P.S.R. ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Sevalpatti (P.O), Sivakasi – 626140.

Department of Mechanical Engineering

M.E., Engineering Design

CURRICULUM
AND
SYLLABI

PG

Regulations 2016

Department of Mechanical Engineering

CANDIDATES ADMITTED DURING 2019-2020 AND ONWARDS

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DEPARTMENT VISION & MISSION

Vision

- To provide broad-based education and training in mechanical engineering and its applications to enable the graduates to meet the demands in a rapidly changing needs in industry, academia and society.

Mission

- To impart high quality technical education and training that encompasses both theory and practices with human and social values
- To equip the students to face tomorrows technology embedded global changes
- To create, explore, and develop innovations in mechanical engineering research

Programme Specific Outcomes (PSOs)

- Ability to critical analysis and problem-solving skills required in the field of Thermal, Production and design engineering for carrying out research activities.
- Ability to conduct experiment and simulate the real life situations involved in engineering using computational techniques and instrumentation; and can work independently in research or industrial environments.
- Capability to present the acquired knowledge coherently both in oral and written discourse.
- Capability to compete the available employment opportunities and solve complex engineering problems related to production, Design, Thermal and allied industries using systematic tools.

PROGRAMME OUTCOMES (POs)

Engineering Graduates will be able to:

PO:1 Critical Thinking Ability to identify, critically analyze, formulate and solve complex engineering problems.

PO:2 Problem Solving Use research based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions in mechanical engineering.

PO:3 Social and Environmental Sustainability An ability to design, operate, control and maintain a mechanical system and process to meet desired needs within realistic constraints such as health, safety, legal, cultural, environmental and security issues related to manufacturability.

PO:4 Modern Tool Usage An ability to innovate and incorporation of novel research techniques with usage of the techniques, IT skills, and modern engineering tools for various changes in manufacturing engineering practice.

PO:5 Ethics Apply ethical principles and commit to professional ethics and responsibilities and norms of the mechanical engineering practice.

PO:6 Leadership Function affectively as an individual, and as a member or team leader in diverse and inter-disciplinary fields.

PO:7 Communication Communicate effectively through written and oral mediums; make effective presentations and exchanges clear instructions.

PO:8 Life-long Learning Ability to engage in independent research and lifelong learning in the broadest contest of technological changes in Mechanical engineering and allied fields.

P.S.R.ENGINEERING COLLEGE

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Tamil Nadu State

REGULATIONS FOR PG [M.E./MBA] PROGRAMME

UNDER CHOICE BASED CREDIT SYSTEM

[For the Students Admitted from the Academic Year 2016 - 2017 and Onwards]

[PG Regulation-2016]

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P.S.R.ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University, Chennai)

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Tamil Nadu State

REGULATIONS FOR UG [M.E./MBA] PROGRAMME

UNDER CHOICE BASED CREDIT SYSTEM

[For the Students Admitted from the Academic Year 2016 - 2017 and Onwards]

[PG Regulation-2016]

1. PRELIMINARY DEFINITIONS AND NOMENCLATURE

In these Regulations, unless the context otherwise requires:

i) "**Programme**" means Under Graduate Degree Programme (M.E./MBA)

ii) **"Branch"** means specialization or discipline of M.E. Degree Programme like "Applied Electronics", "Structural Engineering", etc.

iii) "**Course**" means Theory or Practical subject that is normally studied in a semester.

iv) "**Head of the Institution**" means the Principal of a College / Institution who is responsible for all academic activities of the College / Institution and for implementation of relevant Rules and Regulations.

v) **"Head of the Department"** means Head of the Department concerned.

vi) "**Controller of Examinations"** means the Authority of the College who is responsible for all activities of the Examinations.

vii) "**University**" means ANNA UNIVERSITY.

viii) **"College"** or **"Institution"** means P.S.R. Engineering College.

2. ELIGIBILITY FOR ADMISSION

2.1 Students for admission to the first semester of the Post Graduate Degree Programme shall be required to have passed an appropriate qualifying Degree Examination of Anna University or any examination of any other University as equivalent thereto.

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

2.3 Any other examinations as notified by the Government of Tamil Nadu

2.4 The Part-Time students should satisfy other conditions regarding experience, Sponsorship etc, prescribed by the AICTE / Anna University.

3. PROGRAMMES OFFERED& MODE OF STUDY

3.1 Programmes Offered

A student may be offered admission to any one of the following PG programme of study being offered in this college. The medium of instruction is English.

1. M.E. Computer Science and Engineering
2. M.E. Applied Electronics
3. M.E. Structural Engineering
4. M.E. Power Electronics and Drives
5. M.E. Engineering Design
6. Master of Business Administration (MBA)

3.2 Modes Of Study

3.2.1 Full Time

- Students admitted under 'Full-Time' should be available in the College during the entire duration of working hours for the curricular, co-curricular and extra-curricular activities.

- The Full-time students should not attend any other Full-time programme(s) / course(s) or take up any Full-Time job / Part-Time job during working hours in any Institution or company during the period of Full- Time programme. Violation of the above rules will result in cancellation of admission to the PG programme.

3.2.2 Part Time

In this mode of study, the students are required to attend classes conducted along with the Full Time students as per the curriculum.

4. STRUCTURE OF THE PROGRAMMES

4.1 Categorization of Courses

Every Post Graduate Degree Programme will have a curriculum with syllabi consisting of theory and practical courses that shall be categorized as follows:

i) **Foundation Courses (FC)** may include Mathematics or other basic courses

iv) **Programme Core (PC)** courses include the core courses relevant to the chosen specialization/branch, Project Work.

v) **Open Core (OC)** courses include the core courses relevant to the chosen specialization / branch which a student of other programmes can choose as an elective.

vi) **Programme Elective (PE)** courses include the elective courses relevant to the chosen specialization/ branch.

vii) **Open Elective (OE)** courses include the courses relevant to the chosen specialization / branch which a student can choose from the curriculum of other M.E.

viii) **Employability Skill Enhancement Courses (EEC)**include Internship, Seminar, Industrial/Practical Training etc.,

4.2 Credit Assignment

- One credit for each lecture period allotted per week
- One credit for two tutorial periods allotted per week
- One credit for each seminar/practical session of two periods per week.

4.3 Project Work

The Project work is an important component of Post-Graduate programmes. The Project work for M.E. consists of Phase – I and Phase – II. The Phase – I is to be undertaken during III semester and Phase – II, which is a continuation of Phase – I is to be undertaken during IV semester. For M.B.A. programme, the Project Work has to be undertaken in the final semester.

4.3.1 The Project work for M.E. (for Phase II Project work) and M.B.A, shall be pursued for a minimum of 16 weeks during the final semester.

4.3.2 The Project work shall be carried out under the supervision of a "qualified teacher" in the Department concerned. In this context "qualified teacher" means a faculty member possessing (i) PG degree with a minimum of 3 years of teaching experience or (ii) Ph.D. degree.

4.3.3 A student may, however, in certain cases, be permitted to work on projects in an Industrial / Research Organization, on the recommendations of the Head of the Department. In such cases, the Project work shall be jointly guided by a supervisor of the department and an expert as joint supervisor from the organization and the student shall be instructed to meet the supervisor periodically and to attend the review committee meetings for evaluating the progress.

4.4 Self Study Courses

Students may be permitted to credit one Self Study course with the approval of Departmental Consultative Committee.

The Department may offer self study courses. The purpose of the course is to permit the student to study a course / topic of the student's choice. The students shall study on their own under the guidance of a faculty member. No formal lectures need be delivered. The syllabus of the course and mode of assessments shall be approved by the Departmental Consultative Committee and formal approval of the course by the BOS/ Academic Council, preferably before the commencement of the semester. The self study course of 3 credits can be considered as one elective course. One Faculty member approved by the Head of the Department shall be responsible for the periodic monitoring and evaluation of the course.

5. DURATION OF THE PROGRAMMES

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

Programme	Min. No. of Semesters	Max. No. of Semesters
M.E. (Full-Time)	4	8
M.E. (Part Time)	6	12
MBA (Full Time)	4	8

5.2 Each semester shall normally consist of 90 teaching days (including examination days). The Head of the Department shall ensure that every faculty member imparts instruction as per the number of periods specified in the syllabus covering the full content of the syllabus for the course being taught.

5.3 The total duration for completion of the programme reckoned from the commencement of the first semester to which the student was admitted shall not exceed the maximum duration specified in clause 5.1 irrespective of the period of break of study (vide clause 18) or prevention (vide clause 7.3) in order that the student may be eligible for the award of the degree (vide clause 13).

5.4 The students shall complete the minimum prescribed credits required as per the curriculum of his/her programme for the award of the degree.

6. COURSE ENROLLMENT AND REGISTRATION

6.1 The students on admission have to register and study the courses prescribed in the curriculum in the student's first Semester of study.

6.2 Each student shall be assigned to a Faculty Advisor who shall advice and counsel the student about the details of the academic programme and the choice of courses considering the students' academic background and career objectives.

6.3 Every student shall enroll for the course of the succeeding semester before the last working day of the current semester as notified by the Principal. However, the student shall confirm the enrollment by registering for the courses within the first three working days after the commencement of the concerned semester.

6.4 If the student wishes, he/she may drop or add courses (from II to IV semesters only) within three working days after the commencement of the concerned semester and complete the registration process duly authorized by the Faculty Advisor. Total number of credits of such courses cannot exceed 6. However the maximum number of credits the student can register in a particular semester cannot exceed 30 credits (including courses for which the student has done reappearance registration).

6.5 No course shall be offered by a Department unless a minimum of 5 students register for that course.

6.6 The student shall register for the project work in the semester as specified in the curriculum.

6.7 After registering for a course, a student shall attend the classes, satisfy the attendance

requirements, earn Continuous Assessment marks and appear for the End Semester Examinations.

6.8 If the student wishes, the student shall register for theory courses in which the student has failed in the subsequent semesters when they are offered next (Reappearance Registration). The attendance requirement (vide clause 7) is not compulsory for such courses.

6.9 A student who has already appeared for a course in a semester and passed the examination is not entitled to reappear in the same course for improvement of letter grades / marks.

7. ATTENDANCE REQUIREMENTS FOR APPEARING SEMESTER EXAMINATION

A student who has fulfilled by the following conditions shall be deemed to have satisfied the requirements for appearing end semester examination of a particular course.

7.1 A student will be permitted to appear for the end semester examination of a course, only if he/she secures not less than 75% of attendance taking into account the number of periods required for that course as specified in the curriculum.

7.2 If a student secures attendance between 65% and less than 75% in any course in the current semester of his / her studies 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 Head of the Department concerned and Principal. The student shall be given exemption from the prescribed attendance requirement and the student shall be permitted to appear for the end semester examination of that course. In all such cases, the students should submit the required documents on joining after the absence.

7.3 Students who do not satisfy clause 7.1 and 7.2 and who secure less than 65%attendance in a course will not be permitted to write the End-Semester Examination of that course. The student has to register and repeat this course in a subsequent semester when it is offered next.

7.4 In the case of reappearance registration for a course, the attendancerequirement as mentioned in Clauses 7.1 - 7.3 is not applicable. However, the student has toregister for examination in that course by paying the prescribed fee.

8. ASSESSMENT PROCEDURE FOR AWARDING MARKS

All (M.E. / MBA) Programmes consist of Theory Courses, Practical Courses and Skill Enhancement Courses. Appearance in End Semester Examination is mandatory for all courses including Theory, Practical and Project work. Performance in each course of study shall be evaluated based on (i) Internal Assessments throughout the semester and (ii) End Semester Examination at the end of the semester. Each course shall be evaluated for a maximum of 100 marks as shown below:

Category	Internal Assessment	End Semester Examination
Theory Courses	30	70
Practical Courses	30	70
Project Work	30	70
Employability Skill Enhancement Courses (EEC)	100	Nil

8.1 **Internal Assessment For Theory Courses**

The criteria for determining the internal assessment marks are:

i) **Internal Tests [60% weightage]**

Three tests each carrying sixty (60) marks shall be conducted by the department / Institution. The total marks obtained in all tests put together out of 180, shall be reduced to 60 marks and rounded to nearest integer (this implies equal weight to all the three tests). However retest at the discretion of the head of the department may be conducted for the deserving candidates.

ii) **Assignment or Miniproject [20% weightage]**

A student has to carry out either an assignment or miniproject.

- An assignment normally requires work of average 5 to 6 hours of study and written work of average 5 to 6 hours which has to be submitted to the course tutor for evaluation.
- A mini project shall be in hardware or software. The student has to submit a report before the end of the semester. Mini project will be assessed based on the model presentation and report as decided by the department.

iii) **Seminar [10% weightage]**

The student has to make seminar on the topics related to the course. The students are expected to submit a report of his / her presentation. The seminar will be assessed by the course tutor with common parameters as described by the department.

iv) **Attendance [10% weightage]**

(refer clause 8.5)

8.2 **Internal Assessment For Practical Courses**

Every practical exercise / experiment shall be evaluated based on conduct of exercise / experiment and records maintained. There shall be at least one test. The criteria for determining the internal assessment marks are:

Experiment / Record / Average

Practical classes' performance: 60% weightage

Practical Test: 30% weightage

Attendance (refer clause 8.5): 10% weightage

8.3 **Internal and External Assessment For Project Works**

There shall be three assessments during the semester by a review committee. The students shall make presentation on the progress made before the committee. The criteria for arriving the internal assessment marks and external marks for the project work are:

Project Work	Internal (30)			External (70)			
	Review-1	Review-2	Review-3	Thesis Evaluation	Viva-voce		
					Supervisor	External	Internal
Phase-I	10	10	10	40	10	10	10
Phase-II	10	10	10	40	10	10	10

In all the above cases, the internal marks awarded for 100 marks shall be reduced to 30 Marks.

8.4 **Internal Assessment For Seminar / Employability Skill Enhancement Courses**

The courses under Skill Enhancement are evaluatedby Continuous Assessments only.The seminar / Case study shall carry 100 marks and shall be evaluated through continuous assessment only. Every student is expected to present a minimum of 2 seminars per semester before the evaluation committee and for each seminar, marks can be equally apportioned. The three member committee appointed by Head of the Department will evaluate the seminar and at the end of the semester the marks can be consolidated and taken as the final mark. The evaluation shall be based on the seminar paper / report (40%), presentation (40%) and response to the questions asked during presentation (20%).The Course Committee (vide clause 16) shall devise a common evaluation procedure.

8.5 **Awarding Marks for Attendance**

% of Attendance	Below 75	75	76-80	81-85	86-90	Above 90
Marks	0	2	4	6	8	10

The student on doing reappearance registration has to appear for the assessments along with the current batch of students and earn internal assessment marks again.

9. PASSING REQUIREMENTS

- For each course the examination will be conducted for 100 marks. A candidate who secures not less than 50% of the total marks in the end semester examinations and internal assessment put together in both theory and practical courses, including project work, subject to securing a minimum of 50% in the end-semester examination, wherever applicable, shall be declared to have passed the examination in that subject.

- When the mark secured for 100 in end-semester examination is converted to 70, minimum 35 marks must be secured for pass.

10 AWARD OF LETTER GRADES

The performance of a student will be reported using letter grades, each carrying certain points as detailed below:

Marks Scored	Letter Grade	Grade Points	Description
90 - 100	O	10	Outstanding
80 - 89	A +	9	Excellent
70 - 79	A	8	Very Good
60 - 69	B +	7	Good
55 - 59	B	6	above Average
50 - 54	C	5	Average
0 - 49	RA	0	Reappearance
Incomplete	SA / AB	0	Shortage of Attendance / Absent

'RA' denotes Reappearance registration is required for that particular course.

'SA' denotes shortage of attendance (as per Clause 7) and hence prevented from writing end semester examination.

11 GPA AND CGPA CALCULATION

11.1 After results are declared,Grade Sheets will be issued to each student which will contain the following details:

- the list of courses registered during the semester and the grades scored.
- the Grade Point Average (GPA) for the semester and
- the Cumulative Grade Point Average (CGPA) of all courses registered from first semester onwards.

During each semester, the list of courses registered and the grades scored in each course are used to compute the Grade Point Average (GPA). GPA is the ratio of the sum of the products of the number of credits of courses registered and the grade points corresponding to the grades scored in those courses, taken for all the courses, to the sum of the number of credits of all the courses in the semester.

$$GPA = \frac{\sum_{i=1}^{n} C_i GP_i}{\sum^{n} C_i}$$

Where,

Ci - is the Credits assigned to the course

GPi - is the grade point corresponding to the letter grade obtained for each course

n - is number of all Courses successfully cleared during the particular semester in the case of GPA and during all the semesters in the case of CGPA.

CGPA will be calculated in a similar manner, considering all the courses enrolled from first semester. “RA” and “SA” grades will be excluded for calculating GPA and CGPA.

11.2 If a student studies more number of electives (PE/OE) than required as per the student’s programme curriculum, the courses with higher grades alone will be considered for calculation of CGPA.

12 EXAMINATION PROCEDURE

End Semester examination shall be conducted by the office of the Controller of Examination of the College as per the prescribed rules and regulation on examinations of the college.

12.1 Issue of Mark Sheet

Individual mark sheet for each semester will be issued to the students, through the head of the department concerned, after the publication of the result.

The mark sheet will contain credit, grade, grade point and result status for the course concerned.

12.2 Malpractice

If a student indulges in malpractices in any of the end semester examination, he/she shall be liable for punitive action as prescribed by the Anna University, Chennai from time to time.

12.3 Revaluation

i) Copies of answer script for the theory course(s) can be obtained from the Office of the Controller of Examinations on payment of a prescribed fee specified for this purpose through proper application.

ii) A candidate can apply for revaluation of his/her examination answer paper in a theory course, within a week from the declaration of results, on payment of a prescribed fee through proper application to the Office of the Controller of Examinations, as per the prescribed norms of the College. Revaluation is not permitted for practical course and for project work.

iii) Re totaling is permissible for all arrear and current theory courses.

12.4 Challenging Valuation

In case the student is not satisfied with the outcome of the revaluation the student can apply for ‘Challenge Valuation’. The highest marks obtained by the student in all of the above will be considered for grading.

12.5 Supplementary Examinations

i) Supplementary Examinations is applicable only for the Reappearance (RA) courses.

ii) Supplementary Examinations may be conducted at weekends during the

Semester.

iii) Absent and Withdrawal candidates are also eligible to write Supplementary Examination.

iv) The application for supplementary examination has to be recommended and forwarded by the concerned HOD after due verification.

13 ELIGIBILITY FOR THE AWARD OF DEGREE

A student shall be declared eligible for the award of the M.E. / MBA degree provided the student has

i) Successfully gained the required number of total credits as specified in the curriculum corresponding to the student's programme within the stipulated time.

ii) Successfully completed the course requirements and has passed all the prescribed examinations in all the 4 semesters within a maximum period of 4 years from the commencement of first semester to which the student was admitted.

iii) Successfully passed any additional courses prescribed by the Director, Academic Courses whenever readmitted under regulations other than R-2016

iv) No disciplinary action pending against the student.

v) Approval by the University for the Award of degree.

14 CLASSIFICATION OF DEGREE

14.1 First Class With Distinction

A student who satisfies the following conditions shall be declared to have passed the examination in First class with Distinction:

- Should have passed the examination in all the courses of all the four semesters in First Appearance within three years, which includes authorized break of study of one year. Withdrawal from examination (vide Clause 17) will not be considered as an appearance.
- Should have secured a CGPA of not less than 8.50
- Should NOT have been prevented from writing end semester examination due to lack of attendance in any of the courses.

14.2 First Class

A student who satisfies the following conditions shall be declared to have passed the examination in **First class**:

- Should have passed the examination in all the courses of all four semesters **within three years**, which includes one year of authorized break of study (if availed) or prevention from writing the End Semester Examination due to lack of attendance (if applicable).

- Should have secured a CGPA of not less than 6**.50**

14.3 **Second Class**

All other students (not covered in clauses 14.1 and 14.2) who qualify for the award of the degree **(**vide Clause 12) shall be declared to have passed the examination in **Second Class**.

14.4 A student who is absent in semester examination in a course/ project work after having registered for the same shall be considered to have appeared in that examination (except approved withdrawal from end semester examinations as per clause 17) for the purpose of classification.

15 FACULTY ADVISOR

To help the students in planning their courses of study and for general advice on the academic programme, the Head of the Department of the students will attach a certain number of students to a faculty of the Department who shall function as Faculty Advisor for those students throughout their period of study. The Faculty Advisor shall advise the students in registering and reappearance registering of courses, authorizes the process, monitor their attendance and progress and counsel them periodically. If necessary, the Faculty Advisor may also discuss with or inform the parents about the progress / performance of the students concerned.

The responsibilities for the faculty advisor shall be:

- To inform the students about the various facilities and activities available to enhance the students' curricular and co-curricular activities.
- To guide student enrollment and registration of the courses.
- To authorize the final registration of the courses at the beginning of each semester.
- To monitor the academic and general performance of the students including attendance and to counsel them accordingly.

16 COURSE COMMITTEES

16.1 Common Course Committee

A theory course handled by more than one faculty member shall have a "Common Course Committee" comprising of all faculties teaching that course and some students who have registered for that course. There shall be two student representatives from each batch of that course. One of the faculty members shall be nominated as Course Coordinator by the Head of the Department duly approved by the Principal.

The first meeting of the Common Course Committee shall be held within fifteen days from the date of commencement of the semester. Two or three subsequent meetings in a semester may be held at suitable intervals**.** During these meetings, the student members shall meaningfully interact and express their opinions and suggestions of all the students to improve the effectiveness of the teaching-learning

process. It is the responsibility of the student representatives to convey the proceedings of these meetings to the whole batch.

In addition the faculty members of a Common Course shall meet to ensure uniform evaluation of continuous assessments and prepare a common question paper for the continuous assessment tests after arriving at a common scheme of evaluation for the assessments (vide clause 8). The question paper for the end semester examination is common.

16.2 Multiple Courses Committee

If course(s) handled by a single faculty member, there will be "Multiple Courses Committee". This committee comprises of all the above faculty members and two student representatives from each course. One of the above faculty members, nominated by the Head of the Department shall coordinate the activities of this committee.

The functions of this committee is similar to that of the common course committee, which is as follows:

The first meeting of the Multiple Courses Committee shall be held within fifteen days from the date of commencement of the semester. Two or three subsequent meetings in a semester may be held at suitable intervals**.** During these meetings, the student members shall meaningfully interact and express their opinions and suggestions of all the students to improve the effectiveness of the teaching-learning process. It is the responsibility of the student representatives to convey the proceedings of these meetings to all the students.

16.3 Overall Monitoring Committee

In addition, there shall be a overall monitoring committee for each semester of a programme which comprises of (i) the Course Coordinators / Course Faculty (as applicable), and (ii) Head of the Department. This overall monitoring committee shall meet periodically to discuss academic related matters, progress and status of the students of the semester concerned.

The overall monitoring committee can invite the Faculty Advisors or students for any of the committee meetings if necessary.

17 PROVISION FOR WITHDRAWAL FROM EXAMINATION

17.1 A student may, for valid reasons, (medically unfit / unexpected family situations / National / International sports) be granted permission to withdraw from appearing for the end semester examination in any course or courses in **ANY ONE** of the semester examinations during the entire duration of the degree programme. The

application shall be sent to Principal, through HOD with required documents.

17.2 Withdrawal application shall be valid only if the student is otherwise eligible to write the examination (Clause 7) and if it is made a week before the commencement of the end semester examination in that course or courses and also recommended by the Head of the Department.

17.3 Withdrawal shall not be considered as an appearance for deciding the eligibility of a student for First Class with Distinction.

17.4 Withdrawal is permitted for the end semester examinations in the final semester only if the period of study the student concerned does not exceed 3 years as per clause 14.

18 TEMPORARY BREAK OF STUDY FROM A PROGRAMME

(i) A student is not normally permitted to temporarily break the study. However if a student intends to temporarily discontinued the programme in the middle for valid reasons (such as accident or hospitalization due to prolonged ill health) and to rejoin the programme in a later than the last date for registering for the semester examinations of the semester in question, through the head of the department starting the reasons thereof.

(ii) The student permitted to rejoin the programme after the break shall be governed by the rules and regulations in force at the time of rejoining.

(iii) The duration specified for passing all the courses for the purpose of classification vide clause 14 shall be increased by the period of such break of study permitted.

(iv) The period for completion of the programme reckoned from, the commencement of the first semester to which the candidate was admitted shall not exceed the maximum period specified in clause 8(iii) irrespective of the period of break of study in order that he/she may be eligible for the award of the degree (vide clause 13).

(v) If any student is detained for want of requisite attendance, progress and good conduct, the period spent in that semester shall not be considered as permitted 'break of study' and clause 19(iii) is not applicable for this case.

19 PROCUDURE FOR USING SCRIBER

If a student is physically handicapped (in case of accidents/ill health) at the time of examination, he/she may be permitted to use a scriber to write the examination. In such case 30 minutes, extra time will be permitted. The scriber shall be a non-engineering student/graduate.

20 DISCIPLINE

Every student is required to observe disciplined and decorous behavior both inside and outside the college and not to indulge in any activity, which will tend to bring down the prestige of the college. If an act of indiscipline reported, the principal shall constitute a disciplinary committee consisting of three senior faculty members / HODs of which one should be from the faculty of the student, to inquire into acts of indiscipline. The disciplinary action is subject to review by the Principal in case the student represents to the

Principal. Any expulsion of the student from the college shall be with prior concurrence from directorate of technical education / university.

21 RESPONSIBILITIES OF A COURSE TUTOR

- Every course tutor member is required to maintain an 'Attendance and Assessment Record' for every semester which consists of attendance marked in each Theory / Practical / Skill Enhancement, the assessment marks and the record of class work (topics covered), separately for each course handled by the them. This should be submitted to the Head of the Department periodically (at least three times in a semester) for checking the syllabus coverage and the records of assessment marks and attendance. The Head of the Department will affix his/her signature and date after due verification.
- At the end of the semester, the record should be verified by the Head of the Department who shall keep this document in safe custody (for six years).
- The records of attendance and assessment of both current and previous semesters should be available for inspection.
- The assessments on Course Outcomes (CO), Programme Outcomes (PO) and Programme Educational Objectives also should be carried out and submitted to Programme Coordinator / HOD.

22 REVISION OF REGULATION AND CURRICULUM

The College may from time to time revise, amend or change the Regulations, Curriculum, Syllabus and Scheme of examinations through the Academic Council of the College.

23 ANY OTHER RULES AND PROCEDURE

Any other rules and procedure which are not covered under the above clauses shall be discussed and framed by the Standing Committee of the college. Implementation of the Standing Committee resolutions is based on the approval / ratification by the Academic Council / Board of Management.

P.S.R. ENGINEERING COLLEGE, SIVAKASI-626 140
P.G REGUALTION-2016
M.E. ENGINEERING DESIGN
CURRICULUM
[I – IV SEMESTER]

Total Credits: 70

SEMESTER - I

Sl. No.	Code	Course Title	Category	L-T-P	C
1	162ED11	Applied Mathematics for Design Engineers	FC	3-1-0	4
2	162ED12	Concepts of Engineering Design	PC	3-0-0	3
3	162ED13	Design and Simulation of Mechanisms	PC	3-0-0	3
4	162ED14	Advanced Mechanics of Materials	PC	3-1-0	4
5	-	Elective I	PE	3-0-0	3
6	-	Elective II	PE	3-0-0	3
7	162ED15	CAD Laboratory	EEC	0-0-2	1
No. of Credits: 21					

SEMESTER - II

Sl. No.	Code	Course Title	Category	L-T-P	C
1	162ED21	Finite Element Method in Mechanical Design	PC	3-1-0	4
2	162ED22	Vibration Analysis and Control	PC	3-1-0	4
3	162ED23	Mechanical Behaviour of Materials	PC	3-0-0	3
4	162ED24	Product Design and Development	PC	3-0-0	3
5	-	Elective III	PE	3-0-0	3
6	-	Elective IV	PE	3-0-0	3
7	162ED25	Analysis and Simulation Laboratory	EEC	0-0-2	1
8	162ED26	Technical Seminar	EEC	0-0-2	1
No. of Credits: 22					

SEMESTER - III

Sl. No.	Code	Course Title	Category	L-T-P	C
1	-	Elective V	PE	3-0-0	3
2	-	Elective VI	PE	3-0-0	3
3	-	Elective VII	PE	3-0-0	3
4	162ED31	Project Work – Phase I	EEC	0-0-12	6
No. of Credits: 15					

SEMESTER - IV

Sl. No.	Code	Course Title	Category	L-T-P	C
1	162ED41	Project Work – Phase II	EEC	0-0-24	12
No. of Credits: 12					

FC – Foundation Course; PC – Professional Core; PE - Professional Elective;
EEC – Employability Enhancement Course

ELECTIVES

Sl. No.	Code	Course Title	Category	L-T-P	C
1.	162EDE01	Optimization Techniques in Design	PE	3-0-0	3
2.	162EDE02	Design for Automotive Systems	PE	3-0-0	3
3.	162EDE03	Computer Applications in Design	PE	3-0-0	3
4.	162EDE04	Design for Manufacture Assembly & Environment	PE	3-0-0	3
5.	162EDE05	Design of Experiments	PE	3-0-0	3
6.	162EDE06	Engineering Fracture Mechanics	PE	3-0-0	3
7.	162EDE07	Tribology in Design	PE	3-0-0	3
8.	162EDE08	Computational Fluid Dynamics	PE	3-0-0	3
9.	162EDE09	Design of Material Handling Equipments	PE	3-0-0	3
10.	162EDE10	Integrated Manufacturing Systems	PE	3-0-0	3
11.	162EDE11	Rapid Prototyping and Tooling	PE	3-0-0	3
12.	162EDE12	Composite Materials	PE	3-0-0	3
13.	162EDE13	Surface Engineering	PE	3-0-0	3
14.	162EDE14	Design of Hydraulic and Pneumatic systems	PE	3-0-0	3
15.	162EDE15	Advanced Tool Design	PE	3-0-0	3
16.	162EDE16	Quality Concepts in Design	PE	3-0-0	3
17.	162EDE17	Nanomaterials and Nanotechnology	PE	3-0-0	3
18.	162EDE18	Mechatronics in Manufacturing Systems	PE	3-0-0	3
19.	162EDE19	Productivity Management and Re-engineering	PE	3-0-0	3
20.	162EDE20	Industrial Robotics and Expert Systems	PE	3-0-0	3
21.	162EDE21	Supply Chain Management	PE	3-0-0	3
22.	162EDE22	Reverse Engineering	PE	3-0-0	3
23.	162EDE23	Advanced Machining Process	PE	3-0-0	3
24.	162EDE24	Mechanical Testing of Materials	PE	3-0-0	3
25.	162SEE17	Research Methodology	PE	3-0-0	3

162ED11 APPLIED MATHEMATICS FOR DESIGN ENGINEERS **L-T-P C**

3-1-0 4

Programme: **M.E. ENGINEERING DESIGN** **Sem: 1** **Category: FC**

Aim: To develop the mathematical skill in the area of Applications in Engineering Design

Course Outcomes:

The Students will be able to

CO1: Understand Joint distributions and random variables

CO2: Solve the Finite difference methods and Numerical solution of partial differential equations

CO3: Familiarize with the tensor analysis

CO4: Understand the calculus of variation

CO5: Use fast Fourier transform

RANDOM VARIABLES **12**

Joint distributions – Marginal and Conditional distributions – functions of two – dimensional random variables – Regression curve – Correlation.

COMPUTATIONAL METHODS IN ENGINEERING **12**

Boundary value problems for ODE – Finite difference methods – Numerical solution of PDE – Solution of Laplace's and Poisson equation – Liebmann's iteration process – Solution of heat conduction equation by Schmidt explicit formula and Crank-Nicolson implicit scheme – Solution of wave equation.

TENSOR ANALYSIS **12**

Summation convention – Contra variant and covariant vectors – contraction of tensors – inner product – quotient law – metric tensor – Christoffel symbols – covariant differentiation – gradient, divergence and curl.

CALCULUS OF VARIATION **12**

Variation and its properties – Euler's equation – functionals dependent on first and higher order derivatives – functionals dependent on functions of several independent variables – problems with moving boundaries – direct methods – Ritz and Kantorovich methods.

FAST FOURIER TRANSFORM **12**

Discrete Fourier transform – linearity and periodicity – inverse N-point DFT – DFT approximation of Fourier coefficients – sampled Fourier series – Approximation of Fourier transform by an N-point DFT – FFT – Computational efficiency of FFT.

Lecture : 45 Tutorial : 15 Total Periods : 60

Reference Books

1. James, G., "Advanced Modern Engineering Mathematics", 3rd edition, Pearson Education, (2004)
2. Grewal, B.S., "Numerical methods in Engineering and Science", 7th edition, Khanna Publishers, (2005)
3. Grewal, B.S., "Higher Engineering Mathematics", 40th edition, Khanna Publishers, (2007)
4. Gupta, A.S., "Calculus of variations with applications", Prentice-Hall of India, New Delhi, (1997)
5. Andrews, L.C. and Philips, R. L. "Mathematical Techniques for Engineers and Scientists", Prentice Hall of India, (2006)

Course Outcomes	Program Outcomes (Pos)								Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2						2	3			2
CO2	3	2						2	3			2
CO3	3	2						2	3			2
CO4	3	2						2	3			2
CO5	3	2						2	3			2
CO6												

162ED12 CONCEPTS OF ENGINEERING DESIGN L-T-P C
3-0-0 3

Programme: M.E. ENGINEERING DESIGN Sem: 1 Category: PC

Aim: To understand the basic steps involved in concept of engineering design

Course Outcomes:

The Students will be able to

CO1: Familiarize the various steps involved in the design process and fundamentals
CO2: Develop the skills on ethical requirements and know about customer requirements
CO3: Learn to know the problem solving method
CO4: Identify the mathematical modeling and optimization
CO5: Understand the material selection process and design considerations
CO6: Know the reliability in design

DESIGN FUNDAMENTALS 9

Importance of design – The design process – Considerations of Good Design – Morphology of Design – Organization for design – Computer Aided Engineering – Designing to codes and standards – Concurrent Engineering – Product and process cycles – Technological Forecasting – Market Identification – Competition Bench marking.

CUSTOMER ORIENTED DESIGN & SOCIETAL CONSIDERATIONS 9

Identification of customer needs – customer requirements – Quality Function Deployment – Product Design Specifications – Human Factors in Design – Ergonomics and Aesthetics – Societal consideration – Contracts – Product liability – Protecting intellectual property – Legal and ethical domains – Codes of ethics – Ethical conflicts – Environment responsible design – future trends in interaction of engineering with society.

DESIGN METHODS 9

Creativity and Problem Solving – Creativity methods – Theory of Inventive Problem Solving (TRIZ) – Conceptual decomposition – Generating design concepts – Axiomatic Design – Evaluation methods – Embodiment Design – Product Architecture – Configuration Design – Parametric Design – Role of models in design – Mathematical Modeling – Simulation – Geometric Modeling –Rapid prototyping – Finite Element Analysis – Optimization – Search Methods.

MATERIAL SELECTION PROCESSING AND DESIGN 9

Material Selection Process – Economics – Cost vs Performance – Weighted property Index – Value Analysis – Role of Processing in Design – Classification of Manufacturing Process – Design for Manufacture – Design for Assembly – Designing for castings, Forging, Metal Forming, Machining and Welding – Residual Stresses – Fatigue, Fracture and Failure.

PROBABILITY CONCEPTS IN DESIGN FOR RELIABILITY 9

Probability – Distributions – Test of Hypothesis – Design of Experiments – Reliability Theory – Design for Reliability – Reliability centered Maintenance – Robust Design – Failure mode Effect Analysis.

Total Periods: 45

Reference Books

1. Pahl, G, and Beitz, W., "Engineering Design", Springer, Verlag, NY. (1984)
2. Ray, M.S., "Elements of Engineering Design", Prentice Hall Inc. (1985)
3. Suh, N.P., "The principles of Design", Oxford University Press, NY. (1990)
4. Karl T. Ulrich and Steven D. Eppinger "Product Design and Development" McGraw Hill Edition (2000)
5. Mark N. Horenstein "Design concepts for engineers", Prentice Hall, (2010)

Course Outcomes	Program Outcomes (Pos)								Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	3							3		2	2
CO2	3	3			3	2			3		2	2
CO3	3	3		2					3		2	2
CO4	3	2	2					2	3	2	2	2
CO5	3	2	2					2	3		2	2
CO6												

162ED13 DESIGN AND SIMULATION OF MECHANISMS L-T-P C
3-0-0 3

Programme: **M.E. ENGINEERING DESIGN** **Sem: 1** **Category: PC**

Aim: To impart knowledge in Mechanisms Design, Kinematic analysis and Simulation.

Course Outcomes:

The Students will be able to
CO1: Understand the basics of mechanisms
CO2: Explain the kinematics of linkages
CO3: Demonstrate the kinematics of robot manipulators
CO4: Understand the path curvature theory
CO5: Facilitate the four bar mechanism function by graphical methods
CO6: Explain the CAM mechanism

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.

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.

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.

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.

SYNTHESIS OF COUPLER CURVE BASED MECHANISMS & CAM MECHANISMS **9**

Cognate Linkages – 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.

Lecture : 45 Tutorial : 15 Total Periods : 60

Reference Books

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)

Course Outcomes	Program Outcomes (Pos)								Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	3		2					3	2		
CO2	3	3		2					3	2		
CO3	3	3		2					3	2		
CO4	3	2		2					3	2		
CO5	3	2		2					3	2		
CO6	3	2		2					3	2		

162ED14 ADVANCED MECHANICS OF MATERIALS L-T-P C
3-1-0 4

Programme: **M.E. ENGINEERING DESIGN** **Sem: 1** **Category: PC**

Aim: To impart knowledge in Mechanisms Design, Kinematic analysis and Simulation.

Course Outcomes:

The Students will be able to

CO1: Know the stress-strain relationships and general equation of elasticity in various co-ordinate systems

CO2: Describe the location of shear center of various thin sections

CO3: Understand the circumference, radial stresses and deflections in curved beam

CO4: Explain the deflection of pure bending of plates in various conditions

CO5: Understand the St.Venants theory and elastic membrane analog

CO6: Understand the methods of computing contact stress

ELASTICITY **12**

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.

SHEAR CENTER AND UNSYMMETRICAL BENDING **12**

Location of shear center for various thin sections – shear flows – Stresses and Deflections in beams subjected to unsymmetrical loading – kern of a section.

CURVED FLEXIBLE MEMBERS AND STRESSES IN FLAT PLATES **12**

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.

TORSION OF NON-CIRCULAR SECTIONS **12**

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

STRESSES IN ROTARY SECTIONS AND CONTACT STRESSES **12**

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.

Lecture : 45 Tutorial : 15 Total Periods : 60

Reference Books

1. Arthur P Boresi, Richard J. Schmidt, “Advanced mechanics of materials”, John Wiley, (2002)
2. Timoshenko and Goodier, “Theory of Elasticity”, McGraw Hil, 3rd edition, (2010)
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. Borg.S.F., “Matrix-Tensor methods in continuum Mechanics”, World Scientific pub. Co., 2nd edition, (1990)

Course Outcomes	Program Outcomes (Pos)								Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1		3		3					3		2	
CO2	3	2							3		2	
CO3	3	2							3	2		
CO4	2	3							3	2		
CO5												
CO6												

162ED15 CAD LABORATORY L-T-P C
0-0-2 1

Programme: **M.E. ENGINEERING DESIGN** **Sem: 1** **Category: EEC**

Aim: To communicate knowledge in Solid Modeling by using relevant CAD software

Course Outcomes:

The Students will be able to

CO1. Interpret the fundamentals of the Computer Aided Design
CO2. Determine the basic concepts of graphics like CSG, B-Rep approaches in solid modeling
CO3. Create the basic shapes of engineering components by using CAD software package
CO4. Identify the different sheet metal modeling tools in computer aided modeling of complex structural problems
CO5. Illustrate the solid part modelling to join together using weldment
CO6. Built assembly models

- CAD Introduction
- Sketcher
- Solid modeling – Extrude, Revolve, Sweep, etc and Variational sweep, Loft, etc.,
- Surface modeling – Extrude, Sweep, Trim etc., and Mesh of curves, Free form etc.,
- Feature manipulation – Copy, Edit, Pattern, Suppress, History operations etc.,
- Assembly – Constraints, Exploded Views, Interference check
- Drafting – Layouts, Standard & Sectional Views, Detailing & Plotting

SYSTEM REQUIRMENTS (for a batch of 25 Students)

Description of Equipment	Quantity Required
HARDWARE	
Computer Server Computer System 17" VGA Color Monitor Pentium IV Processor 40 GB HDD 512 MB RAM	1 No. 25 Nos.
Color Desk Jet Printer	1 No.
SOFTWARE	
Suitable modeling software like Pro-E/Solid Works/Solid Edge/CATIA	25 licenses

Total Periods: 45

Course Outcomes	Program Outcomes (Pos)								Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1		3		2			3			3	3	
CO2		2		3					2	3	2	
CO3				3		2				3	3	2
CO4				3			2			2	3	2
CO5	2	2		3						2	3	
CO6	2		2	3			2	2		3	2	2

162ED21 FINITE ELEMENT METHOD IN MECHANICAL DESIGN **L-T-P C**

3-1-0 4

Programme: **M.E. ENGINEERING DESIGN** **Sem: 2** **Category: PC**

Aim: To introduce the fundamentals of vibrations finite element methods used in mechanical design.

Course Outcomes:

The Students will be able to

CO1: Study the general steps in finite element analysis and derive the basic finite element equation

CO2: Study the various finite element methods, concepts, types of elements and element matrices

CO3: Solve the linear elasticity problems in the field of heat transfer and fluid mechanics.

CO4: Assemble the finite element structural dynamics and vibrational matrices

CO5: Solve the transient non-linear problems and find out the stresses and strains through post processing.

GENERAL INTRODUCTION **12**

Introduction – structural element and system – assembly and analysis of a structure – boundary conditions – general pattern – standard discrete system – transformation of coordinates – examples – direct physical approach to problems in elasticity – direct formulation – displacement approach – minimization of total potential – convergence criteria – discretization error – nonconforming elements and patch test – solution process.

GENERALIZATION OF FINITE ELEMENT CONCEPTS AND ELEMENT SHAPE FUNCTIONS **12**

Boundary value problems – integral or weak statements – weighted residual methods – Galerkin method – virtual work as weak form of equations in solid and fluid mechanics – variational principles – establishment of natural variational principles for linear self-adjoint differential equations – standard and hierarchical elements – shape functions – rectangular elements – completeness of polynomials – Lagrange family – Serendipity family – rectangular prisms – tetrahedral elements – global and local finite element approximation – mapped elements – coordinate transformations – geometrical conformity of elements – evaluation of element matrices – numerical integration.

APPLICATIONS TO FIELD PROBLEMS **12**

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.

FINITE ELEMENTS IN STRUCTURAL DYNAMICS AND VIBRATIONS **12**

Dynamic equations – stiffness, mass and damping matrices – consistent and diagonal mass matrices – Extraction of natural frequencies and modes – Reduction of number of degrees of freedom – modal methods – component mode synthesis – harmonic analysis – response history – explicit and implicit direct integration – stability and accuracy – analysis of response spectra.

NON-LINEAR ANALYSIS **12**

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

Lecture : 45 Tutorial : 15 Total Periods : 60

Reference Books

1. Cook R.D., Malkus D. S., Plesha M.E., and Witt R.J., “Concepts and Applications of Finite Element Analysis”, Wiley Student Edition, New Delhi, (2007)
2. Zienkiewicz O.C, Taylor R.L., “The Finite Element Method”, McGraw Hill International Editions, 4th Edition, Volume 2, (1991)
3. Ramamurthi V., “Finite Element Method in Machine Design”, Narosa Publishing House, (2009)
4. Huebner K.H., Dewhirst D.L., Smith D.E & Byron T.G., “The Finite Element Method for Engineers”, Wiley Student Edition, John Wiley & Sons Pvt. Ltd., (2004)
5. Charles E. Knight, “The Finite Element Method in Mechanical Design”, PWS-Kent publishing company, (1993)

Course Outcomes	Program Outcomes (Pos)								Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2							3	2	2	
CO2	3	2							3	2	2	
CO3	3	3		2					3	2	2	
CO4	3	3		2					3	2		2
CO5	3	3		2					3	2		
CO6												

162ED22 VIBRATION ANALYSIS AND CONTROL L-T-P C
3-1-0 4

Programme: M.E. ENGINEERING DESIGN Sem: 2 Category: PC

Aim: To introduce the fundamentals of vibrations, study effect of vibration of different degree of freedom systems.

Course Outcomes:

The Students will be able to
CO1: Study the fundamentals of vibrations
CO2: Understand the vibrations of different degrees of freedom system
CO3: Know the methods of vibration analysis, controlling the effect of vibration
CO4: Discuss the effect of vibrations on important mechanical elements
CO5: Understand the types of vibration measuring instruments
CO6: Test the mode shapes and resonance condition

FUNDAMENTALS OF VIBRATION 12

Introduction – Sources of Vibration – Mathematical Models – Displacement, velocity and Acceleration – Review of Single Degree Freedom Systems – Vibration isolation, Vibrometers and accelerometers – Response to Arbitrary and non-harmonic Excitations – Transient Vibration –Impulse loads – Critical Speed of Shaft – Rotor systems.

TWO DEGREE FREEDOM SYSTEM 12

Introduction-Free Vibration Of Undamped And Damped- Forced Vibration With Harmonic , Excitation System –Coordinate Couplings And Principal Coordinates

MULTI-DEGREE FREEDOM SYSTEM AND CONTINUOUS SYSTEM 12

Multi Degree Freedom System – Influence Coefficients and stiffness coefficients – Flexibility Matrix and Stiffness Matrix – Eigen Values and Eigen Vectors – Matrix Iteration Method – Approximate Methods: Dunkerley, Rayleigh's, and Holzer Method – Geared Systems – Eigen Values & Eigen vectors for large system of equations using sub space, Lanczos method – Continuous System: Vibration of String, Shafts and Beams.

VIBRATION CONTROL 12

Specification of Vibration Limits – Vibration severity standards – Vibration as condition Monitoring tool – Vibration Isolation methods – Dynamic Vibration Absorber, Torsional and Pendulum Type Absorber – Damped Vibration absorbers – Static and Dynamic Balancing – Balancing machines – Field balancing – Vibration Control by Design Modification – Active Vibration Control.

EXPERIMENTAL METHODS IN VIBRATION ANALYSIS 12

Vibration Analysis Overview – Experimental Methods in Vibration Analysis – Vibration Measuring Instruments – Selection of Sensors – Accelerometer Mountings – Vibration Exciters – Mechanical, Hydraulic, Electromagnetic and Electrodynamics – Frequency Measuring Instruments – System Identification from Frequency Response – Testing for resonance and mode shapes.

Lecture : 45 Tutorial : 15 Total Periods : 60

Reference Books

1. Rao, S.S., "Mechanical Vibrations", Addison Wesley Longman, (1995)
2. Thomson, W.T., "Theory of Vibration with Applications", CBS Publishers and Distributors, New Delhi, (1990)
3. Ramamurti, V., "Mechanical Vibration Practice with Basic Theory", Narosa, New Delhi, (2000)
4. Graham Kelly, S. & Shashidar K. Kudari, "Mechanical Vibrations", Tata McGraw Hill Publishing, New Delhi, (2007)
5. Daniel J. Inman, "Vibration with Control", John Wiley & sons Ltd., England, (2006)

Course Outcomes	Program Outcomes (Pos)								Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2							3			
CO2	3	2			2				3	2	2	
CO3	3	2			2				3	2	2	
CO4	3	2			2				3	2	2	
CO5	3	3			2				3	2	2	
CO6												

162ED23 MECHANICAL BEHAVIOUR OF MATERIALS **L-T-P** **C**

3-0-0 **3**

Programme: **M.E. ENGINEERING DESIGN** **Sem: 2** **Category: PC**

Aim: To impart the knowledge about production techniques and applications of materials

Course Outcomes:

The Students will be able to

CO1: Understand the basic concepts of material behavior.

CO2: Know the material behavior under dynamic loads.

CO3: Select the materials for various applications

CO4: Study the properties and applications of modern metallic materials.

CO5: Understand the production techniques and applications of non-metallic material.

BASIC CONCEPTS OF MATERIAL BEHAVIOR **10**

Elasticity in metals and polymers – 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 behaviour – Super plasticity –. Griffith's theory – Ductile, brittle transition in steel – High temperature fracture, creep – Larson Miller parameter – Deformation and fracture mechanism maps.

BEHAVIOUR UNDER DYNAMIC LOADS AND DESIGN APPROACHES **10**

Stress intensity factor and fracture toughness – Fatigue, low and high cycle fatigue test, crack initiation and propagation mechanisms and Paris law.- Safe life, Stress-life, strain-life and fail - safe design approaches -Effect of surface and metallurgical parameters on fatigue – Fracture on non metallic materials – Failure analysis, sources of failure, procedure of failure analysis.

SELECTION OF MATERIALS **10**

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 – Computer aided materials selection.

MODERN METALLIC MATERIALS **8**

Dual phase steels, High strength low alloy (HSLA) steel, Transformation induced plasticity (TRIP) Steel, Maraging steel, Nitrogen steel – Intermetallics, Ni and Ti aluminides – smart materials, shape memory alloys – Metallic glass and nano crystalline materials.

NON METALLIC MATERIALS **7**

Polymeric materials – Formation of polymer structure – Production techniques fibers, foams, adhesives and coating – structure, properties and engineering polymers – Advanced structural ceramics, WC, SiC, Si3N4, CBN and diamond – properties, processing and applications.

Total Periods: 45

Reference Books

1. George E. Dieter, "Mechanical Metallurgy", McGraw Hill, (1988)
2. Thomas H. Courtney, "Mechanical Behavior of Materials", 2nd edition, McGraw Hill, (2000)
3. Charles, J.A., Crane, F.A.A. and Fumess, J.A.G., "Selection and use of engineering materials", 3rd edition, Butterworth-Heiremann, (1997)
4. Flinn, R.A., and Trojan, P.K., "Engineering Materials and their Applications", 4th Edition, Jaico, (1999)
5. Metals Hand book, Vol.10, "Failure Analysis and Prevention", 10th Edition, Jaico, (1999)

Course Outcomes	Program Outcomes (Pos)								Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3								3	2		
CO2	3	2							3	2		
CO3	3	2	2				2		3	2		
CO4	3								3	2		
CO5	3		2		2				3	2		2
CO6												

162ED24 PRODUCT DESIGN AND DEVELOPMENT L-T-P C
3-0-0 3

Programme: **M.E. ENGINEERING DESIGN** **Sem: 2** **Category: PC**

Aim: It is essentially the efficient and effective generation and development of ideas through a process that leads to new products.

Course Outcomes:

The Students will be
CO1: Able to select concepts for various product developments.
CO2: Capability of selecting materials, making experimental plan.
CO3: Strengthen the decision making skills of the students.
CO4: Able to plan the manufacturing procedures.
CO5: Know idea about the intellectual property.

INTRODUCTION **9**

Product Development – Characteristics, Duration, Challenges, Organizations. Development Process – Processes, Process Flow. Product Planning – Identifying Opportunities, Prioritization, Resource allocation and Pre-Project Planning. Customer Needs – Data gathering, Organizing Needs.

CONCEPT DEVELOPMENT **9**

Product and Target specification, various steps in concept generation, Brainstorming, Morphological analysis, Selection of Concepts – Subjective decision-making, Criteria ranking, Criteria weighting, Datum method, EVAD (Design Evaluation) method, Principles of Computer aided decision making.

DESIGN PROCESS **9**

Concept Testing – Survey, Response and Interpretation. Product Architecture, Platform planning, System level design issues. Embodiment design - Introduction, Size and strength, Scheme drawing, Form design, Provisional material and process determination, Design for assembly and manufacture, Industrial design. Modeling - Introduction, Mathematical modeling, Optimization, Scale models, Simulation.

PLANNING FOR MANUFACTURE AND MANAGEMENT **9**

Detail Design - Factor of safety, Selection procedure for bought out components, Material Selection, Robust design, Experimental Plan. Design Management - Management of design for quality, Project planning and control, Production design specification (PDS), Quality function deployment (QFD)-process, Design review, Value analysis/engineering.

IPR AND PROJECT ECONOMICS **9**

Intellectual Property Rights – Introduction, Study prior inventions, Write the description of the invention, Refine Claims, Pursue application. Economics and Management – Financial Model, Project Trade – Off, Accelerating Projects, Project Execution.

Total Periods: 45

Reference Books

1. G. E. Dieter, Engineering Design, McGraw – Hill International, 2009.
2. T. Karl, Ulrich and D. Steven, and Eppinger, Product Design and Development, McGraw Hill 2009.
3. Ken Hurst, Engineering Design Principles, Elsevier Science and Technology Books, 2006.
4. 4. E. Deborah and Bouchoux, Intellectual Property Rights, Cengage Learning India Pvt., 2008

Course Outcomes	Program Outcomes (Pos)								Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3		2						3	2		
CO2	3		2		2				3	2	2	
CO3	3		2						3	2		
CO4	3	2	2						3	2		
CO5	3	2			2		2		3			2
CO6												

162ED25 ANALYSIS AND SIMULATION LABORATORY L-T-P C
0-0-2 1

Programme: **M.E. ENGINEERING DESIGN** **Sem: 2** **Category: EEC**

Aim: To determine the various loads on machine elements, its effects and to make and understand the analysis of load impacts

Course Outcomes:

The Students will be able to

CO1. Determine the various static loads of machine elements
CO2. Analyze the thermal related mechanical systems
CO3. Get knowledge on modal analysis of various elements
CO4. Investigate the boilers by using axisymmetric problems
CO5. Understanding the nature of machine elements under dynamic loads
CO6. Acquire knowledge on analysis of various non linear systems

Analysis of Mechanical Components – Use of FEA Packages like ANSYS/ NASTRAN etc.,
Exercises shall include analysis of

1. Machine elements under Static loads
2. Thermal Analysis of mechanical systems
3. Modal Analysis
4. Machine elements under Dynamic loads
5. Non Linear Systems

Use of kinematics and dynamics simulation software like ADAMS, MATLAB to analyze the velocity and acceleration of mechanical linkages of different mechanisms.

SYSTEM REQUIRMENTS
(for a batch of 25 Students)

Description of Equipment	**Quantity Required**
HARDWARE	
Computer Server	1 No.
Computer System 17" VGA Color Monitor Pentium IV Processor 40 GB HDD 512 MB RAM	25 Nos.
Color Desk Jet Printer	1 No.
SOFTWARE	
Suitable analysis software	25 licenses
C / MATLAB	5 licenses

Total Periods: 45

Course Outcomes	Program Outcomes (Pos)								Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2		2					2	3		
CO2	2	3		3					2	3	2	3
CO3	2	2		3						2	3	2
CO4	2	2		3			2			2	3	2
CO5	2	2		3			2			2	3	
CO6	2	2		3	2		2		2	2	3	

Elective Courses

162EDE01 OPTIMIZATION TECHNIQUES IN DESIGN L-T-P C

3-0-0 3

Programme: M.E. ENGINEERING DESIGN Category: PE

Aim: To describe the concept and principles of optimization techniques in design.

Course Outcomes:

The Students will be able to

CO1: Understand the techniques and application of optimization design.

CO2: Know the constrained techniques in optimization.

CO3: Develop the knowledge of Neural network & Fuzzy logic principles in optimization.

CO4: Understand the design of shaft and structural applications.

CO5: Apply the design of simple linkage mechanisms.

UNCONSTRAINED OPTIMIZATION TECHNIQUES 9

Introduction to optimum design – General principles of optimization – Problem formulation & their classifications – Single variable and multivariable optimization, Techniques of unconstrained minimization – Golden section, Random, pattern and gradient search methods – Interpolation methods.

CONSTRAINED OPTIMIZATION TECHNIQUES 9

Optimization with equality and inequality constraints – Direct methods – Indirect methods using penalty functions, Lagrange multipliers – Geometric programming.

ADVANCED OPTIMIZATION TECHNIQUES 9

Multi stage optimization – dynamic programming, stochastic programming, Multi objective optimization, Genetic algorithms and Simulated Annealing techniques, Neural network & Fuzzy logic principles in optimization.

STATIC APPLICATIONS 9

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

DYNAMIC APPLICATIONS 9

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

Total Periods: 45

Reference Books

1. Rao, Singaresu, S., “Engineering Optimization – Theory & Practice”, New Age International (P) Limited, New Delhi, (2000)
2. Johnson Ray, C., “Optimum design of mechanical elements”, Wiley, John & Sons, (1990)
3. Kalyanamoy Deb, “Optimization for Engineering design algorithms and Examples”, Prentice Hall of India Pvt. (1995)
4. Goldberg, D.E., “Genetic algorithms in search, optimization and machine”, Barnen, Addison-Wesley, New York, (1989)
5. Garret N. Vanderplaats, “Numerical Optimization techniques for engineering design with applications”, McGraw Hill Ryerson ltd., (1984)

Course Outcomes	Program Outcomes (Pos)								Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2							3			
CO2	3			2					3	2		
CO3	3			3	2				3	2		
CO4	3	3							3		2	2
CO5	3	3		2					3	2		
CO6												

162EDE02 DESIGN FOR AUTOMOTIVE SYSTEMS L-T-P C
3-0-0 3

Programme: M.E. ENGINEERING DESIGN Category: PE

Aim: To provide sound knowledge in automotive body design.

Course Outcomes:

The Students will be able to

CO1: Contribute and function in a collaborative environment.
CO2: Identify, analyze and solve technical problems in the automobile field.
CO3: Utilize and apply critical thinking skills for better employability.
CO4: Develop the knowledge about the transmission systems.
CO5: Solve the problems in the suspension and steering systems.

INTRODUCTION 9

Fundamentals of designing automobiles, general layout of the automobile, types of chassis layout, various types of frames, constructional details, materials, unitized frame body construction.

DESIGN OF ENGINE COMPONENTS 9

Choice of material for various engine components, design of cylinder, design of piston assembly, design of connecting rod, design of crankshaft under bending and twisting, balancing weight calculations, design of valves, valve springs and design of flywheel.

DESIGN OF CLUTCH & BRAKES 9

CLUTCHES: Introduction-design diagrams of clutch, calculation of critical parameters of clutches, design calculation of standard elements of friction clutches.

BRAKES: Pressure distribution along shoe length, determining braking torque, design of drum brakesinternally expanding brakes, design of disc brakes.

DESIGN OF TRANSMISSION SYSTEMS 9

Determining main parameters of transmission, differential, axle shafts, gear box, design of universal joint and propeller shaft, location determination of universal joint and propeller shaft.

SUSPENSION AND STEERING SYSTEM 9

Oscillation and smoothness of ride, fundamentals of designing and calculating steering control linkage, steering gears, hydraulic booster.

Automotive Electronics

Sensors in automobiles, engine management system

Total Periods: 45

Reference Books

1. Lukin P Gasparyants G and Rodionov V, “Automobile Chassis Design and Calculations”, Mir Publishers, Moscow, 2005.
2. Heinz Heisier, “Vehicle and Engine Technology”, SAE, New York, 2007.
3. Gillespie T D, “Fundamentals of Vehicle Dynamics”, SAE Inc., New York, 2006.
4. Schwaller A E, “Motor Automotive Technology”, Third Edition, Delman Publishers, New York, 2008.
5. Steed W - “Mechanics of Road Vehicles”- Illiffe Books Ltd., London- 2005.

Course Outcomes	Program Outcomes (Pos)								Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2							3	2		
CO2	3	2							3	2		
CO3	3	2	2		2				3	3		2
CO4	3	3	3		2				3	2		2
CO5	3		3		2				3	2		2
CO6												

162EDE03 COMPUTER APPLICATIONS IN DESIGN L-T-P C

3-0-0 3

Programme: **M.E. ENGINEERING DESIGN** **Category:** **PE**

Aim: To impart knowledge in Computer Graphics, Solid Modeling and also in CAD software

Course Outcomes:

The Students will be able to

CO1: Illustrate the Computer Graphics Fundamentals like Curves, boundary models etc.,

CO2: Understand the surface modeling techniques

CO3: Understand the languages like Auto LISP/C

CO4: Work in Data exchange standards & Solid Geometry

CO5: Facilitates the parametric and variational geometry based software

CO6: Explain the Tolerance analysis & Assembly modeling

INTRODUCTION TO COMPUTER GRAPHICS FUNDAMENTALS 9

Output primitives (points, lines, curves etc.,), 2-D & 3-D transformation (Translation, scaling, rotators) windowing – view ports – clipping transformation – Representation of curves – Bezier curves – cubic spline curve – B-Spline curves – Rational curves – Surface Modeling techniques – surface patch – Coons patch– bi-cubic patch – Bezier and B-spline surfaces – Volume modeling – Boundary models – CSG – other modeling techniques.

INTRODUCTION TO CAD SOFTWARE 9

Writing interactive programs to solve design problems and production of drawings – using any languages like Auto LISP/C/FORTRAN etc., – creation of surfaces – solids etc., using solid modeling packages (prismatic and revolved parts).

SOLID MODELING 9

Regularized Boolean set operations – primitive instancing – sweep representations – boundary representations – constructive solid Geometry – comparison of representations – user interface for solid modeling – Graphics and computing standards – Open GL Data Exchange standards – IGES, STEP etc., – Communication standards.

VISUAL REALISM 9

Hidden – Line – Surface – solid removal algorithms shading – coloring – Introduction to parametric and variational geometry based software's and their principles creation of prismatic and lofted parts using these packages.

ASSEMBLY OF PARTS 9

Assembly modeling – interferences of positions and orientation – tolerances analysis – mass property calculations – mechanism simulation.

Total Periods: 45

Reference Books

1. William M Neumann and Robert F.Sproul, "Principles of Computer Graphics", McGraw Hill Book Co. Singapore, (1989)
2. Donald Hearn and M. Pauline Baker "Computer Graphics", Prentice Hall, Inc., (1992)
3. Ibrahim Zeid "CAD/CAM", Tata McGraw Hill, International Edition, (2007)
4. Foley, Wan Dam, Feiner and Hughes "Computer graphics principles & practices", Pearson Education (2003)
5. Duncan Marsh, "Applied Geometry for Computer Graphics and CAD", Springer, 2nd edition, (2005)

Course Outcomes	Program Outcomes (Pos)								Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3		2	2					3	2		
CO2	3								3		2	
CO3	2	2	3	3					2	3		2
CO4	3	2		2					3	2		2
CO5												
CO6												

162EDE04 DESIGN FOR MANUFACTURE ASSEMBLY & ENVIRONMENT

L-T-P C

3-0-0 3

Programme: **M.E. ENGINEERING DESIGN** **Category:** **PE**

Aim: To study the various factors that enhances the designing of product regarding manufacturing, assembly and environment.

Course Outcomes:

The Students will be able to

CO1: Describe the general design principles for manufacturability

CO2: Understand the factors that influencing form design

CO3: Familiarize the design features to facilitate machining

CO4: Describe the design factors that influencing the redesign of casting

CO5: Know the techniques to reduce environmental impact of a product

CO6: Learn to know about the impact of disassembly and recyclability

INTRODUCTION **9**

General design principles for manufacturability – strength and mechanical factors, mechanisms selection, evaluation method, Process capability – Feature tolerances – Geometric tolerances – Assembly limits –Datum features – Tolerance stacks.

FACTORS INFLUENCING FORM DESIGN **9**

Working principle, Material, Manufacture, Design – Possible solutions – Materials choice – Influence of materials on form design – form design of welded members, forgings and castings.

COMPONENT DESIGN – MACHINING CONSIDERATION **9**

Design features to facilitate machining – drills – milling cutters – keyways – Doweling procedures, counter sunk screws – Reduction of machined area – simplification by separation – simplification by amalgamation – Design for machinability – Design for economy – Design for clampability – Design for accessibility – Design for assembly.

COMPONENT DESIGN – CASTING CONSIDERATION **9**

Redesign of castings based on Parting line considerations – Minimizing core requirements, machined holes, redesign of cast members to obviate cores – Identification of uneconomical design – Modifying the design – group technology – Computer Applications for DFMA.

DESIGN FOR THE ENVIRONMENT **9**

Introduction – Environmental objectives – Global issues – Regional and local issues – Basic DFE methods – Design guide lines – Example application – Lifecycle assessment – Basic method – AT&T's environmentally responsible product assessment – Weighted sum assessment method – Lifecycle assessment method – Techniques to reduce environmental impact – Design to minimize material usage – Design for disassembly – Design for recyclability – Design for remanufacture – Design for energy efficiency – Design to regulations and standards.

Total Periods: 45

Reference Books

1. Boothroyd, G, "Design for Assembly Automation and Product Design", New York, (1980)
2. Dekker. Marcel Bralla, "Design for Manufacture handbook", McGraw hill, (1999)
3. Boothroyd, G, Heartz and Nike, "Product Design for Manufacture", Marcel Dekker, (1994)
4. Dickson, John. R, and Corroda Poly, "Engineering Design and Design for Manufacture and Structural Approach", Field Stone Publisher, USA, (1995)
5. Kevien Otto and Kristin Wood, "Product Design", Pearson Publication, (2004)

Course Outcomes	Program Outcomes (Pos)								Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2							3	2		
CO2	3	2							3	2		
CO3	3	2	2		2				3	3		2
CO4	3	3	3		2				3	2		2
CO5	3		3		2				3	2		2
CO6												

162EDE05 DESIGN OF EXPERIMENTS L-T-P C
3-0-0 3

Programme: M.E. ENGINEERING DESIGN Category: PE

Aim: To design the experiments and analyze data collected from experiments

Course Outcomes:

The Students will be able to
CO1: Familiarize the Fundamentals of design of experiments
CO 2: Practice the various tools used in DOE
CO 3: Conduct experiments based on factorial design
CO 4: Impart the concepts of Taguchi technique
CO 5: Apply for product/process optimization

FUNDAMENTALS OF DESIGN OF EXPERIMENTS 9

Basic principles of design of experiment – randomization – replication – interactions - simple comparative experiments - applications of experimental design - barriers in DOE - practical methodology

ANALYTICAL TOOLS OF DOE 9

Main effects plot - Interactions plots - Cube plots - Pareto plot of factor effects - Normal Probability Plot of factor effects - Response surface plots and regression models - Model building – Analysis of variance

FACTORIAL DESIGNS 9

Single factor experiments - Latin square designs and extensions – Introduction to factorial designs, two levels, 2^k factorial designs - Fractional factorial designs , two-level, three-level and mixed-level factorials

TAGUCHI APPROACH 9

Overview of Taguchi approach - common experiments and methods of analysis. Orthogonal array-properties - Degrees of freedom-confidence level and interval – case study exercises.

PARAMETER OPTIMIZATION 9

Regression models - parameter optimization – single and multi objective optimization - Response surface methodology – grey relational analysis – complex proportional assessment of alternatives (COPRAS) - case study exercises

Total Periods: 45

Reference Books

1. Jiju Antony, " Design of Experiments for Engineers and Scientists", 2nd Edition, Elsevier, Londan, 2014.
2. Oehlert, GaryW. "First Course in Design and Analysis of Experiments", Freeman Publishers, New York, 2000
3. Douglas C. Montgomery, "Design and Analysis of Experiments", 5th edition., Wiley. 2001
4. Ranjit K Roy, Design of Experiments using the Taguchi Approach, John Wiley & sons, Inc., 2001
5. Lennart Eriksson, " Design of Experiments: Principles and Applications", Umetrics Academy, Sweedan, 2008

Course Outcomes	Program Outcomes (Pos)								Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	3							3			
CO2	3			3					3			
CO3	3	3		2					3		2	2
CO4	3	3		3					3			2
CO5	3	2		2	2				3		2	
CO6												

162EDE06 ENGINEERING FRACTURE MECHANICS L-T-P C
3-0-0 3

Programme: **M.E. ENGINEERING DESIGN** **Category:** **PE**

Aim: To understand the fundamentals of fracture mechanics and to study the fatigue crack initiation, growth and applications of fracture mechanics.

Course Outcomes:

The Students will be able to

CO1: Define the near field equations to determine the stress-strain and load-displacement fields around a crack tip for linear elastic cases.

CO2: Identify and formulate the stress intensity factor ((K) for typical crack configurations

CO3: Identify and formulate J-integral and the stress and strain fields around a crack tip for different types of materials

CO4: Define empirical relation describing crack growth law.

CO5: Predict the fatigue life of structures using fracture mechanics approaches.

ELEMENTS OF SOLID MECHANICS **9**

The geometry of stress and strain, elastic deformation, plastic and elasto-plastic deformation – limit analysis – Airy's function – field equation for stress intensity factor.

STATIONARY CRACK UNDER STATIC LOADING **9**

Two dimensional elastic fields – Analytical solutions yielding near a crack front – Irwin's approximation – plastic zone size – Dugdaale model – determination of J integral and its relation to crack opening displacement.

ENERGY BALANCE AND CRACK GROWTH **9**

Griffith analysis – stable and unstable crack growth – Dynamic energy balance – crack arrest mechanism – K1c test methods – R curves – determination of collapse load.

FATIGUE CRACK GROWTH CURVE **9**

Empirical relation describing crack growth law – life calculations for a given load amplitude – effects of changing the load spectrum – rain flow method – external factors affecting the K1c values – leak before break analysis.

APPLICATIONS OF FRACTURE MECHANICS **9**

Crack Initiation under large scale yielding – thickness as a design parameter – mixed mode fractures – crack instability in thermal and residual stress fields – numerical methods.

Total Periods: 45

Reference Books

1. David Broek, "Elementary Engineering Fracture Mechanics", Fifthoff and Noerdhoff International Publisher, (1978)
2. Kare Hellan, "Introduction of Fracture Mechanics", McGraw-Hill Book Company, (1985)
3. Preshant Kumar, "Elements of Fracture Mechanics", Wheeler Publishing, (1999)
4. John M.Barson and Stanely T.Rolfe , "Fatigue and fracture control in structures", Prentice hall Inc. Englewood cliffs, (1977)
5. David Broek, "Elementary Engineering Fracture Mechanics", 4th edition, Kluwer Academic Publishers, (1982)

Course Outcomes	Program Outcomes (Pos)								Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2							3	2		
CO2	3	2							3	2		
CO3	3	2							3	2		
CO4	3	2							3	2		
CO5	3	2							3	2		
CO6	3	2							3	2		

162EDE07	TRIBOLOGY IN DESIGN	L-T-P	C
		3-0-0	3

Programme: M.E. ENGINEERING DESIGN **Category:** PE

Aim: To study about the friction and various types of lubrication between different materials

Course Outcomes:

The Students will be able to

CO1: Understand the types of friction and surface interaction

CO2: Understand Mechanism of various types of wear and surface treatments

CO3: Know the types of lubrication processes

CO4: Familiarize the various lubricant standards.

CO5: Describe the high pressure contacts and the theory of elasto hydrodynamic lubrication

SURFACE INTERACTION AND FRICTION **9**

Topography of Surfaces – Surface features – Properties and measurement – Surface interaction – Adhesive Theory of Sliding Friction – Rolling Friction – Friction properties of metallic and non-metallic materials – friction in extreme conditions –Thermal considerations in sliding contact.

WEAR AND SURFACE TREATMENT **9**

Types of wear – Mechanism of various types of wear – Laws of wear –Theoretical wear models – Wear of Metals and Non metals – Surface treatments – Surface modifications – surface coatings methods – Surface Topography measurements – Laser methods – instrumentation – International standards in friction and wear measurements.

LUBRICANTS AND LUBRICATION REGIMES **9**

Lubricants and their physical properties – Viscosity and other properties of oils – Additives and selection of Lubricants – Lubricants standards ISO,SAE,AGMA,BIS standards – Lubrication Regimes – Solid Lubrication – Dry and marginally lubricated contacts – Boundary Lubrication – Hydrodynamic lubrication – Elasto and plasto hydrodynamic – Magneto hydrodynamic lubrication – Hydro static lubrication – Gas lubrication.

THEORY OF HYDRODYNAMIC AND HYDROSTATIC LUBRICATION **9**

Reynolds Equation – Assumptions and limitations – one and two dimensional Reynolds Equation – Reynolds and Sommerfeld boundary conditions – Pressure wave, flow, load capacity and friction calculations in Hydrodynamic bearings – Long and short bearings – Pad bearings and Journal bearings – Squeeze film effects – Thermal considerations – Hydrostatic lubrication of Pad bearing – Pressure, flow, load and friction calculations – Stiffness considerations – Various types of flow restrictors in hydrostatic bearings.

HIGH PRESSURE CONTACTS AND ELASTO HYDRODYNAMIC LUBRICATION **9**

Rolling contacts of Elastic solids – contact stresses – Hertzian stress equation – Spherical and cylindrical contacts – Contact Fatigue life – Oil film effects – Elasto Hydrodynamic lubrication Theory – Soft and hard EHL – Reynolds equation for elasto hydrodynamic lubrication – Film shape within and outside contact zones – Film thickness and friction calculation – Rolling bearings – Stresses and deflections – Traction drives.

Total Periods: 45

REFERENCE BOOKS

1. Rabinowicz.E, “Friction and Wear of materials”, John Willey &Sons ,UK,(1995)
2. Cameron, A. “Basic Lubrication Theory”, Ellis Herward Ltd., UK, (1981)
3. Halling, J. (Editor) “Principles of Tribology”, Macmillian, (1984)
4. Williams J.A. “Engineering Tribology”, Oxford Univ. Press, (1994)
5. K.Basu, S.N.Sengupta & B.B.Ahuja ., “Fundamentals of Tribology”, Prentice –Hall of India Pvt. Ltd , New Delhi, (2005)

Course Outcomes	Program Outcomes (Pos)								Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3		2		2				3	2		
CO2	3		2					2	3	2		
CO3	3		2						3			
CO4	3		2		2				3	2		
CO5	3	2		2					3			2
CO6												

162EDE08	COMPUTATIONAL FLUID DYNAMICS	L-T-P	C
		3-0-0	3

Programme: M.E. ENGINEERING DESIGN **Category:** PE

Aim: To understand the Computational Fluid Dynamics in engineering problems.

Course Outcomes:

The Students will be able to

CO1: Solve the two and three dimensional steady state problems

CO2: Understanding the governing differential equation and finite difference method

CO3: Know the computation of boundary layer flow, finite difference approach.

CO4: Study about incompressible flow, convection heat transfer and FEM

CO5: Understand the turbulence models

GOVERNING DIFFERENTIAL EQUATION AND FINITE DIFFERENCE METHOD **9**

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.

CONDUCTION HEAT TRANSFER **9**

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

INCOMPRESSIBLE FLUID FLOW **9**

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.

CONVECTION HEAT TRANSFER AND FEM **9**

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.

TURBULENCE MODELS **9**

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

Total Periods: 45

Reference Books

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)

Vibv	Program Outcomes (Pos)								Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2							3	2	2	
CO2	3	2							3	2	2	
CO3	3	3		2					3	2	2	
CO4	3	3		2					3	2		2
CO5	3	3		2					3	2		
CO6												

162EDE09 DESIGN OF MATERIAL HANDLING EQUIPMENTS **L-T-P C**

(Use of Approved Data book is permitted for the end semester examination) **3-0-0 3**

Programme: **M.E. ENGINEERING DESIGN** **Category:** **PE**

Aim: To study about the design concepts of various material handling equipments

Course Outcomes:

The Students will be able to
CO1: Study the types of materials and selection of materials
CO2: Know the designing procedures for various hoists
CO3: Familiarize the drives used in hoisting techniques
CO4: Designing the various types of conveyors
CO5: Designing the different types of elevators and fork lifts

MATERIALS HANDLING EQUIPMENT **5**

Types, selection and applications.

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.

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.

CONVEYORS **10**

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

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 Periods: 45

Reference Books

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. Lingaiah. K. and Narayana Iyengar, “Machine Design Data Hand Book”, Vol. 1 & 2, Suma Publishers, Bangalore, (1983)

Course Outcomes	Program Outcomes (Pos)								Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2							3	2		
CO2	3	2							3	2		
CO3	3	2	2		2				3	3		2
CO4	3	3	3		2				3	2		2
CO5	3		3		2				3	2		2
CO6												

162EDE10 INTEGRATED MANUFACTURING SYSTEMS L-T-P C
3-0-0 3

Programme: **M.E. ENGINEERING DESIGN** **Category:** **PE**

Aim: To study about the design concepts of various material handling equipments

Course Outcomes:

The Students will be able to

CO1: Learn the concepts of computer integrated manufacturing and management system

CO2: Understand the concept of group technology and computer aided process planning

CO3: Learn the fundamentals of computer assisted numerical control programming and programming languages

CO4: Understand the guidelines and criteria for implementing CAD/CAM Systems for inspection and testing of components

CO5: Familiarize the basic fundamentals of FMS

CO6: Discuss concept of Artificial Intelligence and Expert system in CIM

INTRODUCTION **9**

Objectives of a manufacturing system-identifying business opportunities and problems classification production systems-linking manufacturing strategy and systems analysis of manufacturing operations.

GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING **9**

Introduction – part families – parts classification and cooling – group technology machine cells – benefits of group technology – Process planning function CAPP – Computer generated time standards.

COMPUTER AIDED PLANNING AND CONTROL **9**

Production Planning and Control – cost planning and control – inventory management – Material requirements planning (MRP) – shop floor control – Factory data collection system – Automatic identification system – barcode technology – automated data collection system.

COMPUTER MONITORING **9**

Types of production monitoring systems – structure model of manufacturing process – process control & strategies – direct digital control – supervisory computer control – computer in QC – contact inspection methods non-contact inspection method – computer-aided testing – integration of CAQC with CAD/CAM.

INTEGRATED MANUFACTURING SYSTEM **9**

Definition – application – features – types of manufacturing systems – machine tools – materials handling system – computer control system – DNC systems manufacturing cell – Flexible manufacturing systems (FMS) – FMS concept – transfer systems – head changing FMS – variable mission manufacturing system – CAD/CAM system – human labour in the manufacturing system – computer integrated manufacturing system benefits – Rapid prototyping – Artificial Intelligence and Expert system in CIM.

Total Periods: 45

Reference Books

1. David Bedworth, **"Computer Integrated Design and Manufacturing"**, TMH, New Delhi, (1998)
2. Yorem Koren, "**Computer Integrated Manufacturing Systems"**, McGraw Hill, (1983)
3. Ranky, Paul G., "**Computer Integrated Manufacturing"**, Prentice Hall International (1986)
4. Yeomamas,R.W., A. Choudry and P.J.W. Ten Hagen, **"Design rules for a CIM system"**, North Holland Amsterdam, (1985)
5. Groover, M.P., **"Automation, Production System and CIM"**, Prentice-Hall of India, (1998)

Course Outcomes	Program Outcomes (Pos)								Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3								3			
CO2	3	2							3	2		
CO3	3			2					3	2		
CO4	3		2		2				3		2	2
CO5	3		2				2		3		2	2
CO6												

162EDE11	RAPID PROTOTYPING AND TOOLING	L-T-P	C
		3-0-0	3

Programme: M.E. ENGINEERING DESIGN **Category:** PE

Aim: To help local enterprises enhance their global competitiveness by creating values for their discerning customers

Course Outcomes:

The Students will be able to

CO1: Familiarize the model making steps involved in product design
CO2: Understand the various prototyping systems and its working principles
CO3: Learn the applications and limitations of the prototyping systems
CO4: Know the geometric modeling technique and its application in reverse engineering
CO5: Study the rapid tooling technique used in various field of engineering
CO6: Apply the knowledge for various prototyping system

INTRODUCTION **9**

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

LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS **9**

Stereolithography Apparatus, Fused deposition Modeling, Laminated object manufacturing, Three dimensional printing: Working Principles, details of processes, products, materials, advantages, limitations and applications – Case studies.

POWDER BASED RAPID PROTOTYPING SYSTEMS **9**

Selective Laser Sintering, Direct Metal Laser Sintering, Three Dimensional Printing, Laser Engineered Net Shaping, Selective Laser Melting, Electron Beam Melting: Processes, materials, products, advantages, applications and limitations – Case Studies.

REVERSE ENGINEERING AND CAD MODELING **9**

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.

RAPID TOOLING **9**

Classification: Soft tooling, Production tooling, Bridge tooling; direct and indirect – Fabrication processes, Applications. Case studies – automotive, aerospace and electronic industries.

Total Periods: 45

Reference Books

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

Course Outcomes	Program Outcomes (Pos)								Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2					3		2	
CO2	3	2		2					3		2	
CO3	3		2					2	3	2		
CO4	3	2	2	3	2				3		2	3
CO5	3	2		2				2	3		2	2
CO6												

162EDE12	COMPOSITE MATERIALS	L-T-P	C
		3-0-0	3

Programme: **M.E. ENGINEERING DESIGN** **Category:** **PE**

Aim: To understand the fundamentals of composite material and different types of analysis of Laminated flat plate composites.

Course Outcomes:

The Students will be able to

CO1: Understand the fundamentals of composite material strength and its mechanical behavior.

CO2: Use the fiber reinforced Laminate design for different Combinations of plies with different orientations of the fiber.

CO3: Study the thermo-mechanical behavior and study of residual stresses in Laminates during processing.

CO4: Understand the vibration and buckling analysis of Laminated Flat Plates.

CO5: Implement the Classical Laminate Theory (CLT) to study and analysis for residual stresses in an isotropic layered structure such as electronic chips.

LAMINA CONSTITUTIVE RELATIONS **9**

Definition – Need – General Characteristics, Applications – Fibers – Glass, Carbon, Ceramic and Aramid fibers – Matrices – Polymer, Graphite, Ceramic and Metal Matrices – Characteristics of fibers and matrices. Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint – Generalized Hooke's Law – Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Q_{ij}), Typical Commercial material properties, Rule of Mixtures – Generally Orthotropic Lamina – Transformation Matrix, Transformed Stiffness – Manufacturing: Bag Moulding – Compression Moulding – Pultrusion – Filament Winding – Other Manufacturing Processes.

FLAT PLATE LAMINATE CONSTITUTIVE RELATIONS **9**

Definition of stress and Moment Resultants – Strain Displacement relations – Basic Assumptions of Laminated anisotropic plates – Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates – Laminate Structural Moduli – Evaluation of Lamina Properties from Laminate Tests – Quasi-Isotropic Laminates – Determination of Lamina stresses within Laminates.

LAMINA STRENGTH ANALYSIS **9**

Introduction – Maximum Stress and Strain Criteria – Von-Misses Yield criterion for Isotropic Materials – Generalized Hill's Criterion for Anisotropic materials – Tsai-Hill's Failure Criterion for Composites – Tensor Polynomial (Tsai-Wu) Failure criterion – Prediction of laminate Failure.

ANALYSIS OF LAMINATED FLAT PLATES **9**

Equilibrium Equations of Motion – Energy Formulations – Static Bending Analysis – Buckling Analysis – Free Vibrations – Natural Frequencies.

EFFECT OF THERMAL PROPERTIES **9**

Modification of Hooke's Law due to thermal properties – Modification of Laminate Constitutive Equations – Orthotropic Lamina – special Laminate Configurations – Unidirectional, Off-axis, Symmetric Balanced Laminates – Zero C.T.E laminates, Thermally Quasi-Isotropic Laminates.

Total Periods: 45

Reference Books

1. Gibson, R.F., "Principles of Composite Material Mechanics", McGraw-Hill, (1994)
2. Hyer, M.W., "Stress Analysis of Fiber – Reinforced Composite Materials", McGraw-Hill, (1998)
3. Issac M. Daniel and Ori Ishai, "Engineering Mechanics of Composite Materials", Oxford University Press-2006, First Indian Edition – (2007)
4. Mallick, P.K., "Fiber–Reinforced Composites: Materials, Manufacturing and Design", Maneel Dekker Inc, (1993)
5. Mallick, P.K. and Newman, S., (edition), "Composite Materials Technology: Processes and Properties", Hansen Publisher, Munish, (1990)

Course Outcomes	Program Outcomes (Pos)								Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3								3	2		
CO2	3	2							3			
CO3	3		2						3			2
CO4	3	2	2						3	2		2
CO5	3	2	2						3			2
CO6												

162EDE13	SURFACE ENGINEERING	L-T-P	C
		3-0-0	3

Programme: **M.E. ENGINEERING DESIGN** **Category:** **PE**

Aim: To demonstrate a sound knowledge for the systematic application of alternative technologies used to fabricate surface engineering.

Course Outcomes:

The Students will be able to
CO1: Understand the concepts of friction.
CO2: Techniques used to characterize the surface and explain the principles behind their operation.
CO3: Know various testing of corrosion.
CO4: Knowledge of why the surface treatment affects the bulk properties of the material.
CO5: Know about the Engineering Materials.

FRICTION **9**

Topography of Surfaces – Surface features – Properties and measurement – Surface interaction – Adhesive Theory of Sliding Friction – Rolling Friction – Friction properties of metallic and non metallic materials – Friction in extreme conditions – Thermal considerations in sliding contact

WEAR **9**

Introduction – Abrasive wear, Erosive, Cavitation, Adhesion, Fatigue wear and Fretting Wear- Laws of wear – Theoretical wear models – Wear of metals and non metals – International standards in friction and wear measurements

CORROSION **9**

Introduction – Principle of corrosion – Classification of corrosion – Types of corrosion – Factors influencing corrosion – Testing of corrosion – In-service monitoring, Simulated service, Laboratory testing – Evaluation of corrosion – Prevention of Corrosion – Material selection, Alteration of environment, Design, Cathodic and Anodic Protection, Corrosion inhibitors.

SURFACE TREATMENTS **9**

Introduction – Surface properties, Superficial layer – Changing surface metallurgy – Wear resistant coatings and Surface treatments – Techniques – PVD – CVD – Physical CVD – Ion implantation – Surface welding – Thermal spraying – Laser surface hardening and alloying, Applications of coatings and surface treatments in wear and friction control – Characteristics of Wear resistant coatings – New trends in coating technology – DLC – CNC – Thick coatings – Nano-engineered coatings – Other coatings, Corrosion resistant coatings.

ENGINEERING MATERIALS **9**

Introduction – Advanced alloys – Super alloys, Titanium alloys, Magnesium alloys, Aluminium alloys, and Nickel based alloys – Ceramics – Polymers – Biomaterials – Applications – Bio Tribology Nano Tribology.

Total Periods: 45

Reference Books

1. G.W.Stachowiak & A.W.Batchelor , “Engineering Tribology”, Butterworth-Heinemann,UK,2005
2. Rabinowicz.E, “Friction and Wear of materials”, John Willey &Sons ,UK,1995
3. Halling, J. (Editor) – “Principles of Tribology “, Macmillian – 1984.
4. Williams J.A. “Engineering Tribology”, Oxford Univ. Press, 1994.
5. S.K.Basu, S.N.Sengupta & B.B.Ahuja ,”Fundamentals of Tribology”, Prentice –Hall of India Pvt Ltd , New Delhi, 2005

Course Outcomes	Program Outcomes (Pos)								Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3		2		2				3	2		
CO2	3		2					2	3	2		
CO3	3		2						3			
CO4	3		2		2				3	2		
CO5	3	2		2					3			2
CO6												

162EDE14 DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS **L-T-P** **C**

3-0-0 **3**

Programme: **M.E. ENGINEERING DESIGN** **Category:** **PE**

Aim: To obtain a brief knowledge on the function, installation and maintenance of the hydraulic and pneumatic circuits

Course Outcomes:

The Students will be able to

CO1: Identify the selection, specification and characteristics of the actuators

CO2: Know the functions of Pressure, direction and flow control valves

CO3: Design different hydraulic circuits for various applications

CO4: Knows the pneumatic systems and to design the circuits by various methods

CO5: Attain knowledge on installation and maintenance of the circuits

OIL HYDRAULIC SYSTEMS AND HYDRAULIC ACTUATORS **9**

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

CONTROL AND REGULATION ELEMENTS **9**

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

HYDRAULIC CIRCUITS **9**

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

PNEUMATIC SYSTEMS AND CIRCUITS **9**

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

INSTALLATION, MAINTENANCE AND SPECIAL CIRCUITS **9**

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 Periods: 45

Reference Books

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 – Heinemann, (1997)
5. Shanmuga Sundaram, K., "Hydraulic and Pneumatic Controls: Understanding made Easy", S.Chand & Co Book publishers, New Delhi, (2009)

Course Outcomes	Program Outcomes (Pos)								Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2							3	2		
CO2	3	2							3	2		
CO3	3	2	2		2				3	3		2
CO4	3	3	3		2				3	2		2
CO5	3		3		2				3	2		2
CO6												

162EDE15	ADVANCED TOOL DESIGN	L-T-P	C
		3-0-0	3

Programme: **M.E. ENGINEERING DESIGN** **Category:** **PE**

Aim: To study the various factors that enhances the designing of product regarding manufacturing, assembly and environment

Course Outcomes:

The Students will be able to

CO1: Study the general design principles of component design.
CO2: Understand the factors that influences the form design
CO3: Discuss the design features to facilitate machining.
CO4: Describe the design factors that influencing the redesign of casting
CO5: Design of components for environment, assembly.

INTRODUCTION TO TOOL DESIGN **9**

Introduction – Tool Engineering – Tool Classifications – Tool Design Objectives – Tool Design in manufacturing – Challenges and requirements – Standards in tool design – Tool drawings – Surface finish – Fits and Tolerances – Tooling Materials – Ferrous and Non ferrous Tooling Materials – Carbides, Ceramics and Diamond – Non metallic tool materials – Designing with relation to heat treatment.

DESIGN OF CUTTING TOOLS **9**

Mechanics of Metal cutting – Oblique and orthogonal cutting – Chip formation and shear angle – Single –point cutting tools – Milling cutters – Hole making cutting tools – Broaching Tools – Design of Form relieved and profile relieved cutters – Design of gear and thread milling cutters.

DESIGN OF JIGS AND FIXTURES **9**

Introduction – Fixed Gages – Gage Tolerances – 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 – Thrust and Turning Moments in drilling – Drill jigs and modern manufacturing – Types of Fixtures – Vise Fixtures – Milling Fixtures – Boring Fixtures – Broaching Fixtures – Lathe Fixtures – Grinding Fixtures – Modular Fixtures – Cutting Force Calculations.

DESIGN OF PRESS TOOL DIES **9**

Types of Dies – Method of Die operation – Clearance and cutting force calculations – Blanking and Piercing die design – Pilots – Strippers and pressure pads – Presswork materials – Strip layout – Short-run tooling for Piercing – Bending dies – Forming dies – Drawing dies – Design and drafting.

TOOL DESIGN FOR CNC MACHINE TOOLS **9**

Introduction –Tooling requirements for Numerical control systems – Fixture design for CNC machine tools – Sub plate and tombstone fixtures – Universal fixtures – Cutting tools – Tool holding methods – Automatic tool changers and tool positioners – Tool presetting – General explanation of the Brown and Sharp machine.

Total Periods: 45

Reference Books

1. Cyrll Donaldson, George H.LeCain, V.C. Goold, **"Tool Design"**, Tata McGraw Hill Publishing Company Ltd., (2000)
2. Hoffman, E.G., **"Jigs and Fixture Design"**, Thomson Asia Pvt Ltd, Singapore, (2004)
3. Prakash Hiralal Joshi, **"Tooling data"**, Wheeler Publishing, (2000)
4. Venkataraman K., **"Design of Jigs, Fixtures and Presstools"**, TMH, (2005)
5. Haslehurst M., **"Manufacturing Technology"**, The ELBS, (1978)

Course Outcomes	Program Outcomes (Pos)								Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2							3	2		
CO2	3	2							3	2		
CO3	3	2	2		2				3	3		2
CO4	3	3	3		2				3	2		2
CO5	3		3		2				3	2		2
CO6												

162EDE16	QUALITY CONCEPTS IN DESIGN	L-T-P	C
		3-0-0	3

Programme: M.E. ENGINEERING DESIGN **Category:** PE

Aim: To study all the concepts coming under the quality for designing purpose

Course Outcomes:

The Students will be able to
CO1: Study about the QFD and house of quality
CO2: Know about the advancements of FMEA
CO3: Familiarize the product testing methods in DOE
CO4: Describe the statistical consideration of quality concepts
CO5: Study the details about SIX SIGMA

DESIGN FOR QUALITY **9**

Quality Function Deployment – House of Quality – Objectives and functions – Targets – Stakeholders – Measures and Matrices – Design of Experiments – design process – Identification of control factors, noise factors, and performance metrics – developing the experimental plan – experimental design – testing noise factors – Running the experiments – Conducting the analysis – Selecting and conforming factor – Set points – reflecting and repeating.

FAILURE MODE EFFECT ANALYSIS **9**

Basic methods: Refining geometry and layout, general process of product embodiment – Embodiment checklist – Advanced methods: systems modeling, mechanical embodiment principles – FMEA method – linking fault states to systems modeling – Case study – computer monitor stand for a docking station.

DESIGN OF EXPERIMENTS **9**

Design of experiments – Basic methods – Two factorial experiments – Extended method – reduced tests and fractional experiments, orthogonality, base design method, higher dimensional fractional factorial design – Statistical analysis of experiments: Degree of freedom, correlation coefficient, standard error of the residual t-test, ANOVA – ratio test, other indicators – residual plots, Advanced DOE method for product testing – Product applications of physical modeling and DOE, Blender panel display evaluation, coffee grinder experimental optimization – Taguchi method.

STATISTICAL CONSIDERATION AND RELIABILITY **9**

Frequency distributions and Histograms – Run charts – stem and leaf plots – Pareto diagrams – Cause and Effect diagrams – Box plots- Probability distribution – Statistical Process control – Scatter diagrams – Multivariable charts – Matrix plots and 3-D plots – Reliability – Survival and Failure – Series and parallel systems – Mean time between failure – Weibull distribution.

DESIGN FOR SIX SIGMA **9**

Basis of SIX SIGMA – Project selection for SIX SIGMA – SIX SIGMA problem solving – SIX SIGMA in service and small organizations – SIX SIGMA and lean production – Lean SIX SIGMA and services.

Total Periods: 45

Reference Books

1. Kevin Otto & Kristin Wood, “Product Design Techniques in Reverse Engineering and New Product Development”, Pearson Education (LPE), (2001)
2. Karl t. Ulrich, steven d. Eppinger, “Product Design And Development”, Tata McGraw Hill, 3rd Edition, (2003)
3. James R. Evens, William M Lindsay, “The Management and control of Quality”, 6th edition-Pub:son south-western, (2011)
4. Amitava Mitra, “Fundamentals of Quality control and improvement”, 2nd edition, Pearson Education Asia, (2002)
5. Dhillon, B.S., “Advanced Design Concepts for Engineers”, Technomic Publication company, USA, (1998)

Course Outcomes	Program Outcomes (Pos)								Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2		2	2			3		2	
CO2	3	2		2					3			
CO3	3	3		2			2		3	2	2	
CO4	3	2		2					3		2	2
CO5	3				2	2		2	3		2	3
CO6												

162EDE17	NANOMATERIALS AND NANOTECHNOLOGY	L-T-P	C
		3-0-0	3

Programme: **M.E. ENGINEERING DESIGN** **Category:** **PE**

Aim: To study and understand the various dimensional Nano structures, fabrication of nano structures, Nano electronics and nano scale heat transfer

Course Outcomes:

The Students will be able to

CO1: Acquire the knowledge of the representatives of Nano particles and Characteristic techniques of nano materials.

CO2: Familiar with new trends in engineering, namely nanotechnology and nanofabrication and with their applications in modern industries.

CO3: Get the knowledge in the field of nanotechnology and nano materials.

CO4: Acquire the Knowledge of various energy bands of electrons and its applications

CO5: Understand the concepts of heat transfer, fluid mechanics in nano scale level

ZERO – DIMENSIONAL NANOSTRUCTURES **9**

Nanoparticles through homogenous nucleation, nanoparticles through the heterogeneous nucleation, kineticallyconfined synthesis of nanoparticles, epitaxial core – shell nanoparticles. One Dimensional Nanostructure-Nanowires And Nanorods: Spontaneous growth, template based synthesis, electro spinning, and lithography.

TWO-DIMENSIONAL NANOSTRUCTURES-THIN FILMS **9**

Fundamentals of film growth, vacuum science, physical vapor deposition (PVD), Chemical Vapor Deposition(CVD), Atomic Layer Deposition (ALD), Electrochemical Deposition, Sol-Gel films.

NANOSTRUCTURES FABRICAITON **9**

Lithography, nano manipulation and nanolithography, soft lithography, assembly of nanoparticels and nanowires, other methods of micro fabrication, Scanning Electron Microscope. Nanomechanics: A high speed review of motion: Displacement, velocity, acceleration and force, nano mechanical oscillation, feeling faint forces.

NANO ELECTRONICS: ELECTRON ENERGY BANDS, ELECTRONS IN SOLIDS **9**

Conductors, insulation and semi conductors, fermi energy, the density of states for solids, quantum confinement, tunneling, single electron phenomenon, molecular electronics. Nanophotonics: Photonics properties of nanomaterials, near-field light, optical tweezers, photonic crystals.

NANO SCALE HEAT TRANSFER **9**

Nanoscale heat, conduction, convection, radiation. Nanoscale Fluid Mechanics: Fluids at the nanoscale: major concepts, flow fluids flow at the nanoscale, applications of nanofludics

Total Periods: 45

Reference Books

1. Ben Rogers, Pennathur and Adams, Nanotechnology: Understanding Small System, CRC Press, 2008.
2. Bhushan, Bharat (Ed.) Handbook of Nanotechnology, Springer 2006.
3. Guozhong Cao, Nanostructures and Nanomaterials, Imperial College Press, 2006.
4. Yury Gogotsi, Nanomaterials Handbook, Drexel University, Philadelphia, Pennsylvania, USA, 2006.
5. Lundstrom, Mark, Guo, Jing, Nanoscale transistors, Device physics, modeling and simulation, Springer, 2006.

Course Outcomes	Program Outcomes (Pos)								Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2							3	2		
CO2	3	2	2		2				3			2
CO3	3		2						3	2		
CO4	3	2	2	2					3	2		2
CO5	3		2						3			2
CO6												

162EDE18	MECHATRONICS IN MANUFACTURING SYSTEMS	L-T-P	C
		3-0-0	3

Programme: M.E. ENGINEERING DESIGN **Category:** PE

Aim: To understand the state-of-art technology and products in Mechatronics and Robotics, take up challenging assignment in future to create professional environment.

Course Outcomes:

The Students will be able to

CO1: Learn to know about the basic mechatronics systems.

CO2: Understand the modern mechatronics components.

CO3: Understand the concept of actuators.

CO4: Understand the concept of PLC.

CO5: Learn to evaluate appropriate technology and create devise realistic industrial systems.

INTRODUCTION **7**

Introduction to Mechatronics – Systems – Need for Mechatronics – Emerging area of Mechatronics – Classification of Mechatronics – Measurement Systems – Control Systems.

SENSORS AND TRANSDUCERS **10**

Introduction – Performance Terminology – Potentiometer – LVDT – Capacitance – sensors – Strain gauges – Eddy current sensor – Hall effect sensor – Temperature sensors – Light sensors – Selection of sensors – Signal processing.

ACTUATORS **10**

Actuators – Mechanical – Electrical – Fluid Power – Piezoelectric – Magnetostrictive – Shape memory alloy – applications – selection actuators.

PROGRAMMABLE LOGIC CONTROLLERS **9**

Introduction – Basic structure – Input and output processing – Programming – Mnemonics – Timers, counters and internal relays – Data handling – Selection of PLC.

DESIGN AND MECHATRONICS CASE STUDIES **9**

Designing – Possible design solutions – Traditional and Mechatronics design concepts – Case studies of Mechatronics systems – Pick and place Robot – Conveyor based material handling system – PC based CNC drilling machine – Engine Management system – Automatic car park barrier – Data acquisition Case studies.

Total Periods: 45

Reference Books

1. Devadas Shetty and Richard A. Kolk, “Mechatronics System Design”, PWS Publishing Company, (2007)
2. Godfrey C. Onwubolu, “Mechatronics Principles and Applications”, Elsevier (2006)
3. Nitaigour, Premchand Malhalik, “Mechatronic Principles, Concepts, Applications, Tata McGraw-Hill Publishing company Limited, (2003)
4. Michael B.Histand and Davis G.Alciatore, “Introduction to Mechatronics and Measurement systems”. McGraw Hill International edition, (1999)
5. Bradley D.A, Dawson.D, Buru N.C and Loader A.J, “Mechatronics” Nelson Thornes ltd, Eswar press, Indian print, (2004)

Course Outcomes	Program Outcomes (Pos)								Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3								3			
CO2	3	2							3	2		
CO3	3			2					3	2		
CO4	3		2		2				3		2	2
CO5	3		2				2		3		2	2
CO6												

162EDE19 PRODUCTIVITY MANAGEMENT AND RE-ENGINEERING **L-T-P C**

3-0-0 3

Programme: **M.E. ENGINEERING DESIGN** **Category:** **PE**

Prerequisites: Nil

Aim: To study the various factors that enhances the productivity management and the applications of re-engineering concept.

Course Outcomes:

The Students will be able to

CO1: Know the role productivity concepts

CO2: Understand the systems approach to productivity measurement

CO3: Study the organizational transformation models

CO4: Discuss the reengineering tools

CO5: Understand the re-engineering process improvement models

PRODUCTIVITY **9**

Productivity Concepts – Macro and Micro factors of productivity – Dynamics of Productivity – Productivity Cycle Productivity Measurement at International, National and Organization level – Productivity measurement models.

SYSTEMS APPROACH TO PRODUCTIVITY MEASUREMENT **9**

Conceptual frame work, Management by Objectives (MBO), Performance Objectivated Productivity (POP) – Methodology and application to manufacturing and service sector.

ORGANISATIONAL TRANSFORMATION **9**

Elements of Organisational Transformation and Reengineering – Principles of organizational transformation and re-engineering, fundamentals of process re-engineering, preparing the workforce for transformation and re-engineering, methodology, guidelines, LMI CIP Model – DSMC Q & PMP model.

RE-ENGINEERING TOOLS AND IMPLEMENTATION **9**

PMI models, PASIM Model, Moen and Nolan Strategy for process improvement, LMICIP Model, NPRDC Model.

RE-ENGINEERING PROCESS IMPROVEMENT MODELS **9**

Analytical and process tools and techniques – Information and Communication Technology – Implementation of Reengineering Projects – Success Factors and common implementation Problem – Cases.

Total Periods: 45

Reference Books

1. Sumanth, D.J., “Productivity Engineering and Management”, TMH, New Delhi, (1990)
2. Edosomwan, J.A., “Organisational Transformation and Process Re-engineering”, Library Cataloging in Pub. Data, (1996)
3. Rastogi, P.N., “Re-engineering and Re-inventing the Enterprise”, Wheeler Pub. New Delhi, (1995)
4. Premvrat, Sardana, G.D. and Sahay, B.S., “Productivity Management – A Systems Approach”, Narosa Publishing House. New Delhi, (1998)
5. Donald Shandler, “Reengineering the training function: How to align training with the new corporate agenda”, St.Lucie press, (1996)

Course Outcomes	Program Outcomes (Pos)								Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3								3			
CO2	3	2	2						3		2	
CO3	3				2		2		3		2	
CO4	3				2	2	2		3	2		
CO5	3	2		3	2				3	2	2	
CO6												

162EDE20	INDUSTRIAL ROBOTICS AND EXPERT SYSTEMS	L-T-P	C
		3-0-0	3

Programme: **M.E. ENGINEERING DESIGN** **Category:** **PE**

Aim: To know the robot kinematics, control of various drives and programming concepts

Course Outcomes:

The Students will be able to

CO1: Understand the kinematics and dynamics of robot control systems

CO2: Know various drives and gripper functions

CO3: Describe the principles and the functions of sensors and robot vision system

CO4: Knows the work cell layouts and safety systems followed in the industrial applications

CO5:Design the program for robot motion and the problems obtained are solved and reduced by artificial intelligence and expert systems

INTRODUCTION AND ROBOT KINEMATICS **9**

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.

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.

ROBOT SENSORS **9**

Transducers and Sensors – Tactile sensor – Proximity and range sensors – Sensing joint forces – Robotic vision system – Image Representation – Image Grabbing – Image processing and analysis – Edge Enhancement – Contrast Stretching – Band Rationing – Image segmentation – Pattern recognition – Training of vision system.

ROBOT CELL DESIGN AND APPLICATION **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.

ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS **9**

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 Periods: 45

Reference Books

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. Richard. D, Klafter, Thomas, A, Chmielewski, Michael Negin, “Robotics Engineering – An Integrated Approach”, Prentice-Hall of India Pvt. Ltd., (1984)
4. Deb, S.R., “Robotics Technology and Flexible Automation”, Tata Mc Graw-Hill, (1994)
5. Mikell, P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey, “Industrial Robotics Technology, Programming and Applications”, Mc Graw-Hill, Int. (1986).

Course Outcomes	Program Outcomes (Pos)								Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3		2						3			
CO2	3								3			
CO3	3	2							3	2	2	
CO4	3		3						3	2	2	2
CO5	3	2		3	2				3			2
CO6												

162EDE21 SUPPLY CHAIN MANAGEMENT L-T-P C
3-0-0 3

Programme: M.E ENGINEERING DESIGN Category: PE

Aim: To provide an overview of the current scenario of Supply Chain Management

Course Outcomes:

The Students will be able to
CO1: Understand the role of supply chain management
CO2: Know the various inventory management models in SCM
CO3: Practice the supply chain sourcing decisions
CO4: Apply various distribution network models
CO5: Discuss the SCM logistics decisions
CO6: Understand the role of IT in SCM

SUPPLY CHAIN MANAGEMENT 9

Supply chain network - supply chain management - building blocks of a supply chain network - business processes in supply chains - types of supply chains and examples – supply chain drivers - supply chain performance measures

SUPPLY CHAIN INVENTORY MANAGEMENT 9

Strategic, tactical, and operational decisions in supply chains - supply chain inventory management – EOQ – EPQ - demand forecasting – impact of uncertainty of supply in safety inventory – managing safety inventory in multi echelon supply chains - bullwhip effect.

SOURCING AND DISTRIBUTION MANAGEMENT. 9

Role of sourcing – in-house sourcing and outsourcing – supplier relation – procurement processes – risk management in sourcing - distribution management – types of distribution

LOGISTICS IN SUPPLY CHAIN MANAGEMENT 9

Logistics – concepts, definitions, approaches, factors affecting logistics – modes – design option for a transportation network

SUPPLY CHAIN AUTOMATION 9

Factors affecting coordination - impact of E business in supply chain performance - IT enabled supply chains – role of IT in forecasting, inventory management, procurement, transportation - customer relationship management - ERP and supply chains - supply chain automation and supply chain integration.

Total Periods: 45

Reference Books

1. Sunil Chopra and Peter Meindl, “Supply Chain Management: Strategy, Planning, and Operation”, Pearson Education, New Delhi (2015)
2. Larsen T.S., Schary P.B., Mikkola J.H. and Kotzab H., “Managing the global supply chain”, Viva Books, New Delhi, (2007)
3. Ayers, J.B., “Hand book of Supply Chain Management”, The St. Lencie press, (2000)
4. John T. Mentzer, “Supply Chain Management”, Sage Publications, New Delhi (2001)
5. R.B. Handfield and E.L. Nochols, “Introduction to Supply Chain Management”, Prentice Hall, New Delhi (1999)

Course Outcomes	Program Outcomes (Pos)								Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3								3			2
CO2	3								3			2
CO3	3	2	2		2				3	2	2	2
CO4	3		2	2	2	2	2		3	2		2
CO5	3		2		2		2	2	3		2	
CO6	3			3	2	2	2		3		2	3

162EDE22 REVERSE ENGINEERING L-T-P C
3-0-0 3

Programme: M.E. ENGINEERING DESIGN Category: PE

Aim: To understand the fundamentals of reverse engineering, tools for reverse engineering used in factory environment.

Course Outcomes:

The Students will be able to
CO1: Understand basics of reverse engineering.
CO2: Understand the Tools and concepts used in reverse engineering.
CO3: Learn the software tools used in data management.
CO4: Learn to integrate reverse engineering for real time applications.
CO5: Understand the coordinate measurement, feature capturing in reverse engineering.

INTRODUCTION 9

Scope of tasks of R.E. – Domain Analysis – Process of Duplicating.

TOOLS FOR RE 9

Functionality- dimensional- developing technical data - digitizing techniques - construction of surface model - solid-part material- characteristics evaluation –software and application- prototyping – verification

CONCEPTS OF RE 9

History of Reverse Engineering – Preserving and preparation for the four stage process – Evaluation and Verification – Technical Data Generation, Data Verification, Project Implementation.

DATA MANAGEMENT 9

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

INTEGRATION 9

Cognitive approach to program understated – Integrating formal and structured methods in reverse engineering – Integrating reverse engineering, reuse and specification tool environments to reverse engineering – coordinate measurement – feature capturing – surface and solid member.

Total Periods: 45

Reference Books

1. Biggerstaff,T.J., “Design Recovery for Maintenance and Reuse”, IEEE Corpn. (1991)
2. Rugaban, S., “White paper on RE”, Technical Report, Georgia Instt. of Technology, (1994)
3. Katheryn, A. Ingle, “Reverse Engineering”, McGraw-Hill, (1994)
4. Aiken, Peter, “Data Reverse Engineering”, McGraw-Hill, (1996)
5. Linda Wills, Kluiver “Reverse Engineering”, Academic Publishers, (1996)

Course Outcomes	Program Outcomes (Pos)								Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2		2	2			3		2	
CO2	3	2		2					3			
CO3	3	3		2			2		3	2	2	
CO4	3	2		2					3		2	2
CO5	3				2	2		2	3		2	3
CO6												

162EDE23 ADVANCED MACHINING PROCESSES L-T-P C
3-0-0 3

Programme: **M.E. ENGINEERING DESIGN** **Category:** **PE**

Aim: To understand the various advanced machining processes, advantages and applications

Course Outcomes:

The Students will be able to

CO1. Classify unconventional machining process and identify various process selection parameters
CO2. Learn various mechanical energy based process
CO3. Understand the various unconventional machining process based on electrical energy
CO4. Study the various chemical energy machining process, parameters affecting it and applications
CO5. Know the machining process that fall under electro chemical energy, its parameters and applications.
CO6. Explain the various thermal energy based machining processes in detail along with their applications.

INTRODUCTION **9**

Introduction to advanced machining processes – Need – classification – Brief overview - Ultrasonic machining(USM) - Ultrasonic Machining (USM) - Working Principles – equipment used – Process parameters – MRR – Variation in techniques used – Applications

MECHANICAL ENERGY BASED PROCESSES **9**

Abrasive jet machining (AJM) - Water jet cutting (WJC) and Abrasive water jet machining (AWJM) - Magnetic abrasive finishing (MAF) - Abrasive flow finishing (AFF)- Magnetorheological finishing (MRF) - Magnetorheological abrasive flow finishing (MRAFF) - working Principle – equipments – Process Parameters – Surface Finish and MRR – Applications

ELECTRICAL ENERGY BASED PROCESSES **9**

Electric Discharge Machining (EDM) – Electric Discharge Grinding (EDG) - Electric Discharge Diamond Grinding (EDDG) - Wire Electric Discharge Machining (W-EDM) - working Principle – equipments – Process Parameters – Surface Finish and MRR – Applications

ELECTRO-CHEMICAL ENERGY BASED PROCESSES **9**

Electrochemical Machining (ECM) - Electrochemical Grinding (ECG) - Electrostream Drilling (ESD) - Shaped Tube Electrolytic Machining (STEM) – working Principle – equipments –Process Parameters – Surface finish and MRR – Applications

THERMAL ENERGY BASED PROCESSES **9**

Laser Beam machining and drilling (LBM), plasma Arc machining (PAM) and Electron Beam Machining (EBM) – Principles – Equipment –Types – Beam control techniques – Applications

Total Periods: 45

Reference Books

1. Benedict G.F., “Nontraditional Manufacturing Processes”, Marcel Dekker Inc., New York, (2014)
2. Pandey P.C. and Shan H.S., “Modern Machining Processes”, Tata McGraw-Hill, New Delhi (2015)
3. Mc Geough, “Advanced Methods of Machining”, Chapman and Hall, London, (2010)
4. Paul De Garmo, Black J.T. and Ronald A. Kohser., “Material and Processes in Manufacturing”, Prentice Hall of India Pvt. Ltd., New Delhi, (2012)

Course Outcomes	Program Outcomes (Pos)								Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3			2					3		2	
CO2	3		2	2					3		2	
CO3	3		2	2					3			2
CO4	3	2	2	2					3			2
CO5	3		2	2					3			2
CO6	3	2	2	2					3			2

162EDE24 MECHANICAL TESTING OF MATERIALS L-T-P C
3-0-0 3

Programme: **M.E. ENGINEERING DESIGN** **Category:** **PE**

Aim: To study the various testing process and failure of the materials

Course Outcomes:

The Students will be able to
CO1: Learn the flow testing property
CO2: Understand the stress concentration and fatigue failures
CO3: Study the creep analysis
CO4: Prepare samples by using polymer
CO5: Solve the problems while working in polymer
CO6: Analyze the failure in the materials for mechanical applications

FLOW PROPERTY TESTING **9**

Tension - Engineering & true stress-strain curves, evaluation of tensile properties tensile instability, effect of strain-rate & temperature on flow properties - Compression - Comparison with tension, buckling & barreling. Bending - Pure bending & flexure formula. Torsion - Stresses for elastic & plastic strain, Torsion vs. Tension - Impact - Notched bar impact tests, transition Temperature & metallurgical factors affecting it.

FATIGUE **9**

Fatigue - Stress cycles & S-N curve, effect of variables like mean stress, stress concentration, surface, size, metallurgical factors etc.

CREEP **9**

Creep - Creep, stress rupture & stress relaxation tests, development of creep resistant alloys, prediction of long time properties.

POLYMER TESTING **9**

Polymer testing (sample preparation, testing standards and methods, analysis of polymer and additives) - problems of polymer (thermoxidative degradation, fire hazards, toxicity, effluent disposal, feedstock scarcity).

FAILURE ANALYSIS **9**

Modes of failures, corrosion failure, high temperature failure, Case studies in failure analysis. Prevention of failures

Total Periods: 45

Reference Books

1. Dowling, Norman E, "Mechanical Behavior of Materials", Prentice Hall, 3rd Edition, (2006)
2. Marc Andre Meyers, Krishan Kumar Chawla, "Mechanical Behavior of Materials", Prentice Hall, (1998)
3. Yung-Li Lee, Jwo Pan, Richard Hathaway, Mark Barkey, "Fatigue Testing and Analysis: Theory and Practice", Butterworth-Heinemann, (2004)
4. Norman E. Dowling, "Mechanical Behavior of Materials: Engineering Methods for Deformation, Fracture, and Fatigue", Prentice Hall; 2nd Edition, (1998)

Course Outcomes	Program Outcomes (Pos)								Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	3							3	2		
CO2	3			2					3	2		
CO3	3								3	2		
CO4	3	2	2	2					3	2		
CO5	3	2							3	2		
CO6												

162SEE17	RESEARCH METHODOLOGY	L-T-P	C
		3-0-0	3

Programme: **Common to all Branches** **Category:** **PE**

Aim: The objective of this course is to develop the research skills of the students in investigating into the research problems with a view to arriving at objective findings and conclusions and interpreting the results of their investigation in the form of systematic reports.

Course Outcomes:

The Students will be able to

CO1: Understand the basics elements in research

CO2: Discuss the various faces of experimental design methodology

CO3: Illustrate the data collection methods with its aspects

CO4: Apply the knowledge of multivariate statistical techniques

CO5: Develop research report as a model

CONCEPT OF RESEARCH AND ITS APPLICATION **9**

Concept of research and its Application - types of research - Quantitative and Qualitative Research Techniques - Types of problems Encountered by the Researcher - Process of Research - Steps Involved in Research Process - Hypothesis development – Hypothesis testing with quantitative data. Research design –Purpose of the study: Exploratory, Descriptive, Hypothesis Testing.

EXPERIMENTAL DESIGN **9**

Laboratory and the Field Experiment –Internal and External Validity –Factors affecting Internal validity. Measurement of variables –Scales and measurements of variables. Developing scales – Rating scale and attitudinal scales –Validity testing of scales –Reliability concept in scales being developed –Stability Measures.

DATA COLLECTION METHODS **9**

Concept of Sample, Sample Size and Sampling Procedure - Various Types of Sampling Techniques - Determination and Selection of Sample Member - Types of Data: Secondary and Primary - Precautions in Preparation of Questionnaire and Collection of Data - Various Methods of Data Collection - Preparation of Questionnaire and Schedule - Types of Questions, Sequencing of Questions - Check Questions, Length of Questionnaire.

ANALYSIS OF DATA **9**

Data Analysis - Coding, Editing and Tabulation of Data - Various Kinds of Charts and Diagrams Used in Data Analysis - Factor Analysis –Cluster Analysis –Discriminant Analysis –Multiple Regression and Correlation –Canonical Correlation – Use of SPSS in Data Analysis - Application and Analysis of Variance (ANOVA) - Measurement and Central Tendency - Measure of Dispersion and their advantages.

REPORT PREPARATION **9**

Report Preparation and it's Significance - Types and Layout of Research Report - Precautions in Preparing the Research Report - Integral parts of a report –Title of a report, Table of contents, Abstract, Synopsis, Introduction and Body of a report –Experimental results and discussion – recommendations and implementation - Conclusions and Scope for future work - Bibliography and Annexure.

Total Periods: 45

Reference Books

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., "An introduction to Research Methodology", RBSA Publishers, (2002)
2. Kothari, C.R., "Research Methodology: Methods and Techniques", New Age International, (1990)
3. Sinha, S.C. and Dhiman, A.K., "Research Methodology", Ess Ess Publications. volume 2, (2002)
4. Panneer Selvam, "Research Methodology", Prentice Hall of India, Edition, (2008)

Course Outcomes	Program Outcomes (Pos)								Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3		2						3		2	
CO2	2	2	3	2					3	3	2	2
CO3			2		3	2	2		2		2	
CO4		3		2	2	2			3	2		
CO5			2		3	2	2				2	3
CO6												