODULE V FINITE ELEMENTS IN STRUCTURAL DYNAMICS APPLICATIONS 9

Dynamic equations – mass and damping matrices – natural frequencies and modes – damping – reduction of number of degrees-of-freedom-response

history – model methods – Ritz vectors – component mode synthesis – harmonic response – direct integration techniques – explicit and implicit methods – analysis by response spectra – example problems.

Total Hours: 60

REFERENCES:

1. Reddy J.N. An Introduction to the Finite Element Method, McGraw Hill, International Edition, 1993.
2. Cook, Robert Davis et al "Concepts and Applications of Finite Element Analysis", Wiley, John & Sons, 1999.
3. Chandrupatla & Belagundu, "Finite Elements in Engineering", Prentice Hall of India Private Ltd., 1997.
4. Zienkiewicz.O.C, Taylor.R.L "The Finite Element Method" McGraw Hill International Editions, Fourth Edition, 1991, Volume 2.
5. Bathe, K.J., "Finite Element Procedures in Engineering Analysis, 1990.
6. S.S.Rao, Finite Element Analysis, 2002 Edition.
7. David V Hutton "Fundamentals of Finite Element Analysis". McGraw-Hill International Edition, 2004.

OUTCOMES:

- Students can study the fundamentals of finite element method.
- Students can apply finite element method for solving one dimensional and two dimensional structural and thermal problems.
- Students can apply finite element method fir nonlinear and structural dynamic problems.

MEB6105	CAD LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To review and train in CAD modeling.
- To train on various areas of finite element analysis of mechanical components.

LIST OF EXERCISES

1. Review of Computer Aided Drafting, Solid Modeling assembly and drawing generation using a CAD Package.
2. Analysis of Mechanical Components – Use of FEA packages, Exercises shall include FEA analysis of
   - i) Machine elements under static loads
   - ii) Heat transfer and Flow Analysis
   - iii) Determination of natural frequency
   - iv) Non-linear Analysis
   - v) Contact Analysis
   - vi) Fatigue Analysis
3. Use of kinematics and dynamics simulation software - Analysis of velocity & acceleration for mechanical linkages of different mechanisms.

OUTCOMES:

- Students will be able to review and train in CAD modeling.
- Students will be get trained on various areas of finite element analysis of mechanical components.

SEMESTER II

MEB6211 ADVANCED METROLOGY AND NDT

L	T	P	C
3	0	0	3

OBJECTIVE:

- To gain knowledge in the advanced measuring methods and the non destructive techniques.

MODULE I MEASURING MACHINES 9

Tool Maker's microscope - Co-ordinate measuring machines - Universal measuring machine - Laser metrology - Use of computers - Machine vision technology -Microprocessors in metrology.

MODULE II STATISTICAL QUALITY CONTROL 9

Data presentation - Statistical measures and tools - Process capability – control charts for variables and for attributes - Theory of probability – Sampling plants - Reliability and life testing.

MODULE III LIQUID PENETRANT AND MAGNETIC PARTICLE TESTS 9

Characteristics of liquid penetrates - different washable systems - Developers - applications - Methods of production of magnetic fields - Principles of operation of magnetic particle test - Applications - Advantages and limitations.

MODULE IV RADIOGRAPHY 9

Sources of ray-x-ray production - properties of Gamma and x rays - film characteristics - exposure charts - contrasts - operational characteristics of x ray equipment - applications.

MODULE V ULTRASONIC AND ACOUSTIC EMISSION TECHNIQUES 9

Production of ultrasonic waves - different types of waves - general characteristics of waves - pulse echo method - A, B, C scans - Principles of acoustic emission techniques - Advantages and limitations - Instrumentation and applications.

Total Hours: 45

REFERENCES:

1. JAIN, R.K. “Engineering Metrology", Khanna Publishers, 1997.
2. Barry Hull and Vernon John, " Non Destructive Testing ", MacMillan, 1988.
3. American Society for Metals, “Metals Hand Book", Vol. II, 1976.
4. Progress in Acoustic Emission, “Proceedings of 10th International Acoustic Emission Symposium", Japanese Society for NDI, 1990.

OUTCOME:

- Students would gain knowledge in the advanced measuring methods and the non destructive techniques.

MEB6212 INTEGRATED PRODUCT DESIGN

L	T	P	C
3	0	0	3

OBJECTIVE:

- To gain knowledge on multiple functional areas like marketing, finance, industrial design, engineering and production in creating a new product

MODULE I INTRODUCTION **8**

Need for IPPD-Strategic importance of Product development - integration of customer, designer, material supplier and process planner, Competitor and customer - behavior analysis. Understanding customer-promoting customer understanding-involve customer in development and managing requirements - Organization process management and improvement.

MODULE II CONCEPT GENERATION, SELECTION AND TESTING **10**

Plan and establish product specifications. Task - Structured approaches - clarification - search-externally and internally-Explore systematically - reflect on the solutions and processes - concept selection - methodology - benefits. Implications - Product change - variety - component standardization - product performance - manufacturability – Concept Testing Methodologies.

MODULE III PRODUCT ARCHITECTURE **8**

Product development management - establishing the architecture - creation - clustering - geometric layout development - Fundamental and incidental interactions - related system level design issues - secondary systems - architecture of the chunks - creating detailed interface specifications-Portfolio Architecture.

MODULE IV INDUSTRIAL DESIGN **8**

Integrate process design - Managing costs - Robust design - Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing processes electronically - Need for industrial design-impact – design process - investigation of customer needs - conceptualization - refinement - management of the industrial design process - technology driven products - user - driven products - assessing the quality of industrial design.

MODULE V DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT **11**

Definition - Estimation of Manufacturing cost-reducing the component costs and assembly costs – Minimize system complexity - Prototype basics - Principles of prototyping - Planning for prototypes - Economic Analysis - Understanding and representing tasks-baseline project planning - accelerating the project-project execution.

Total Hours: 60

REFERENCES:

1. Karl T.Ulrich and Steven D.Eppinger, Product Design and Development, McGraw Hill International Edns.1999
2. Concurrent Engg./Integrated Product Development. Kemnneth Crow, DRM
3. Associates, 6/3,Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book
4. Effective Product Design and Development, Stephen Rosenthal, Business One Orwin, Homewood, 1992,ISBN, 1-55623-603-4
5. Tool Design – Integrated Methods for successful Product Engineering, Stuart Pugh, Addison Wesley Publishing,Neyourk, NY, 1991, ISBN 0-202-41639-5

OUTCOME:

- Students would gain knowledge on multiple functional areas like marketing, finance, industrial design, engineering and production in creating a new product.

MEB6213 MECHANICAL VIBRATIONS L T P C
3 0 0 3

OBJECTIVES:

- To understand the fundamentals of vibration phenomenon and its measurement.
- To know the various constraints of vibration system and its analysis.
- To study the vibrations of various generic components, its effect on balancing and the devices for its measurements.

MODULE I FUNDAMENTALS OF VIBRATION 8

Review of Single degree system - Response to arbitrary periodic exicitations - Duhamel's Integral – Impulse Response function - Virtual work - Lagrange's equation - Single degree freedom forced vibration with elastically coupled viscous dampers - System Identification from frequency response - Transient Vibration – Laplace transformation formulation.

MODULE II TWO - DEGREE FREEDOM SYSTEMS 8

Free vibration of spring - coupled system - mass coupled system - Bending vibration of two degree of freedom system - forced vibration - Vibration Absorber - Vibration isolation.

MODULE III MULTI-DEGREE FREEDOM SYSTEM 12

Normal mode of vibration - Flexibility Matrix and Stiffness matrix - Eigen values and Eigen vectors – orthogonal properties - Modal matrix-Modal Analysis - Forced Vibration by matrix inversion - Modal damping in forced vibration - Numerical methods for fundamental frequencies

MODULE IV VIBRATION OF CONTINUOUS SYSTEMS 8

Systems governed by wave equations - Vibration of strings - vibration of rods - Euler Equation for Beams -Effect of Rotary inertia and shear deformation - Vibration of plates.

MODULE V MACHINE DYNAMICS 9

Vibration isolation – Role of foundation – Balancing of rotating and reciprocating masses in machines – Applications in machines like Turbines, Compressors, Grinding Machine and Presses.

Experimental Vibration Analysis - Vibration exciters, Sensors and Spectrum Analysers - Industrial case studies.

Total Hours: 45

REFERENCES:

1. Thomson, W.T. - "Theory of Vibration with Applications", CBS Publishers and Distributors, NewDelhi, 1990.
2. Rao, J.S., & Gupta, K. - "Introductory Course on Theory and Practice of Mechanical Vibrations", New Age International Ltd., 1984.
3. Den Hartog, J.P. "Mechanical Vibrations", Dover Publication 1990.
4. Rao, S.S., "Mechanical Vibrations", Addison Wesley Longman 1995.

OUTCOMES:

- Students can be able to understand the fundamentals of vibration phenomenon and its measurement.
- Students can be able to know the various constraints of vibration system and its analysis.
- Students can be able to study the vibrations of various generic components, its effect on balancing and the devices for its measurements.

MEB6214 INTEGRATED MANUFACTURING SYSTEMS AND MANAGEMENT **L T P C 3 0 0 3**

OBJECTIVES:

- To know about the Product life cycle and its management.
- To learn the Manufacturing strategies and compositeness.
- To understand the Designing of Products, facilities and jobs.
- To gain knowledge on Inventory systems, MRP and information control systems.

MODULE I FIELD OF MANUFACTURING MANAGEMENT 9

Introduction – Manufacturing Strategies and competitiveness-Meeting the competitive Project management-Product Life Cycle – Role of CIM in Modern Manufacturing Management.

MODULE II DESIGNING OF PRODUCTION PROCESSES 9

Process selection-Process flow Design – Operations Technology -Waiting line management-Computer simulation of waiting lines – Quality management.

MODULE III DESIGN OF FACILITIES AND JOBS 9

Capacity and Requirement planning – Strategies – Planning service capacity-JIT –Facility location and layout-Job Design and Work measurement. – Lean Manufacturing.

MODULE IV INVENTORY SYSTEMS AND MRP 9

Definition-Purposes of Inventory-Inventory models-Fixed order Quantity models and Fixed-time period models - MRP Systems-MRP system structures-Improvements in the MRP system-Advanced MRP-type systems.

MODULE V INFORMATION SYSTEM FOR MANUFACTURING 9

Parts oriented production information system - concepts and structure - computerized production scheduling, online production control systems, Computer based production management system, computerized manufacturing information system - case study.

Total Hours: 45

REFERENCES:

1. Chase, Aquilano and Jacobs, Production and Operations Management, , Tata McGraw Hill, eighth Edition.
2. Robert A. Olsen, Manufacturing management: a quantitative approach,International Textbook Co, 1968.
3. Chary S.N., Production and Operations Management, Tata McGraw-Hill, 3rd Edition 2006.
4. Jay Heizer, Barry Render Production and Operations Management: Strategic and Tactical Decisions, Business & Economics – 1996.
5. Jae K. Shim, Joel G. Siegel, Operations Management,- Business & Economics – 1999.

OUTCOMES:

- Students would know about the Product life cycle and its management.
- Students would learn the Manufacturing strategies and compositeness.
- Students would understand the Designing of Products, facilities and jobs.
- Students would gain knowledge on Inventory systems, MRP and information control systems.

MEB6215	CAM & METROLOGY LAB	L T P C 0 0 4 2

OBJECTIVES:

- To train on part programming and program generation from a CAD model.
- To train on machining in various CNC machines.
- To train on various modern measuring instruments.

LIST OF EXERCISES :

1. Computer Aided Manufacturing

(i) Automatic Program Generation for CNC Machining using advanced CAM Packages

(ii) Machining of components in VMC and Turning Center using programs generated by CAM packages

(iii) Machining using special machining cycles in Fanuc and Siemens controllers

2. Metrology

(i) Measurement of dimensional features in complex components like engine block or cylinder head using CMM

(ii) Cloud point data generation for Free form surfaces using CMM

(iii) Automated inspection using Vision system

(iv) Surface roughness measurement

(v) Comprehensive reverse engineering of industrial components

OUTCOMES:

- Students would get trained on part programming and program generation from a CAD model
- Students would get trained on machining in various CNC machines
- Students would get trained on various modern measuring instruments

MEB6216	DESIGN / FABRICATION PROJECT	L	T	P	C
		0	0	4	2

The main objective is to inculcate problem based learning and to promote team spirit.

Students will be asked to take a real world problem and solve it by designing or fabricating a system

The students will work in groups.

SEMESTER III

MEB7102	PROJECT MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To acquire knowledge on project planning, implementation and analysis.
- To give an exposure on network analysis and Project scheduling.

MODULE I INTRODUCTION & PROJECT INITIATION 9

Introduction to PM: Projects in Contemporary Organization, Project Life Cycle Project Initiation: Strategic Management, Project Selection & Evaluation, Selection Criteria & Models.

MODULE II RISK ANALYSIS 9

Risk Management, Portfolio Process, Project Proposals, Project manager: Demands on Project manager, Selecting the Project Manager, Multicultural Communication, Project Organization: Organizational Concepts in PM, Selecting an Organizational Form.

MODULE III PROJECT PLANNING & IMPLEMENTATION 9

Project Planning: Systems integration, WBS, Responsibility Charts, Interface Coordination, Conflict and Negotiation in PM: Nature of Negotiation, Conflict and Project Life Cycle.

Project Implementation: Budgeting and Cost Estimation: Estimating Project Budgets, Improving Cost.

MODULE IV NETWORK ANALYSIS & PROBLEMS 9

Algorithms for shortest route problems-Dijkstra's, Flyod's, and Dantzig's algorithms; Algorithms for minimal spanning tree- Kruskal's algorithm and Prim's algorithm; Algorithms for maximal flow problems. Maximum flow minimum cut explanation.

Estimation Process, Scheduling: Background, Network Techniques: PERT & CPM, Risk Analysis.

MODULE V PROJECT SCHEDULING WITH LIMITED RESOURCES 9

Complexity of project scheduling with limited resources, leveling the demands on key resources, A simple heuristic program for resource allocation.

REFERENCES:

1. A Management Guide to PERT/CPM, Jerome, D. Weist and Ferdinand K. Levy, Prentice Hall of India, New Delhi, 1994.
2. Projects Planning, Implementation and Control, Prasanna Chandra, Tata McGraw-Hill, Publishing Company Ltd., New Delhi, 1995.
3. Operations Research: Principles and Practice, Ravindran, A. Phillips, Don T. and Solberg, James J. Second edition, John Wiley & Sons, 1987.
4. Project Management with CPM and PERT, Moder J.V. and Phillips, C.R.E. Van Nostrand Reinhold Company, 1964.
5. Project Management and Control, Narendra Singh, Himalaya Publishing

OUTCOME:

- On completion of the course the student will be able to plan, schedule, analyze and execute the project effectively.

ELECTIVES

		L	T	P	C
MEBY01	**ADVANCED MECHANISMS DESIGN AND SIMULATION**	**3**	**0**	**0**	**3**

OBJECTIVE:

- To provide knowledge in the kinematic analysis of mechanisms and their synthesis

MODULE I INTRODUCTION **9**

Review of fundamentals of kinematics-classifications of mechanisms-components of mechanisms – mobility analysis – formation of one D.O.F. multi loop kinematic chains, Network formula – Gross motion concepts-Basic kinematic structures of serial and parallel robot manipulators-Compliant mechanisms-Equivalent mechanisms.

MODULE II KINEMATIC ANALYSIS **9**

Position Analysis – Vector loop equations for four bar, slider crank, inverted slider crank, geared five bar and six bar linkages. Analytical methods for velocity and acceleration Analysis– four bar linkage jerk analysis. Plane complex mechanisms-auxiliary point method. Spatial RSSR mechanism-Denavit-Hartenberg Parameters – Forward and inverse kinematics of robot manipulators.

MODULE III PATH CURVATURE THEORY, COUPLER CURVE **9**

Fixed and moving centrodes, inflection points and inflection circle. Euler Savary equation, graphical constructions – cubic of stationary curvature. Four bar coupler curve-cusp-crunode-coupler driven six-bar mechanisms-straight line mechanisms.

MODULE IV SYNTHESIS OF FOUR BAR MECHANISMS **9**

Type synthesis – Number synthesis – Associated Linkage Concept. Dimensional synthesis – function generation, path generation, motion generation. Graphical methods-Pole technique-inversion technique-point position reduction-two, three and four position synthesis of four- bar mechanisms. Analytical methods- Freudenstein's Equation-Bloch's Synthesis.

MODULE V SYNTHESIS OF COUPLER CURVE BASED MECHANISMS & CAM MECHANISMS 9

Cognate Lingages-parallel motion Linkages. Design of six bar mechanisms-single dwell-double dwell-double stroke. Geared five bar mechanism-multi-dwell. Cam Mechanisms- determination of optimum size of cams. Mechanism defects. Study and use of Mechanism using Simulation Soft-ware packages. Students should design and fabricate a mechanism model as term project.

Total Hours: 45

REFERENCES:

1. Robert L.Norton., "Design of Machinery",Tata McGraw Hill, 2005.
2. Sandor G.N., and Erdman A.G., "Advanced Mechanism Design Analysis and Synthesis", Prentice Hall, 1984.
3. Uicker, J.J., Pennock, G. R. and Shigley, J.E., "Theory of Machines and Mechanisms", Oxford University Press, 2005.
4. Amitabha Ghosh and Asok Kumar Mallik, "Theory of Mechanism and Machines", EWLP, Delhi, 1999.
5. Kenneth J, Waldron, Gary L. Kinzel, "Kinematics, Dynamics and Design of Machinery", John Wiley-sons, 1999.
6. Ramamurti, V., "Mechanics of Machines", Narosa, 2005.

OUTCOME:

- Students are expected to have understood the kinematic analysis and synthesis of four bar mechanism, coupler curve based mechanism and cam mechanism.

MEBY02 ADVANCED STRENGTH OF MATERIALS

L	T	P	C
3	0	0	3

OBJECTIVE:

- To provide knowledge in the design of 2D and 3D members by understanding their state of stresses and the design of curved members and non circular sections.

MODULE I ELASTICITY **9**

Stress-Strain relations and general equations of elasticity in Cartesian, Polar and curvilinear 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. Energy methods.

MODULE II SHEAR CENTER AND UNSYMMETRICAL BENDING **10**

Location of shear center for various thin sections - shear flows. Stresses And deflections in beams subjected to unsymmetrical loading-kern of a section.

MODULE III CURVED FLEXIBLE MEMBERS AND STRESSES IN FLAT PLATES **10**

Circumference and radial stresses – deflections - curved beam with restrained ends - closed ring subjected to concentrated load and uniform load - chain links and crane hooks. Solution of rectangular plates – pure bending of plates – deflection – uniformly distributed load – various end conditions.

MODULE IV TORSION OF NON-CIRCULAR SECTIONS **7**

Torsion of rectangular cross section - St.Venants theory - elastic membrane analogy - Prandtl's stress function - torsional stress in hollow thin walled Stress

MODULE V STRESSES IN ROTARY SECTIONS AND CONTACT STRESSES **9**

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

Total Hours: 45

REFERENCES:

1. Arthur P Boresi, Richard J. Schmidt, “Advanced mechanics of materials”,John Wiley, 2002.
2. Timoshenko and Goodier, "Theory of Elasticity", McGraw Hill.
3. Robert D. Cook, Warren C. Young, "Advanced Mechanics of Materials", Mc millan pub. Co., 1985.
4. Srinath. L.S., “Advanced Mechanics of solids”, Tata McGraw Hill, 1992.
5. Ryder G H ,Strength of Materials Macmillan, India Ltd, 2007

OUTCOME:

- The students are expected to Analyze two dimensional complex stress problems; Calculate stress and deflections in curved beams, Analyze torsion of non circular and thin walled sections.

MEBY03 ADVANCED TOOL DESIGN L T P C
3 0 0 3

OBJECTIVES:

- To study the basic concepts of tool design.
- To design various tooling such as cutting tools, Jigs and fixtures, press tools and CNC machine tools.

MODULE I TOOL-DESIGN METHODS 5

Introduction – The Design Procedure – Statement of the problem – The Needs Analysis –Research and Ideation – Tentative Design Solutions – The Finished Design – Drafting and Design Techniques in Tooling drawings – Screws and Dowels – Hole location – Jig-boring practice –Installation of Drill Bushings – Punch and Die Manufacture – Electro-discharge machining –Electro-discharge machining for cavity.

MODULE II TOOLING MATERIALS AND HEAT TREATMENT 9

Introduction – Properties of Materials – Ferrous Tooling Materials – Tool steels – Cast Iron – Mild, or low-carbon Steel – Nonmetallic Tooling Materials – Nonferrous Tooling Materials – Metal cutting Tools – Single-point cutting tools – Milling cutters – Drills and Drilling – Reamer classification –Taps – Tap classification- the selection of carbide cutting tools – Determining the insert thickness for carbide tools.

MODULE III DESIGN OF DRILL JIGS 9

Introduction – Fixed Gages – Gage Tolerances – The selection of material for Gages – Indicating Gages – Automatic gages – Principles of location – Locating methods and devices – Principles of clamping – Drill jigs – Chip formation in drilling – General considerations in the design of drill jigs – Drill bushings – Methods of construction – Drill jigs and modern manufacturing.

MODULE IV DESIGN OF FIXTURES AND DIES 14

Introduction – Fixtures and economics – Types of Fixtures – Vise Fixtures – Milling Fixtures –Boring Fixtures – Broaching Fixtures – Lathe Fixtures – Grinding Fixtures – Types of Die construction – Die-design fundamentals – Blanking and Piercing die construction – Pilots – Strippers and pressure pads-

Presswork materials – Strip layout – Short-run tooling for Piercing – Bending dies – Forming dies – Drawing operations.

MODULE V TOOL DESIGN FOR NUMERICALLY CONTROLLED MACHINE TOOLS 8

Introduction – The need for numerical control – A basic explanation of numeric control – Numerical control systems in use today – Fixture design for numerically controlled machine tools – Cutting tools for numerical control – Tool holding methods for numerical control – Automatic tool changers and tool positioners – Tool presetting – Introduction – General explanation of the Brown and sharp machine – tooling for Automatic screw machines.

Total Hours: 45

REFERENCES:

1. Cyrll Donaldson, George H.LeCain, V.C. Goold, “Tool Design”, Tata McGraw Hill Publishing Company Ltd., 2000.
2. Prakash Hiralal Joshi, “Tooling data”, Wheeler Publishing, 2000.

OUTCOMES:

- Students will be able to study the basic concepts of tool design.
- Students will be able to design various tooling such as cutting tools, Jigs and fixtures, press tools and CNC machine tools.

MEBY04 ADVANCES IN MANUFACTURING TECHNOLOGY **L T P C**
3 0 0 3

OBJECTIVES:

- To study the various newer machining processes and their applications.
- To understand the concepts of various micro fabrication devices and technology.

MODULE I METAL CUTTING AND TOOL MATERIALS **12**

Orthogonal and oblique cutting - Types of tool wear, Abrasion, Diffusion, Oxidation, Fatigue and Adhesive wear - Prediction of tool life - Monitoring of tool wear, Cutting forces and vibration – Tool materials, Cemented carbide, Coated carbide, Cermets, Ceramic, CBN and PCD - Selection of machining parameters and Tools.

MODULE II SPECIAL MACHINING **9**

Deep hole drilling - Gun drills - Gun boring - Trepanning - Honing - Lapping - Super finishing - Burnishing - Broaching - High speed machining.

MODULE III UNCONVENTIONAL MACHINING **9**

Principles, processes, Various influencing parameters and Applications of Ultrasonic machining, Electro Discharge Machining, Electro Chemical Machining, Electron and Laser Beam Machining, Plasma Arc Machining and Water Jet Machining.

MODULE IV RAPID PROTOTYPING **6**

Stereo lithography - Laminated object manufacturing - selective laser sintering - Vacuum process casting – Resin injection - Applications of RPT - Micro finishing process.

MODULE V ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS **9**

Introduction - Pattern recognition - Control strategies - Heuristic search, Forward and Backward reasoning - Search algorithms - Game playing - Knowledge representation - structural representation of knowledge – Expert systems in manufacturing.

Total Hours: 45

REFERENCES:

1. Armarego E.J.A. and Brown R.H., “The machining of metals ", Prentice Hall, 1982.
2. Battacharya," Theory of metal cutting ", NCB Agency, 1984.
3. HMT Manual, “Non-traditional machining methods ", 1975.
4. Rich E. and Knight K., “Artificial Intelligence ", McGraw Hill Inc, 1991.
5. Pham D.T., “Expert Systems in Engineering ", IFS Publishers, Springer-Verlag, 1988.
6. Durvent W.R., “The Lithographic hand book ", Narosa Publishers, 1995.
7. Pandey P.S. and Shah N. “Modern Manufacturing Processes ", 1980.
8. Sadasivan T.A. and Sarathy D. “Cutting tools for Productive Machining ", Widia (India) Limited, 1999.

OUTCOMES:

- Students will be able to know the various newer machining processes and their applications.
- Students will be able to understand the concepts of various micro fabrication devices and technology.

MEBY05 ARTIFICIAL INTELLIGENCE L T P C
3 0 0 3

OBJECTIVE:

- To learn about the fundamentals of artificial intelligence and application tools.
- To know about the implementation of artificial intelligence in Industry and the suspected problems.

MODULE I INTRODUCTION TO ARTIFICIAL INTELLIGENCE 9

Definition, Three AI branches- Expert Systems, Natural language systems, Perception for vision, speech and touch-Eminent domains-misconception-human intelligence- Development of an system: goal, fact obtaining data- rules, inferences- verification thro- the inference Mechanism.

MODULE II KNOWLEDGE BASED SYSTEMS 9

Identification – knowledge bases- knowledge- representation – methods-reasoning strategies frames, rules- logic, scamentic network. Object oriented programming- acquiring knowledge from an expert.

MODULE III AI APPLICATION DEVELOPMENT TOOLS 8

Building a knowledge system- choosing a tool for building expert system-inheritance- A knowledge base tool with data base feature application areas-problem features.

MODULE IV AI IN INDUSTRY 10

Planning and scheduling- Project management-factory simulation- Long term planning and integration of knowledge systems. Sales, design, Manufacturing, distribution, field services and Expert system integration- Diagnosis and Trouble shooting overview of robots applications- Welding, spray painting, grinding-Pa…. handling transfer, assembly operation, parts sorting and inspection.

MODULE V PERCEPTION AND WARNING 9

Techniques used in solving, perceptual problems-constraint satisfaction, random learning and Neural nets, concept learning by analogy, Introduction to AI Programming language.

Total Hours: 45

REFERENCES:

1. Winston, P.H., “Artificial Intelligence”, Addision Wesley.
2. Nilsson, N.J., “Principles of Artificial Intelligence”,
3. Rich, E., “Artificial Intelligence”, Mc Graw Hill, 1983.
4. Rauch Hindin.B., “A guide to commercial Artificial Intelligence – Fundamentals and real world applications”, Prentice Hall, Englewood Cliffs, New Jerscy.
5. Klafter, Richard D., and Chemieleswski,A., “ Robotic Engineering”, Prentice Hall international Editions.

OUTCOMES:

- Students will be able to learn about the fundamentals of artificial intelligence and application tools.
- Students will be able to know about the implementation of artificial intelligence in Industry and the suspected problems.

MEBY06 CNC MACHINES AND COMPUTER AIDED MANUFACTURING

L	T	P	C
3	0	0	3

OBJECTIVE:

- To impart in depth knowledge of Computer Numerical Machines and various programming modules involved in Computer Aided Manufacturing system.

MODULE I INTRODUCTION TO CNC MACHINE TOOLS 7

Development of CNC Technology, principles, features, advantages, economic benefits, applications, CNC, DNC concept, classification of CNC Machine, types of control, CNC controllers, characteristics, interpolators.

MODULE II STRUCTURE OF CNC MACHINE TOOL 9

CNC Machine building, structural details, configuration and design, guideways - friction and anti friction and other types of guide ways, elements used to convert the rotary motion to a linear motion - Screw and nut, recirculating ball screw, planetary roller screw, recirculating roller screw, rack and pinion, torque transmission elements - gears, timing belts, flexible couplings, Bearings.

MODULE III DRIVES AND CONTROLS 9

Spindle drives - DC shunt motor, 3 phase AC induction motor, feed drives - stepper motor, servo principle, DC & AC servomotors. Open loop and closed loop control, Axis measuring system - synchro, synchro-resolver, gratings, moire fringe gratings, encoders, inductosyn, laser interferometer.

MODULE IV CNC PROGRAMMING 10

Coordinate system, structure of a part program, G & M Codes, Manual part programming for Fanuc, Heidenhain, Sinumeric control system, CAPP, APT part programming using CAD/CAM, Parametric Programming.

MODULE V TOOLING AND MAINTENANCE OF CNC 10

Cutting tool materials, carbide insets classification, qualified, semi qualified and preset tooling, tooling system for Machining centre and Turning centre, work holding devices, maintenance of CNC Machines.

Total Hours: 45

REFERENCES:

1. HMT, Mechatronics, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1998.
2. James Madison, “CNC Machining Hand Book ", Industrial Press Inc., 1996.
3. Steve Krar, Arthur Gill, “CNC Technology and Programming ", McGraw-Hill International Editions, 1990.
4. Berry Leathan - Jones, “Introduction to Computer Numerical Control ", Pitman, London, 1987.
5. Hans B.Kief, T.Fredericx Waters, “Computer Numerical Control ", MacMillan / McGraw-Hill, 1992.
6. Bernard Hodgers, “CNC Part Programming Work Book ", city and Guids / Macmillan, 1994.
7. David Gribbs, “An Introduction to CNC Machining ", Cassell, 1987.
8. Sadasivan, T.A. and Sarathy, D, “Cutting Tools for Productive Machining ", Widia (India) Ltd., August 1999.
9. Radhakrishnan, P. “Computer Numerical Control Machines ", New Central Book Agency, 1992.
10. Peter Smid, “CNC Programming Hand Book ", Industrial Press Inc., 2000.

OUTCOME:

- At the end of this course the students are expected to be knowledgeable in CAD/CAM integration, CNC Structure and its drives and control system details, CNC machine tool and work holding devices, CNC programming for various operating systems used in CNC machine, various module of Part programming using manual method and generation of CNC codes and maintenance of CNC machines.

MEBY07 COMPUTATIONAL FLUID DYNAMICS

L	T	P	C
3	0	0	3

OBJECTIVE:

- To provide an overview of the theory and numerics of CFD and an introduction to the use of commercial CFD codes to analyze flow and heat transfer in problems of practical engineering interest.

MODULE I GOVERNING DIFFERENTIAL EQUATION AND FINITE DIFFERENCE METHOD **10**

Classification, Initial and Boundary conditions – Initial and Boundary Value problems – Finite difference method, Central, Forward, Backward difference, Uniform and non-uniform Grids, Numerical Errors, Grid Independence Test.

MODULE II CONDUCTION HEAT TRANSFER **10**

Steady one-dimensional conduction, Two and three dimensional steady state problems, Transient one-dimensional problem, Two-dimensional Transient Problems.

MODULE III INCOMPRESSIBLE FLUID FLOW **10**

Governing Equations, Stream Function – Verticity method, Determination of pressure for viscous flow, SIMPLE Procedure of Patankar and Spalding, Computation of Boundary layer flow, finite difference approach.

MODULE IV CONVECTION HEAT TRANSFER AND FEM **10**

Steady One-Dimensional and Two-Dimensional Convection – diffusion, Unsteady one-dimensional convection – diffusion, Unsteady two-dimensional convection – Diffusion – Introduction to finite element method – solution of steady heat conduction by FEM – Incompressible flow – simulation by FEM.

MODULE V TURBULENCE MODELS **5**

Algebraic Models – One equation model, K – ε Models, Standard and High and Low Reynolds number models, Prediction of fluid flow and heat transfer using standard codes.

Total Hours: 45

REFERENCES:

1. Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 1995.
2. Ghoshdasdidar, P.S., "Computer Simulation of flow and heat transfer" Tata McGraw-Hill Publishing Company Ltd., 1998.
3. Subas, V.Patankar "Numerical heat transfer fluid flow", Hemisphere Publishing Corporation, 1980.
4. Taylor, C and Hughes, J.B. "Finite Element Programming of the Navier- Stokes Equation", Pineridge Press Limited, U.K., 1981.
5. Anderson, D.A., Tannehill, J.I., and Pletcher, R.H., "Computational fluid Mechanics and Heat Transfer " Hemisphere Publishing Corporation, New York, USA,1984.
6. Fletcher, C.A.J. "Computational Techniques for Fluid Dynamics 1" Fundamental and General Techniques, Springer – Verlag, 1987.
7. Fletcher, C.A.J. "Computational Techniques for fluid Dynamics 2" Specific Techniques for Different Flow Categories, Springer – Verlag, 1987.Bose, T.X., "Numerical Fluid Dynamics" Narosa Publishing House, 1997.

OUTCOME:

- At the end of the course students will understand the process of developing a geometrical model of the flow, applying appropriate boundary conditions, specifying solution parameters, and visualizing the results. They will also have an appreciation for the factors limiting the accuracy of CFD solutions.

MEBY08 COMPUTER AIDED PROCESS PLANNING

L	T	P	C
3	0	0	3

OBJECTIVE:

- To impart the knowledge of computer aided process planning and various approach of process planning in manufacturing cycle.

MODULE I INTRODUCTION **9**

The Place of Process Planning in the Manufacturing cycle - Process Planning and Production Planning – Process Planning and Concurrent Engineering, CAPP, Group Technology.

MODULE II PART DESIGN REPRESENTATION **9**

Design Drafting - Dimensioning - Conventional tolerance - Geometric tolerance - CAD - input / output devices - topology - Geometric transformation - Perspective transformation - Data structure - Geometric modelling for process planning - GT coding - The optiz system - The MICLASS system.

MODULE III PROCESS ENGINEERING AND PROCESS PLANNING **9**

Experienced, based planning - Decision table and decision trees - Process capability analysis - Process Planning - Variant process planning - Generative approach - Forward and Backward planning, Input format, AI.

MODULE IV COMPUTER AIDED PROCESS PLANNING SYSTEMS **9**

Logical Design of a Process Planning - Implementation considerations - manufacturing system components, production Volume, No. of production families - CAM-I, CAPP, MIPLAN, APPAS, AUTOPLAN and PRO, CPPP.

MODULE V AN INTERGRADED PROCESS PLANNING SYSTEMS **9**

Totally integrated process planning systems - An Overview - Modulus structure - Data Structure, operation - Report Generation, Expert process planning.

Total Hours: 45

REFERENCES:

1. Gideon Halevi and Roland D. Weill, “Principles of Process Planning ", A logical approach, Chapman & Hall, 1995.

2. Tien-Chien Chang, Richard A.Wysk, "An Introduction to automated process planning systems ", Prentice Hall, 1985.

3. Chang, T.C., “An Expert Process Planning System ", Prentice Hall, 1985.

4. Nanua Singh, “Systems Approach to Computer Integrated Design and Manufacturing ", John Wiley & Sons, 1996.

5. Rao, “Computer Aided Manufacturing ", Tata McGraw Hill Publishing Co., 2000.

OUTCOME:

- At the end of this course the students are expected to be acquainted the computer aided process planning in detail in manufacturing process, the place of implementation, various approaches and its developments in manufacturing cycle.

MEBY09 DATA COMMUNICATION IN CAD/CAM

L	T	P	C
3	0	0	3

OBJECTIVE:

- To provide knowledge on the various data communication tools used to transfer data in the CAD / CAM environment.

MODULE I DIGITAL COMPUTERS & MICRO PROCESSORS 9

Block diagram - register transfer language - arithmetic, logic and shift micro operations - instruction code - training and control instruction cycle - I/O and interrupt design of basic computer. Machine language - assembly language - assembler.

Registers ALU and Bus Systems - timing and control signals - machine cycle and timing diagram - functional block diagrams of 80 x 86 and modes of operation. Features of Pentium Processors.

MODULE II OPERATING SYSTEM & ENVIRONMENTS 9

Types - functions - UNIX & WINDOWS NT - Architecture - Graphical User Interfaces.

Compilers - Analysis of the Source program - the phases of a compiler - cousins of the compiler, the grouping of phases - compiler construction tools.

MODULE III COMMUNICATION MODEL 9

Data communication and networking - protocols and architecture - data transmission concepts and terminology - guided transmission media - wireless transmission - data encoding - asynchronous and synchronous communication - base band interface standards RS232C, RS449 interface.

MODULE IV COMPUTER NETWORKS 9

Network structure - network architecture - the OSI reference model services - network standardization – example - Managing remote systems in network - network file systems - net working in manufacturing.

MODULE V INTERNET 9

Internet services - Protocols - intranet information services - mail based service

- system and network requirements - Internet tools - usenet - e-mail - IRC - www - FTP - Telnet.

Total Hours: 45

REFERENCES:

1. Morris Mano. M., “Computer System Architecture”, Prentice Hall of India, 1996.
2. Gaonkar R.S., “Microprocessor Architecture, Programming and Applications of 8085”, Penram International, 1997
3. Peterson J.L., Galvin P. and Silberschaz, A., “Operating Systems Concepts”, Addison Wesley, 1997.
4. Alfred V. Aho, Ravi Setjhi, Jeffrey D Ullman, “Compilers Principles Techniques and Tools”, Addison Wesley, 1986.
5. William Stallings, “Data of Computer Communications”, Prentice Hall of India, 1997.
6. Andrew S. Tanenbanum “Computer Networks”, Prentice Hall of India 3rd Edition, 1996.
7. Christian Crumlish, “The ABC's of the Internet”, BPB Publication, 1996.

OUTCOME:

- Students are expected to have knowledge in the operating systems, communication models, computer networks and internet protocols.

MEBY10 DESIGN OF HYDRAULIC & PNEUMATIC SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the various fluid power system and their application.
- To understand the designing of various fluid power circuits for a particular application.
- To learn the modern controls for fluid power system and their maintenance.

MODULE I OIL HYDRAULIC SYSTEMS AND ACTUATORS 5

Hydraulic Power Generators - Selection and specification of pumps, pump characteristics. Hydraulic actuators - Linear and Rotary Actuators - selection, specification and characteristics.

MODULE II CONTROL AND REGULATION ELEMENTS 10

Pressure, direction and flow control valves - relief valves, non return and safety valves – actuation systems.

MODULE III HYDRAULIC CIRCUITS 8

Reciprocation, quick return, sequencing, synchronizing circuits - accumulator circuits – industrial circuits –Hydraulic press circuits - milling machine, grinding, planning, copying, forklift, and earth mover circuits - design and selection of components - safety and emergency manuals.

MODULE IV PNEUMATIC SYSTEMS AND CIRCUITS 15

Pneumatic fundamentals - control elements, position and pressure sensing - logic circuits - switching circuits - fringe conditions modules and their integration - sequential circuits – cascade methods - mapping methods – step counter method - compound circuit design – combination circuit design.

MODULE V INSTALLATION, MAINTENANCE AND SPECIAL CIRCUITS 7

Pneumatic equipments - selection of components - design calculations - application - fault finding –hydro pneumatic circuits - use of microprocessors for sequencing - PLC, Low cost automation - Robotic circuits.

Total Hours: 45

REFERENCES:

1. Antony Espossito, “Fluid power with Applications”, Prentice Hall, 1980.
2. Dudleyt, A.Pease and John J.Pippenger, “Basic Fluid Power”, Prentice Hall, 1987.
3. Andrew Parr, “Hydraulic and Pneumatics”, (HB), Jaico Publishing House, 1999.
4. Bolton. W. “Pneumatic and Hydraulic Systems”, Butterworth - Heineman, 1997.
5. Majumdar, “Oil Hydraulics Systems: Principles and Maintenance” Tata McGraw Hill, 2004
6. Majumdar, “Pneumatic system : Principles and Maintenance” Tata McGrawHill, 2004.

OUTCOMES:

- Students will be able to study the various fluid power system and their application.
- Students will be able to understand the designing of various fluid power circuits for a particular application.
- Students will be able to learn the modern controls for fluid power system and their maintenance.

MEBY11 DESIGN OF MATERIAL HANDLING EQUIPMENTS

L	T	P	C
3	0	0	3

OBJECTIVE:

- To impart the knowledge of material handling equipments and its design.

MODULE I MATERIALS HANDLING EQUIPMENT **5**

Types, selection and applications

MODULE II DESIGN OF HOISTS **10**

Design of hoisting elements: Welded and roller chains - Hemp and wire ropes - Design of ropes, pulleys, pulley systems, sprockets and drums, Load handling attachments. Design of forged hooks and eye hooks – crane grabs - lifting magnets - Grabbing attachments - Design of arresting gear - Brakes: shoe, band and cone types.

MODULE III DRIVES OF HOISTING GEAR **10**

Hand and power drives - Traveling gear - Rail traveling mechanism - cantilever and monorail cranes - slewing, jib and luffing gear - cogwheel drive - selecting the motor ratings.

MODULE IV CONVEYORS **10**

Types - description - design and applications of Belt conveyors, apron conveyors and escalators Pneumatic conveyors, Screw conveyors and vibratory conveyors.

MODULE V ELEVATORS **10**

Bucket elevators: design - loading and bucket arrangements - Cage elevators - shaft way, guides, counter weights, hoisting machine, safety devices - Design of fork lift trucks.

Total Hours: 45

REFERENCES:

1. Rudenko, N., Materials handling equipment, ELnvee Publishers, 1970.
2. Spivakovsy, A.O. and Dyachkov, V.K., Conveying Machines, Volumes I and II, MIR Publishers, 1985.

3. Alexandrov, M., Materials Handling Equipments, MIR Publishers, 1981.

4. Boltzharol, A., Materials Handling Handbook, The Ronald Press Company, 1958.

5. P.S.G. Tech., "Design Data Book", Kalaikathir Achchagam, Coimbatore, 2003.

6. Lingaiah. K. and Narayana Iyengar, "Machine Design Data Hand Book", Vol.1 & 2, Suma Publishers, Bangalore, 1983

OUTCOME:

- At the end of this course the students are expected to understand the design background for material handling equipments, selection of material handling equipment and its materials according to their applications.

MEBY12	FLEXIBLE COMPETITIVE MANUFACTURING SYSTEMS	L T P C 3 0 0 3

OBJECTIVE:

- To impart knowledge on the swiftness and flexibility of changes in the manufacturing technology.

MODULE I MANUFACTURING SYSTEMS & CONTROL 9

Automated Manufacturing Systems - Modelling - Role of performance modelling - simulation models- Analytical models. Product cycle - Manufacturing automation - Economics of scale and scope - input/output model - plant configurations. Performance measures - Manufacturing lead-time - Work in process -Machine utilization - Throughput – Capacity - Flexibility - performability - Quality. Control Systems - Control system architecture - Factory communications - Local area networks - Factory net works - Open systems interconnection model - Net work to network interconnections - Manufacturing automation protocol - Database management system.

MODULE II MANUFACTURING PROCESSES 9

Examples of stochastic processes - Poisson process Discrete time Markov chain models - Definition and notation - Sojourn times in states - Examples of DTMCs in manufacturing - Chapman - Kolmogorov equation - Steady-state analysis. Continuous Time Markov Chain Models - Definitions and notation - Sojourn times in states - examples of CTMCs in manufacturing - Equations for CTMC evolution - Markov model of a transfer line.

Birth and Death Processes in Manufacturing - Steady state analysis of BD Processes - Typical BD processes in manufacturing.

MODULE III QUEUING MODELS 9

Notation for queues - Examples of queues in manufacturing systems - Performance measures - Little's result - Steady state analysis of M/M/m queue, queues with general distributions and queues with breakdowns - Analysis of a flexible machine center.

MODULE IV QUEUING NETWORKS 9

Examples of QN models in manufacturing - Little's law in queuing networks -

Tandem queue - An open queuing network with feed back - An open central server model for FMS - Closed transfer line - Closed server model - Garden Newell networks.

MODULE V PETRI NETS **9**

Classical Petri Nets - Definitions - Transition firing and reachability - Representational power - properties - Manufacturing models. Stochastic Petri Nets - Exponential timed Petri Nets - Generalized Stochastic Petri Nets - modelling of KANBAN systems - Manufacturing models.

Total Hours: 45

REFERENCES:

1. Viswanadham, N and Narahari, Y. “Performance Modelling of Automated Manufacturing Systems”, Prentice Hall of India, New Delhi, 1994.
2. Trivedi, K.S., “Probability and Statistics with Reliability, Queuing and Computer Science Applications”, Prentice Hall, New Jersey, 1982.
3. Gupta S.C., & Kapoor V.K., “Fundamentals of Mathematical Statistics”, 3rd Edition, Sultan Chand and Sons, New Delhi, 1988.

OUTCOME:

- At the end of this course the students are expected to knowledgeable on the quality improvement, automation, and advanced manufacturing techniques to create the highest-caliber products quickly, efficiently, inexpensively, and in synchronization with the marketing, sales, and customer service of the company.

MEBY13 INDUSTRIAL ROBOTICS & FLEXIBLE AUTOMATION

L	T	P	C
3	0	0	3

OBJECTIVE:

- The objective of this course is to introduce the basic concepts in Robotics The course will illustrate the robot kinematics, sensors, effectors, control systems, and briefly discuss robot application in industry.

MODULE I INTRODUCTION AND ROBOT KINEMATICS 10

Definition need and scope of Industrial robots – Robot anatomy – Work volume – Precision movement – End effectors – Sensors. Robot Kinematics – Direct and inverse kinematics – Robot trajectories – Control of robot manipulators – Robot dynamics – Methods for orientation and location of objects.

MODULE II ROBOT DRIVES AND CONTROL 9

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 9

Transducers and Sensors – Sensors in Robot – Tactile sensor – Proximity and range sensors – Sensing joint forces – Robotic vision system – Image Grabbing – Image processing and analysis – Image segmentation – Pattern recognition – Training of vision system.

MODULE IV ROBOT FOR FLEXIBLE AUTOMATION 9

Robot work cell design and control – Safety in Robotics – Robot cell layouts – Multiple Robots and machine interference – Robot cycle time analysis. Industrial application of robots.

MODULE V ROBOT PROGRAMMING, AI & EXPERT SYSTEMS 8

Methods of Robot Programming – Characteristics of task level languages lead through programming methods – Motion interpolation. Artificial intelligence – Basics – Goals of artificial intelligence – AI techniques – problem representation in AI – Problem reduction and solution techniques - Application of AI and KBES in Robots.

Total Hours: 45

REFERENCES:

1. Fu .K.S., R.C. Gonzalez and C.S.G. Lee, “Robotics Control, Sensing, Vision and Intelligence”, Mc Graw Hill, 1987.
2. Yoram Koren, “Robotics for Engineers”, Mc Graw-Hill, 1987.
3. Kozyrey, Yu. “Industrial Robots”, MIR Publishers Moscow, 1985.
4. Richard. D, Klafter, Thomas, A, Chmielewski, Michael Negin, “Robotics Engineering – An Integrated Approach”, Prentice-Hall of India Pvt. Ltd., 1984.
5. Deb, S.R. “Robotics Technology and Flexible Automation”, Tata Mc Graw-Hill, 1994.
6. Mikell, P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey, “Industrial Robotics Technology, Programming and Applications”, Mc Graw-Hill, Int. 1986.
7. Timothy Jordanides et al, “Expert Systems and Robotics”, Springer –Verlag, New York, May 1991.

OUTCOME:

- On completion of this course, the students are expected to have knowledge in the working of principle robots and there usage in the industrial environment. They are expected to create scaled down working robots for projects.

MEBY14 INDUSTRIAL SAFETY MANAGEMENT **L T P C**
3 0 0 3

OBJECTIVE:

- To introduce the various safety measures and accident prevention methods to be followed in the industry.

MODULE I SAFETY MANAGEMENT **9**

Evaluation of modern safety concepts - Safety management functions - safety organization, safety department - safety committee, safety audit - performance measurements and motivation - employee participation in safety - safety and productivity.

MODULE II OPERATIONAL SAFETY **9**

Hot metal Operation - Boiler, pressure vessels - heat treatment shop - gas furnace operation - electroplating-hot bending pipes - Safety in welding and cutting. Cold-metal Operation - Safety in Machine shop - Cold bending and chamfering of pipes - metal cutting - shot blasting, grinding, painting - power press and other machines.

MODULE III SAFETY MEASURES **9**

Layout design and material handling - Use of electricity - Management of toxic gases and chemicals - Industrial fires and prevention - Road safety - highway and urban safety - Safety of sewage disposal and cleaning - Control of environmental pollution - Managing emergencies in Industries - planning, security and risk assessments, on- site and off site. Control of major industrial hazards.

MODULE IV ACCIDENT PREVENTION **9**

Human side of safety - personal protective equipment - Causes and cost of accidents. Accident prevention programmes - Specific hazard control strategies - HAZOP - Training and development of employees - First Aid- Fire fighting devices - Accident reporting, investigation.

MODULE V SAFETY, HEALTH, WELFARE & LAWS **9**

Safety and health standards - Industrial hygiene - occupational diseases prevention - Welfare facilities - History of legislations related to Safety-pressure

vessel act-Indian boiler act - The environmental protection act - Electricity act - Explosive act.

Total Hours: 45

REFERENCES:

1. John V. Grimaldi and Rollin H. Simonds, “Safety Management”, All India Travelers bookseller, New Delhi-1989.
2. Krishnan N.V., “Safety in Industry”, Jaico Publisher House, 1996.
3. Occupational Safety Manual BHEL.
4. Industrial safety and the law by P.M.C. Nair Publisher's, Trivandrum.
5. Managing emergencies in industries, Loss Prevention of India Ltd., Proceedings, 1999.
6. Singh, U.K. and Dewan, J.M., “Safety, Security and risk management”, APH Publishing Company, New Delhi, 1996.

OUTCOME:

- The students are expected to have knowledge in the safety laws, safety management, the safety rules to be followed at various places of the workplace and accident prevention measures to be followed.

MEBY15 MANUFACTURING INFORMATION SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVE:

- To impart and understand the concept of database and its development in detail which is involved in manufacturing information system.

MODULE I INTRODUCTION **5**

The evolution of order policies, from MRP to MRP II, the role of Production organization, Operations control.

MODULE II DATABASE **7**

Terminologies - Entities and attributes - Data models, schema and subschema - Data Independence – ER Diagram - Trends in database.

MODULE III DESIGNING DATABASE **13**

Hierarchical model - Network approach - Relational Data model -concepts, principles, keys, relational operations - functional dependence -Normalisation, types - Query languages.

MODULE IV MANUFACTURING CONSIDERATION **10**

The product and its structure, Inventory and process flow - Shop floor control - Data structure and procedure -various model - the order scheduling module, input / output analysis module the stock status database – the complete IOM database.

MODULE V INFORMATION SYSTEM FOR MANUFACTURING **10**

Parts oriented production information system - concepts and structure - computerised production scheduling, online production control systems, Computer based production management system, computerised manufacturing information system - case study.

Total Hours: 45

REFERENCES:

1. Luca G. Sartori, “Manufacturing Information Systems”, Addison-Wesley Publishing Company, 1988.

2. Date.C.J., “An Introduction to Database systems”, Narosa Publishing House, 1997.

3. Orlicky.G., “Material Requirements Planning”, McGraw-Hill Publishing Co., 1975.

4. Kerr.R, “Knowledge based Manufacturing Management”, Addison-wesley, 1991.

OUTCOME:

- On completion of this course, the students are expected to be conversant with order policies, data base terminologies, designing, manufacturing considerations and information system for manufacturing.

MEBY16 MECHATRONICS L T P C
3 0 0 3

OBJECTIVES:

- To learn the Mechatronics systems such as controls and drives, real time interfacing, data acquisition system, sensors for condition monitoring, mechanical controlling, automated manufacturing.
- To understand the basic concepts, properties and interfacing of controls and drives in the Mechatronics System Design.

MODULE I INTRODUCTION 3

Introduction to Mechatronics - Systems - Mechatronics in Products - Measurement Systems -Control Systems - Traditional design and Mechatronics Design.

MODULE II SENSORS AND TRANSDUCERS 12

Introduction - Performance Terminology - Displacement, Position and Proximity - Velocity and Motion – Force and Torque - Fluid pressure – Vibration Sensors - Temperature sensors – Light sensors - Selection of sensors - Signal processing - Servo systems.

MODULE II MICROPROCESSORS IN MECHATRONICS 15

Introduction - Architecture - Pin configuration - Instruction set - Programming of Microprocessors using 8085 instructions - Interfacing input and output devices - Interfacing D/A converters and A/D converters –Applications - Temperature control - Stepper motor control - Traffic light controller.

MODULE IV PROGRAMMABLE LOGIC CONTROLLERS 8

Introduction - Basic structure - Input / Output processing - Programming - Mnemonics Timers, Internal relays and counters - Data handling - Analog input / output - Selection of PLC. Introduction to Controllers.

MODULE V DESIGN AND MECHATRONICS 7

Designing - Possible design solutions - Case studies of Mechatronics systems.

Total Hours: 45

REFERENCES:

1. Michael B.Histand and David G. Alciatore, “Introduction to Mechatronics and Measurement Systems", McGraw-Hill International Editions, 1999.
2. Bradley, D.A., Dawson, D, Buru, N.C. and Loader, AJ., " Mechatronics ", Chapman and Hall, 1993.
3. Ramesh.S, Gaonkar, “Microprocessor Architecture, Programming and Applications ", Wiley Eastern, 1998.
4. Lawrence J.Kamm, “Understanding Electro-Mechanical Engineering, An Introduction to Mechatronics ", Prentice-Hall, 2000.
5. Ghosh, P.K. and Sridhar, P.R., 0000 to 8085, “Introduction to Microprocessors for Engineers and Scientists ", Second Edition, Prentice Hall, 1995.

OUTCOMES:

- Students will be able to learn the Mechatronics systems such as controls and drives, real time interfacing, data acquisition system, sensors for condition monitoring, mechanical controlling, automated manufacturing.
- Students will be able to understand the basic concepts, properties and interfacing of controls and drives in the Mechatronics System Design.

MEBY17 NEWER MATERIALS L T P C
3 0 0 3

OBJECTIVE:

- To know about the various new materials for modern applications and their manufacturing processes.

MODULE I INTRODUCTION 5

Chemistry and Classification of Polymers - Properties of Thermo Plastics - Properties of Thermosetting Plastics - Applications - Merits and Demerits.

MODULE II PROCESSING OF PLASTICS 12

Extrusion - Injection Moulding - Blow Moulding - Compression and Transfer Moulding - Casting –Thermo Forming.

MODULE III MACHINING AND JOINING OF PLASTICS 7

General Machining properties of Plastics - Machining Parameters and Their effect - Joining of Plastics - Mechanical Fastners - Thermal bonding - Press Fitting.

MODULE IV COMPOSITE MATERIALS AND PROCESSING 12

Fibres - Glass, Boron, Carbon, Organic, Ceramic and Metallic Fibers - Matrix Materials - Polymers,Metals and Ceramics – Composites Processing- Open Mould Processes, Bag Moulding,Compression Moulding with BMC and SMC - Filament winding - Pultrusion - Centrifugal Casting -Injection Moulding - Application of PMC's.

MODULE V PROCESSING OF METAL MATRIX COMPOSITES 9

Solid State Fabrication Techniques - Diffusion Bonding - Powder Metallurgy Techniques – Plasma Spray, Chemical and Physical Vapour Deposition of Matrix on Fibres - Liquid State Fabrication Methods - Infiltration - Squeeze Casting - Rheo Casting –Application of MMCS.

Total Hours: 45

REFERENCES:

1. Harold Belofsky, Plastics: “Product Design and Process Engineering”, Hanser Publishers, 1995.
2. Bera, E and Moet, A, “High Performance Polymers ", Hanser Publishers, 1991.
3. Hensen, F, “Plastics Extrusion technology ", Hanser Publishers, 1988.
4. Johannaber F, “Injection Moulding Machines ", Hanser Publishers, 1983.
5. Rauwendaal, C, “Polymer extrusion ", Hanser Publishers, 1990.
6. Rosatao, D.V., “Blow Moulding Handbook, Hanser Publisher, 1989.
7. Seamour,E.B., " Modern Plastics Moulding ", John Wiley.
8. John Dalmonte, “Plastics Moulding ", John Wiley.
9. Akira Kobyashi, “Machining of Plastics ", Mc-Graw Hill.
10. Krishan K.Chawla, “Composite Materials science and Engineering ", springer-Verlag, 1987.
11. Agarwal. D. and Broutman L.J., “Analysis and Performance of Fiber Composites ", Wiley, 1990.
12. Mallick, P.K. and Newman, S. “Composite Materials Technology ", Hanser Publishers, 1990.

OUTCOME:

- Students will be able to know about the various new materials for modern applications and their manufacturing processes.

MEBY18 OPTIMIZATION TECHNIQUES IN DESIGN

L	T	P	C
3	0	0	3

OBJECTIVE:

- To introduce the various optimization techniques with applications and their advancements in design engineering.

MODULE I INTRODUCTION **5**

General Characteristics of mechanical elements, adequate and optimum design, principles of optimization, formulation of objective function, design constraints – Classification of optimization problem.

MODULE II OPTIMIZATION TECHNIQUES **10**

Single variable and multivariable optimization, Techniques of unconstrained minimization – Golden section, Random, pattern and gradient search methods – Interpolation methods; Optimization with equality and inequality constraints.

MODULE III MULTI OBJECTIVE OPTIMIZATION **10**

Direct methods – Indirect methods using penalty functions, Lagrange multipliers; Geometric programming and stochastic programming; Multi objective optimization, Genetic algorithms and Simulated Annealing techniques.

MODULE IV STATIC APPLICATIONS **10**

Structural applications – Design of simple truss members. Design applications – Design of simple axial, transverse loaded members for minimum cost, maximum weight – Design of shafts and torsionally loaded members – Design of springs.

MODULE V DYNAMIC APPLICATIONS **10**

Dynamic Applications – Optimum design of single, two degree of freedom systems, vibration absorbers. Application in Mechanisms – Optimum design of simple linkage mechanisms.

Total Hours: 45

REFERENCES:

1. Johnson Ray, C., “Optimum design of mechanical elements”, Wiley, John & Sons, 1990.

2. Goldberg, D.E., “Genetic algorithms in search, optimization and machine”, Barnen, Addison-Wesley, New York, 1989.

3. Kalyanamoy Deb, “Optimization for Engineering design algorithms and Examples”, Prentice Hall of India Pvt. 1995.

OUTCOME:

- At the end of this course the students are expected to understand the make use of the optimization techniques while modeling and solving the engineering applications such static and dynamic problems of design field.

MEBY19 PRECISION ENGINEERING & NANO TECHNOLOGY **L T P C**
3 0 0 3

OBJECTIVE:

- To impart the principles of Precision Engineering, Nano Technology, Material based precision concept and its applications.

MODULE I MATERIALS FOR PRECISION ENGINEERING **8**

Introduction – Accuracy and Precision– Need for high precision – concept of accuracy – tolerance an fits: system – Hole and shaft system – expects accuracy of a Manufacturing process – types of fits – Selective assembly. Materials-Diamond – types-single crystal- PCD – Natural-synthetic CBN - Ceramics – coated metals and non-metals–High– performance polymer – alloys – refractory metals: cutting tools – performance – components of instruments – Jewels – self Lubrication – smart materials – properties – testing – applications.

MODULE II PRECISION MACHINING AND ERRORS **12**

Precision grinding: IC chip manufacturing- ELID process – aspherical surface generation Grinding wheel- Designer and selection of grinding wheel-High-speed grinding-High-speed milling-Micro machining – Diamond turning-MEMS – micro finishing process – surface roughness measures – concept and non-concept method – comparison of features with machining process. Static stiffness - influence on machining accuracy. Introduction – over all stiffness in a machine/instrument – errors due to variation of cutting forces – clamping forces – errors due to compliance while machining. Inaccuracy due to thermal effects: Heat sources –war dissipation – Geometry of thermal deformation-influence of forced iso-static dimensional wear of elements – instruments; Machining tools their influence an accuracy- error due to clamping and setting location.

MODULE III PRECISION MACHINE ELEMENTS **6**

Introduction- guide ways- Drive systems; rolling element bearings-Principles, construction, classification, application etc., -Lubricated sliding bearings-construction – Principles etc.,- Hydrostatics bearings-types – aerostatic bearings – linear drive motors – magnetic bearings- applications-limitations - advantages.

MODULE IV NANOMATERIALS SYNTHESIS AND CHARACTERIZATION 10

Amorphous, crystalline, microcrystalline, quasi-crystalline and nano-crystalline materials. Historical development of nanomaterials – Issues in fabrication and characterization of nanomaterials Methods of production of Nanoparticles, Sol-gel synthesis, Inert gas condensation, High energy Ball milling, Plasma synthesis, Electro deposition and other techniques. Synthesis of Carbon Nanotubes – Solid carbon source based production techniques, Gaseous carbon source based production techniques - Growth mechanisms-Nano wires. Scanning Probe Microscopy (SPM), Transmission electron microscope, Scanning transmission electron microscope, Atomic force microscope, Scanning thermal microscopy Nano indentation.

MODULE V APPLICATIONS OF NANOMATERIALS 9

Applications in Mechanical, Electronics engineering industries – Use of nanomaterials in automobiles, aerospace, defense and medical applications – Metallic, polymeric, organic and ceramic nanomaterials. LIGA, Ion beam etching, Molecular manufacturing techniques – Nano machining techniques, Top/Bottom up Nano fabrication techniques - Sub micron lithographic technique, conventional film growth technique, Chemical etching, Quantum materials.

Total Hours: 45

REFERENCES:

1. Murthy R.L., Precision Engineering in Manufacturing, New age Instruction Publishes 2005. New Delhi.
2. Venkatesh V.C. and Sudin, Izwan, Precision engineering: - Tata McGraw Hill Co., New Delhi, 2007.
3. Bandyopadhyay A.K., “Nano Materials”, New Age International Publishers, New Delhi, 2007
4. Bharat Bhushan, “Handbook of Nanotechnology”, Springer, Germany, 2004.
5. JAMESD, MEADOWS, - “Geometric Dimensioning and tolerancing”, Marcel Dekker Inc.1995
6. Mark Ratner and Daniel Ratner, “Nano Technology”, Pearson Education, New Delhi, 2003.

7. Gregory Timp, “Nanotechnology”, Springer, India, 2005

8. Ahmed Busnaina, “Nanomanufacturing Handbook”, CRC Press, London, 2006.

OUTCOME:

- At the end of this course the students are knowledgeable about the principle, application and need of precision, concept of part accuracy, Machining accuracy and aware of errors, and their sources. In addition, the students are acquainted about synthesis, characteristic and applications of nano materials.

MEBY20 RAPID PROTOTYPING AND TOOLING L T P C
3 0 0 3

OBJECTIVE:

- To provide knowledge on different types of Rapid Prototyping systems and its applications in various fields.

MODULE I INTRODUCTION 8

Need - Development of RP systems – RP process chain - Impact of Rapid Prototyping on Product Development –Digital prototyping - Virtual prototyping- Rapid Tooling - Benefits- Applications.

MODULE II REVERSE ENGINEERING AND CAD MODELING 10

Basic concept- Digitization techniques – Model Reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data Requirements – geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing and contour data organization, direct and adaptive slicing, Tool path generation.

MODULE III LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS 10

Stereolithography (SLA): Apparatus: Principle, per-build process, part-building, post-build processes, photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and applications.

Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications.Fused deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials and applications. laminated object manufacturing(LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies.

MODULE IV POWDER BASED RAPID PROTOTYPING SYSTEMS 10

Selective Laser Sintering(SLS): Principle, process, Indirect and direct SLS-powder structures, modeling of SLS, materials, post processing, post curing,

surface deviation and accuracy, Applications. Laser Engineered Net Shaping(LENS): Processes, materials, products, advantages, limitations and applications– Case Studies.

MODULE V OTHER RAPID PROTOTYPING TECHNOLOGIES 7

Three dimensional Printing (3DP):Principle, basic process, Physics of 3DP, types of printing, process capabilities, material system. Solid based, Liquid based and powder based 3DP systems, strength and weakness, Applications and case studies. Shape Deposition Manufacturing (SDM): Introduction, basic process, shape decomposition, mold SDM and applications. Selective Laser Melting, Electron Beam Melting – Rapid manufacturing.

Total Hours : 45

REFERENCES:

1. Chua C.K., Leong K.F., and Lim C.S., Rapid prototyping: Principles and applications, second edition, World Scientific Publishers, 2003.
2. Andreas Gebhardt, Hanser Gardener, Rapid prototyping, Publications, 2003.
3. Liou W.Liou, Frank W.Liou, Rapid Prototyping and Engineering applications: A tool box for prototype development, CRC Press, 2007.
4. Ali K. Kamrani, Emad Abouel Nasr, Rapid Prototyping: Theory and practice, Springer, 2006.
5. Peter D.Hilton, Hilton/Jacobs, Paul F.Jacobs,Rapid Tooling: Technologies and Industrial Applications, CRC press, 2000.

OUTCOME:

- The course expose the students to different types of Rapid prototyping processes, materials used in RP systems and reverse engineering.

MEBY21 RELIABILITY AND TOTAL PRODUCTIVE MAINTENANCE **L T P C 3 0 0 3**

OBJECTIVE:

- To convey the knowledge about failure analysis, concept of reliability, principle of maintenance and concept of total productive maintenance.

MODULE I RELIABILITY CONCEPT AND FAILURE DATA ANALYSIS 11

Reliability definition – Quality and Reliability– Reliability mathematics – Reliability functions – Hazard rate – Measures of Reliability – Design life –A priori and posteriori probabilities – Mortality of a component –Bath tub curve – Useful life. Failure Data Analysis-Data collection –Empirical methods: Ungrouped/ Grouped, Complete/Censored data – Time to failure distributions: Exponential, Weibull – Hazard plotting – Goodness of fit tests.

MODULE II RELIABILITY ASSESSMENT AND MONITORING 9

Different configurations – Redundancy – m/n system – Complex systems: RBD – Baye's method – Cut and tie sets – Fault Tree Analysis – Standby system. Reliability Monitoring-Life testing methods: Failure terminated – Time terminated – Sequential Testing –Reliability growth monitoring – Reliability allocation – Software reliability.

MODULE III RELIABILITY IMPROVEMENT 6

Analysis of downtime – Repair time distribution – System MTTR – Maintainability prediction – Measures of maintainability – System Availability – Replacement theory.

MODULE IV MAINTENANCE MODELS 10

Maintenance definition – Maintenance objectives – Maintenance management –Functions of maintenance department – Tero technology – Maintenance costs. Maintenance policies – Imperfect maintenance – PM versus b/d maintenance – Optimal PM schedule and product characteristics – Inspection decisions: Maximizing profit – Minimizing downtime – Replacement models.

MODULE V MAINTENANCE LOGISTICS, QUALITY AND TPM 9

Maintenance staffing – Human factors –Resource requirements: Optimal size of service facility – Optimal repair effort – Maintenance planning and scheduling

– Spares planning – Capital spare. Five Zero concept –FMECA – Maintainability prediction– Design for maintainability – Maintainability allocation – Reliability Centered Maintenance. TPM fundamentals – Chronic and sporadic losses – Six big losses – OEE as a measure – TPM pillars– Autonomous maintenance –TPM implementation.

Total Hours: 45

REFERENCES:

1. Charles E. Ebeling, “An introduction to Reliability and Maintainability engineering”, TMH, 2000.
2. Roy Billington and Ronald N. Allan, “Reliability Evaluation of Engineering Systems”, Springer, 2007.
3. Andrew K.S.Jardine & Albert H.C.Tsang, “Maintenance, Replacement and Reliability”, Taylor and Francis, 2006.
4. Bikas Badhury & S.K.Basu, “Tero Technology: Reliability Engineering and Maintenance Management”, Asian Books, 2003.
5. Seichi Nakajima, “Total Productive Maintenance”, Productivity Press, 1993.

OUTCOME:

- At the end of this course the students are expected to understand the essentiality of reliability engineering, reliability prediction and the implementation of total productive maintenance.

MEBY22 TRIBOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To expose to the basic principles of tribology and the most common industrial systems that experience friction and wear.
- To create an awareness of the importance of tribology in design and selection of machine elements.
- To familiarize engineering students with the basic concepts of tribology which would be useful in choosing and designing various tribological machine elements like bearings, gears, cams and constant velocity joints.

MODULE I SURFACES, FRICTION AND WEAR 8

Topography of Surfaces – Surface features – Surface interaction – Theory of Friction – Sliding and Rolling Friction, Friction properties of metallic and non-metallic materials – friction in extreme conditions – wear, types of wear – mechanism of wear – wear resistance materials – surface treatment – Surface modifications – surface coatings.

MODULE II LUBRICATION THEORY 8

Lubricants and their physical properties lubricants standards – Lubrication Regimes Hydrodynamic lubrication – Reynolds Equation, Thermal, inertia and turbulent effects – Elasto hydrodynamic and plasto hydrodynamic and magneto hydrodynamic lubrication – Hydro static lubrication – Gas lubrication.

MODULE III DESIGN OF FLUID FILM BEARINGS 12

Design and performance analysis of thrust and journal bearings – Full, partial, fixed and pivoted journal bearings design – lubricant flow and delivery – power loss, Heat and temperature rotating loads and dynamic loads in journal bearings – special bearings – Hydrostatic Bearing design.

MODULE IV ROLLING ELEMENT BEARINGS 10

Geometry and kinematics – Materials and manufacturing processes – contact stresses – Hertzian stress equation – Load divisions – Stresses and deflection – Axial loads and rotational effects, Bearing life capacity and variable loads – ISO standards – Oil films and their effects – Rolling Bearings Failures.

MODULE V TRIBO MEASUREMENT IN INSTRUMENTATION 7

Surface Topography measurements – Electron microscope and friction and wear measurements – Laser method – instrumentation - International standards – bearings performance measurements – bearing vibration measurement.

Total Hours: 45

REFERENCES:

1. Cameron, A. “Basic Lubrication Theory”, Ellis Herward Ltd., OK, 1981
2. Hulling, J. (Editor) – “Principles of Tribology “, Macmillian – 1984.
3. Williams J.A. “Engineering Tribology”, Oxford Univ. Press, 1994.
4. Neale, M.J. “Tribology Hand Book”, Butterworth Heinemann, 1995.

OUTCOMES:

- Have a comprehensive, systematic and integrated knowledge of the principles of friction, wear and lubrication.
- Have the ability to identify, analyse and address industrial friction and wear-related problems.
- Understand the differences between proactive & predictive maintenance and their applications in industry.

SSB7181 SOCIETY, TECHNOLOGY AND SUSTAINABILITY **L T P C**
3 0 0 3

OBJECTIVES:

- Aware of new technologies through advances in Science and Engineering.
- To make them realise the profound impact on society.
- Understand the ethical issues raised by technological changes and its effect on society.
- To introduce students a broad range of perspectives on the adoption and use of technologies.
- To make them realize the need of sustainability in the context of emerging technologies.

MODULE I TECHNOLOGY AND ITS IMPACTS **9**

Origin and evolution of technologies – Nature of technology- Innovation – Historical Perspective of technology – Sources of technological change - Co-evolution of technology and economy – Scientific knowledge and technological advance – Science and Engineering aspects of Technology – Impact on the Society – Social and Ethical Issues associated with technological change – Social and environmental consequences - Impact of technological change on human life –Technology and responsibility – Technology and social justice.

MODULE II TECHNOLOGY AND ITS ADVANCEMENT **9**

Sociological aspects of technology – Ethics and technology – Technology and responsibility – International Economics, Globalisation and Human Rights – Sustainability and Technology – Population and environment - Technology, Energy and Environment – Organisations and technological change.

MODULE III SOCIETY AND TECHNOLOGY **9**

Impact of technologies on contemporary society – Role of society in fostering the development of technology – Response to the adaption and use of technology – Impact of technology on developer and consumers – Technological change and globalisation.

MODULE IV IMPACT OF A SPECIFIC TECHNOLOGY ON HUMAN WELFARE 9

Impact of the following technologies on Human life – Medical and Biomedical – Genetics Technology – Electronics and Communications – Electronic media Technology – Information Systems Technology – Nanotechnology – Space Technology and Energy Technology.

MODULE V THE IMPORTANCE OF SUSTAINABILITY 9

Sustainability – A brief history – Concepts and contexts for sustainability – Ecological imbalance and biodiversity loss – Climate change – Population explosion. Industrial ecology – systems approach to sustainability – Green engineering and technology- sustainable design- sustainable manufacturing- Green consumer movements – Environmental ethics – Sustainability of the planet Earth – Future planning for sustainability.

Total Hours: 45

REFERENCES:

1. Volti Rudi, “Society and Technology Change”, 6th Edition, Worth publishers Inc, USA, 2009.
2. Arthur W.A, “The nature of Technology: What it is and how it evolves”, Free Press, NY, USA, 2009.
3. Winston M and Edelbach R, “Society, Ethics and Technology”, 3rd Edition, San Francisco, USA, 2005.
4. Martin A.A Abraham, ‘Sustainability Science and Engineering: Defining Principles’, Elsevier Inc, USA, 2006.
5. R.V.G.Menon, “Technology and Society”, Pearson Education, India, 2011.

OUTCOMES:

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

- understand the benefits of modern technology for the well-being of human life.
- connect sustainability concepts and technology to the real world challenges.
- find pathway for sustainable society.